A COMPARISON OF FOURTH-GENERATION LANGUAGE USAGE IN FORTUNE 500 COMPANIES AND COLLEGIATE INFORMATION SYSTEMS CURRICULA

By

MARY LISA MILLER II

Bachelor of Science in Education
Southeastern Oklahoma State University
Durant, Oklahoma
1984

Master of Science
Oklahoma State University
Stillwater, Oklahoma
1986

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Thesis Approved:

Jeretta A. Horn
Thesis Adviser

Richard Alberson

Jane L. Snible

John J. Gardiner

Norman N. Durham
Dean of the Graduate College

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CHAPTER I

THE RESEARCH PROBLEM

Introduction

Man's search for excellence has directed him down a path leading to the creation and advancement of computer technology. According to Cobb (1985), industry has witnessed five distinct stages of computer language development: machine, assembler, high-level, nonprocedural, and knowledge-based. Olsen (1985) lends further support to the computer language evolution by indicating that as each generation has evolved, the necessity for better management through systems analysis and design methodologies has become evident.

The first generation of computer languages, machine-level, consisted of combinations of 0s and 1s. This rudimentary approach to programming left much to be desired. The desire for a better programming method led to the utilization of the assembler and assembly languages in the 1950s. Lack of standards and the need for better data management techniques spurred on the endless search for a solution to the drudgery presented by endless programming tasks. Although third-generation languages provided standardization and data management techniques, the complications and endless programming required signaled the need for a langauge that would reduce complications encountered through systems development backlogs that were now in evidence. Each of

these stages has produced languages that were relevant, useful, and helpful in creating a more computer-oriented society.

As the push for a computer-literate society increased, so did the complexity of designing, maintaining, and implementing a system. More systems analysis and design tools for aiding in the design and development of complex databases were on the market. This led to a need for more efficient maintenance and implementation procedures. Through the progressing stages of software advancement, industry has adjusted to incorporate each new generation of languages into its organization. Education has followed suit by incorporating new instructional methods and techniques into its classrooms.

Communication has been the primary linkage between computers and people. Because of the increasing communication need, this linkage is now passing through the fourth generation of software. According to Catchings and VanName (1986), fourth-generation languages are fulfilling this communication need through application generators and/or end-user productivity tools. Education has begun to reflect its interest in fourth-generation languages by incorporating language application packages into the classroom. This shifting emphasis in education and industry is leading to a more people-oriented approach utilizing nonprocedural languages.

The systems analyst's job functions have been affected by each new computer language development. Awad (1985) suggests systems analysis has its early roots in the 1890s. From this period to today, as the need for a more efficient work environment grew, so did the need for systems analysts. As the work environment gravitated toward computer utilization, the systems analyst's job functions changed. His/her job

functions have become more centered on the computer/people communication link.

Need for the Study

As the fourth generation of software begins to permeate our business world, new programming languages are dawning on the horizon. The need for an examination of this fourth group of languages and its effect on education is imperative if it wishes to keep abreast of this new trend in software.

After examining information systems programs in universities accredited by the American Assembly of Collegiate Schools of Business, Aulgur (1982) recommended that more graduates with business and information processing degrees were needed. With the increased number of students entering the information processing area, individual studies of course work are also needed to determine the status and trends of students seeking degrees in this area. Schooley (1985) recommended that an examination be undertaken of fourth-generation design tools and their effect on the systems analyst.

After an extensive review of literature, no articles relating specifically to the fourth generation's effect on computer-related courses offered at the university could be found by this researcher. However, numerous articles have been written concerning the imminent demise and replacement of COBOL and its third-generation counterparts by the new champion, fourth-generation languages (Harding, 1985). With the replacement of third-generation languages by fourth, educational instruction will shift more focus into this area.

The movement into a new computer dimension echoes the need for a new educational perspective reflecting industry's shift. The extent of industrial and educational involvement will need to be gauged in order to determine the extent of educational focus which must be directed to this area. As technology passes through the fourth generation on its way to the fifth, new curriculum developments and requirements will be reflected in information systems classes.

Statement of the Problem

This study sought to determine the extent that fourth-generation languages were impacting on information systems instruction offered at American Assembly of Collegiate Schools of Business (AACSB) accredited schools and the information systems environments of Fortune 500 companies. Specific subproblems to be addressed in this study were:

1. Identification of fourth-generation language utilization in both industry and in the classroom.
2. Identification of how fourth-generation languages are altering instruction offered at AACSB-accredited schools.
3. Fourth-generation language's most and least beneficial characteristic, result, or use as perceived by industry.
4. Fourth-generation language's most and least beneficial characteristic, result, or use as perceived by education.
5. New curriculum developments occurring as a result of fourth-generation languages.
6. Identification of any perceived differences which exist between industry and education based on their most and least beneficial characteristic, result, or use perceptions.

Statement of Purpose

The purpose of this study was to provide information that would help university instructors develop new materials, courses, course outlines, and appropriate teaching methods to facilitate the entrance of fourth-generation language instruction into curricula. A related purpose of this study was to provide information that would encourage the development of new programming courses and related development of programming instruction. Also, as the emphasis on systems design tools changes, this reflection should be incorporated in the appropriate educational classes in order to reflect fourth-generation language's involvement in industry and curriculum.

Delimitations of the Study

The following delimitations were imposed for the purposes of this study:

1. The population in this study consisted of the universities accredited by the AACSB. Therefore, the ability to generalize the results of this study may be restricted to the accredited AACSB institutions.
2. The second population used in this study was the Fortune 500 companies. The ability to generalize the results of this study may be restricted to the Fortune 500 companies.

Limitations of the Study

Information collected during this study was limited by several factors:

1. No control could be placed on participant response. Therefore, data received can only be generalized to those who voluntarily completed and returned the questionnaire.
2. Topics covered in computer-related courses may vary according to type of textbook used, instructors' views, and style of instruction. The scope of this study can only reflect the amount of instruction directed at the inclusion of the fourth-generation language topic in computer-related courses.
3. Systems analysts' knowledge of fourth-generation languages and its effect on their work may limit the generalizability of the study.
4. The instructor completing the questionnaire may not have information reflecting fourth-generation language teaching practices of other faculty members.
5. A standard fourth-generation language at the time this study was conducted did not exist. The operational definition provided in this study was used.

Assumptions

The nature of this study designated that the following assumptions be made:

1. Fortune 500 companies employ individuals to occupy the job position titled 'Systems Analyst.'
2. Systems analysts will have knowledge of fourth-generation languages.

Definitions

The definitions provided below are listed to enhance the readability and interpretation of this study.

American Assembly of Collegiate Schools of Business (AACSB) - Established in 1916, the AACSB is an accrediting body associated with baccalaureate and master degree programs offered at universities or colleges offering a business administration or management degree. In 1986 - 1987, the AACSB's accredited educational institutions numbered 247.

Adaptive Maintenance Programming - As the needs of the user change, the systems programs are modified to reflect the change.

Application Generation - Single statements of code which can be used by a programmer to execute or generate reports, menus, and database queries automatically.

Automated Data Dictionary - A computerized detailed listing of the characteristics of a particular data element.

Computer-Related Instructor - The instructor who occupies the position of coordinator of computer-related courses offered through the business college or who teaches in the information systems area.

Coding Requirements - The number or amount of code or coding lines which must be supplied to the computer in order for the acceptance of input, processing of the input, and the generation of output in accordance with the output design to take place.

Corrective Maintenance Programming - If a problem is detected with coding or logic flow, coding statements are altered.

Documentation Requirements - Detailed information describing programs, maintenance and activities which exists within the information systems environment.

Fourth-Generation Language - A generic term applied to nonprocedural languages which: (1) reduce programming tasks and maintenance; (2) require minimum training to operate; (3) evolved in the mid 70s. For purposes of this study, 12 fourth-generation language characteristics, uses or results were identified:

Prototyping	Application Generation
Nonprocedural Programming	End-user Programming
Automated Data Dictionaries	Maintenance Reduction
Data Modeling	Decision Support System
Documentation automation	Automated design Tools
Training Time Reduction	Security Concerns

Industrial Fortune 500 Companies - The industrial Fortune 500 companies consist of those companies receiving the largest revenue based on sales. To be eligible for inclusion on this listing, companies must receive 50 percent of their annual sales from manufacturing and/or mining.

Nonprocedural Programming - Programming statements describing what information is to be produced. Nonprocedural programming focuses on what is to be produced not on how to produce the needed information.

Prototyping - The process of designing model systems which can be used to demonstrate the possible outcomes of the candidate system. Prototypes used in the systems design phase may later evolve into the actual system that will be used.

Procedural Programming - Programming which focuses on providing the computer with a description of how and what is to be produced. Procedural programming's primary focus is on describing how the information is to be produced.

Senior Systems Analyst - The person who supervises the information systems development activiities within the Fortune 500 information systems departments. The senior systems analyst will also perform those duties or tasks which are directly related to systems analysis and design as it relates to the development of the information system.

Hypotheses

This study tested 12 hypotheses. The 12 hypotheses tested at the .05 significance level were:

H_1: There is no significant difference between the ranks assigned to the prototyping use's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_2: There is no significant difference between the ranks assigned to the application generation use's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_3: There is no significant difference between the ranks assigned to the nonprocedural programming characteristic's beneficiality by the members of the accredited AACSB

population and the Fortune 500 population who incorporate a fourth-generation language.

H_4: There is no significant difference between the ranks assigned to the end user programming result's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_5: There is no significant difference between the ranks assigned to the automated data dictionaries result's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_6: There is no significant difference between the ranks assigned to the maintenance reduction characteristic's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_7: There is no significant difference between the ranks assigned to the data modeling use's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_8: There is no significant difference between the ranks assigned to the decision support systems use's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_9: There is no significant difference between the ranks assigned to the documentation automation result's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_{10}: There is no significant difference between the ranks assigned to the automated design tools use's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_{11}: There is no significant difference between the ranks assigned to the security feature result's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_{12}: There is no significant difference between the ranks assigned to the training time reduction characteristic's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

CHAPTER II

REVIEW OF RELATED LITERATURE

Awad (1985) researched the needed qualifications for a systems analyst. He found required knowledge focused on four areas: systems theory, application, programming, and hardware/software specifications. He also added that the systems analyst must deal with all phases of systems analysis and design. Predictions have been made indicating that as technology progresses, business systems will be developed by systems analysts rather than by programmers who are presently writing the program coding (Infosystems, 1985).

Since the study's goal was to identify potential areas for educational change resulting from fourth-generation language's impact on selected design and maintenance procedures used in industry, the review of current literature was divided into four topical areas: discovering a fourth-generation language; industrial impact of fourth-generation languages; and educational impact of fourth-generation languages.

Discovering Fourth-Generation Languages

The facilitation of fourth-generation software came with the development and implementation of databases. Until the database development, third-generation languages utilized program-dependent data.

Third-generation programs needed to provide descriptions of each data element. Fourth-generation programs allowed the data to be program independent; that is the data can be accessed by many different programs (Dun's Business Month, 1985). Agreement is lent to this concept by Cobb (1985) who stated that "without structure-independent DBMSs, fourth-generation languages would never have come into existence."

Dun's Business Month (1985) credits the initiation of artificial intelligence with the increase of fourth-generation language projects. Many advantages have been created through the usage of fourth-generation languages. Perhaps the greatest benefit is the reduction of programming, suggested Grant (1985). While stating that fourth-generation software creates programs automatically, he also indicated that a fourth-generation language must be nonprocedural and require less programming than its third-generation programming counterparts.

Catchings and Van Name (1986) revealed that fourth-generation languages permit users to spend far less time explaining how the information should be generated. The fourth-generation language's environment takes defining the environment upon itself. Cobb (1985) lent support to these comments by stating that fourth-generation languages have been nicknamed nonprocedural languages because they shift the burden of program flow to the software packages. A description of 'what' is needed can be specified rather than 'how' the task is to be accomplished. Several benefits of fourth-generation languages were identified by Cobb. These are outlined below.

1. Fourth-generation languages are results-oriented;

2. Fourth-generation languages improve productivity by at least 5 to 1, and by as much as 300 to 1 for some activities;

3. A large percentage of staff can deal directly with computers without going through intermediaries, since fourth-generation languages are designed for both computer specialists and end users;

4. Fourth-generation languages are ideal as application generators.

Grindlay (1984) pointed out that fourth-generation languages should be easy to learn, nonprocedural, and able to handle administrative computing requirements. Wexelblat (1984) added that contemporary programming should free the programmer from "specifying correct algorithms." The programmer needs to stop programming the computer to solve problems and teach it how to solve the problems.

Defining a fourth-generation language is often a hard and complicated task since everyone is quick to give his/her own definition. As fourth-generation languages take-over become dominate, more and more software packages will advertise their fourth-generation language characteristics. Catchings and Van Name (1986) suggested this action has led to the wide and varied definitions that have been given to describe a fourth-generation language. Snyders (1986) examined the differing definitions given by leading authorities in the field. One authority stipulated that a fourth-generation language is any language excluding COBOL and Fortran. Other authorities claim the language must be nonprocedural. Nonprocedural fourth-generation languages are often referred to as "information centers 4GLs." People who believe that a fourth-generation language can have procedural duties refer to it as a "development center 4GL."

Products covered under the fourth-generation umbrella must be differentiated between nonrelational and relational, said Pascal (1987). He contends that confusion surrounds the relational concept. The confusion results from ambiguity surrounding database management systems and fourth-generation languages. Not all fourth-generation products are relational. Pascal indicated that while most database management systems on the market are relational, only one true relational fourth-generation language exists. The misunderstanding surrounding the difference between relational fourth-generation products and nonrelational fourth-generation language products must be extinguished before confusing connotations can be removed. Pascal (1987) credited "the responsibility that the nonrelational fourth-generation language products have for the persistence of obsolete programming techniques."

Further clarification is added by Hurst (1987) who stresses that the distinguishing factor between a database management system and a fourth-generation language centers on data handling. A database management system is designed to help alleviate backup and recovery problems, while a fourth-generation language is designed to help alleviate less complex data structures.

Coha (1983) revealed that fourth-generation languages were expected to increase "productivity in both development and maintenance." Increased productivity is a reason many companies are implementing fourth-generation languages into their information systems. Snyders (1986) suggested by using a fourth-generation language, productivity can be gained in two specific areas -- programmer productivity and overall organizational productivity. Organizations not using a fourth-generation language indicated that 70 percent of programming

related to program maintenance. Since fewer lines of code are needed when using fourth-generation languages, less time can be devoted to maintenance and more to application programming. In contrast to Snyders' comments is a study conducted by Inmon (1984). He revealed that utilizing a fourth-generation language did not guarantee increased productivity levels. Of six factors identified, system quality played a crucial role in a system's productivity.

Although the biggest advantage to implementing a fourth-generation language is productivity, Grant (1985) stressed the promise of increased productivity must be carefully weighed against several other factors. The larger, more complex a task is, the more resources will be required to execute the job.

Industrial Impact of Fourth-Generation Languages

Maintenance and documentation is a major downfall of third-generation application programs. Although new standards are being developed for these languages, application programs which are now being written are reflecting fourth-generation usage. While third-generation languages, such as COBOL, have two decades in the industry supporting their usage, Gullo (1987) felt that industry is now focusing on less maintenance, which fourth-generation languages can provide. Projections of all new application programming show that 75 percent of coding is now being written utilizing fourth-generation languages. Harding (1985) stated fourth-generation language's coding requirements will reduce maintenance and upkeep of the system. Procedure code is managed in an easier, more efficient manner.

Vendors stipulate that fourth-generation languages will take over the market, pushing COBOL aside. Others, however, contend that fourth-generation languages and COBOL will coexist in the business environment. This coexistence will be a result of several factors. A big investment has been made in systems that use the COBOL language. Lack of fourth-generation language standards is another reason. Programmers proficient in one fourth-generation language does not guarantee that programmers will be proficient in all fourth-generation languages (Snyders, 1986).

The need for more advanced software technology spawned the development of fourth-generation languages. This development was signaled by a need to reduce maintenance, cost, and time (Tinnerello, 1985). Further support is added to this by Snyders (1986) when she stated that maintenance and documentation is reduced by as much as 70 percent through fourth-generation language implementation. A reduction in program coding will result in maintenance and documentation emphasis being reduced.

Reasons for the move to fourth-generation languages include hardware enhancements, increased user demands, and intense competition. With the personal computer's increased processing ability and with more and more new software packages invading the marketplace, competition for software vendors has escalated. This competition in the marketplace led to the development of fourth-generation software (Catchings & Van Name, 1986).

Olsen (1984) suggested business's infatuation with computers has led to more complex systems development. Although the software is becoming easier to use, programs can still be difficult and time

consuming in their development. Fourth-generation languages are not only changing the way users program, but are also changing systems analysis and design tools. Fourth-generation languages appeared on the scene to alleviate the backlog of programming and systems development tasks that were occurring.

Customization and better control are added by Harding (1985) to the petition for the fourth-generation language utilization in industry. This type of software offers performance and better efficiency to the list of fourth-generation characteristics. Better control is afforded to organizations switching to a fourth-generation language.

Case and Manley (1986) reported that the fourth-generation is characterized by program/system generators. Program generators were developed to shift minor programming tasks to the end user. Resulting from the move was the need to design and develop systems faster than the current practice.

The task of writing programs has remained, until recently, unchanged. Programmers have been so busy automating everyone else's job that the programmer has neglected automating his own tasks. "Supertekkies" want programming techniques to survive, and resist, to some extent, the developing program market which is opening up areas for end users to write their own program, thus, decreasing the need for programmers. Although resistance exists, Wennel (1986) contends the benefits to be gained from implementation are too great to offset nonutilization. Contrasting remarks are given by Coha (1983) who stipulates fourth-generation language programmers will begin to evolve, and the tasks information service personnel perform will center more on planning and the technical nature rather than on programming skills.

Industry will see an increase in fourth-generation programmers and the number of fourth-generation language end users is also expected to increase. Coha (1983) stated ". . . the number of FGL programmers is expected to rise 680 percent from 1983 to 1985, and that the number of nonprogrammers using the language in the same period is expected to rise 990 percent."

Grindlay (1984) identified several problems which are occurring in the fourth-generation usage area. These are:

-- The lack of standardized, generally accepted data management techniques and procedures;

-- The lack of well-defined, well-documented, and well-integrated databases supporting business operations;

-- The lack of integrated communications networks in multihost environments; and

-- A critical shortage of appropriately trained data processing generalists who have a "service" orientation and know the true businesses in which their companies are engaged.

Impact on resources and product quality are two major issues circulating concerning fourth-generation languages. Christoff (1985) distinguishes between the fourth generation's utilization of central processing unit power and the third generation's usage of central processing unit power. Although this is an area for concern, systems analysts need not be solely concerned with this issue.

An extension to the proper utilization of the central processing unit is expanded on by Lukac (1984). He pointed out that the major expenditure is percentage of central processing unit time used. Consideration must be given to the required amount of access for fourth generation users. He contended that it is crucial for good database design when working with fourth-generation languages.

Production of quality output is an area which will still be an issue for fourth-generation language users. Proper management of the environment is essential. Management can be incorporated into the environment through policies concerning data design, file creation, and data element names. In order to manage the information environment, a quality product must be designed and produced, said Christoff (1985). He added three ingredients are necessary to produce this quality product: (1) integrity; (2) dependability; (3) ease of use. In order for these ingredients to be effective, the environment should focus on three factors: design, creation, and consistency.

The introduction of fourth-generation languages into business systems means new approaches to different systems development tasks must be examined stated Grindlay (1984). New feats can be accomplished by freeing programmers and users from data dependency. Also, users are more comfortable working with fourth-generation languages. Systems developers should rethink the development process. By stating "we have placed too much emphasis on how to get the job done (programming) rather than on what the job really is (data resource management)," Grindlay reported fourth-generation languages can speed up the processes and tasks required in each of the following steps:

Initial Feasibility Study
Requirements Analysis
User Sign Off
Documentation
Final Acceptance
Retirement
Design Code, Test the System
Systems Specifications
Installation & Training
Maintenance (Corrective,
Adaptive, and Perfective)

Burch (1986) stressed that users be included in the development phase of the system so that potential conflict areas can be avoided. By permitting users to assist in the development and design phases, a system can be built reflecting the user's request rather than the systems analyst's.

Before fourth-generation languages afforded many users the opportunity to write their own programs, this task was the concern of the information systems programmers. Now, the responsibility for updating and maintaining programs is becoming more and more a gray area. Tinnirello (1985) believed several solutions have merit. One idea uses the information systems department as a consulting department which provides help when the users have problems. Another approach designates certain users as authorities within individual departments. A third possibility is a group formation of end users to assist all end users of a specific fourth-generation product throughout the organization.

The advancement in software is slowly eroding the need for technical competence, reported Odell (1985). By allowing users to design their own system, responsibility for that system's operation shifts from the Management Information Systems department to the individual users. However, a problem arises when users become the developers of their own system. This problem results in a reduction of management information system employees needed for system's design and development. Data duplication, lack of data integrity, and increased cost will result. The security and maintenance areas may suffer neglect due to the shift toward end user design. Although the fourth-generation languages are making systems design a task which can be performed by end users with little or no technical knowledge, an imperative need still

exists for management systems personnel to keep abreast of the work being conducted in each individual system.

Hughes (1986) stated that systems development must remain in the hands of the professionals. The inclusion of fourth-generation language's ease of use should not be reasons for turning systems development over to the users.

Time is a crucial factor during the development and design phases. Time is the measure that is most commonly used when determining if a system is ready for operation. The system's overall effectiveness and longevity are often overridden in an attempt to get the system developed on time. During the analysis and design phase the analyst must gather necessary data through the various data gathering techniques available. He must also provide an extensive problem definition. Alternative systems can be examined through utilizing a systems engineering package. By permitting the analyst to view alternate systems and the effects each will have on the future system, a more complete candidate system can be developed. (Windsor, 1986)

As a result of fourth-generation languages, prototyping's impact is being felt in industry. Two basic prototyping approaches, the information-center approach and development approach, are currently being used. The information-center approach stresses developing the visual effects first, then designing applications that will be used to generate the output. The development approach designs the application programs then goes back and designs the output. By implementing prototyping into the business environment, users and information specialists can work together to develop a system that will fulfill the user's needs. By addressing the information needs, time can be saved by

not having to backtrack and redevelop and redesign systems (Infosystems, 1986). Opponents state that not enough time is spent thinking, planning, and designing the system; it is a system designed by hackers -- someone who hacks away until the system is developed (Firdman, 1987).

The selection of the right fourth-generation language is important because of its more noticeable programming differences. Schussel (1986) stressed the need to examine the language's syntax, programmer support tools available, integration support, amount of education and investment needed, and the target user's needs.

Fourth-generation language selection should focus on selecting a language which, when implemented, will best meet the end user's needs (Tinnerillo, 1985). Selection of the right programming language is essential for business, stressed Elfing (1985). Elfing suggests that the organization should examine four features in order to increase meeting the information system's information needs: application identification, language features, practical considerations, and language suitability.

Appropriate systems development methodologies and techniques must be selected if a system is to be designed properly. Approval of all parties concerned and adaptability are key issues when selecting a methodology. By comparing what needs to be done with what a methodology can do, productivity can be evaluated. Requirements to be examined when selecting a methodology are cost, adaptability, user satisfaction, training support, vendor support, and ability to meet business specifications. (Levine, 1985)

Although Roman (1986) stated that mastery, creation of simple applications, and quick extractions offer other advantages for

incorporation of this new language, structured methodologies may be a deterrent. Until recently fourth-generation languages had the ability to manage large application programs, but utilization of this power could not be fully captured.

Educational Impact of Fourth-Generation Languages

The surge of fourth-generation language utilization in industry is affecting systems analysts' jobs and the educational system which produces these analysts (Tinnerello, 1985). Carolina Steel Corporation found that a fourth-generation language increased the learning curve. After two weeks of training, computer personnel were writing effective programs (Data Management, 1986).

Digital Equipment Corporation has developed a fourth-generation software package called Powerhouse. Usage of this new software package is being taught in development centers. Although the package is designed for application programmers, it is being used effectively to train end users. Powerhouse is being used effectively in over 110 educational institutions where students may receive credit (Digital Equipment, 1985).

Although fourth-generation technology has brought about new and innovative ideas, several traditional methodologies should be utilized, according to Hughes (1986). Data flow should be understood so that sources of input may be identified. Planning a system, whether a third- or a fourth-generation language will be used, is a must. Hughes identified three key areas where change will be necessary:

(1) All phases of the systems development lifecyle will be affected.

(2) Traditional design phase will be eliminated.

(3) Prototypes will be used to develop the system.

Educating users to work with fourth-generation languages, Stevens (1986) stated, should center training requirements only on providing those skills necessary to complete the job. Skills usage should center on accessing the data and not on training the user how to program the entire system.

Most computer users will be end users -- not programmers, reported Sandberg-Diment (1985). Although end users will gain limited programming knowledge working with application packages, programming knowledge acquired in this fashion has a very limited scope. Sandberg-Diment stressed that programming classes have a place in the school's curriculum only as an elective, not as part of the core requirements.

Both Auglur (1982) and Schooley (1985) have made recommendations to study the effects of computer technology in education. While Auglur's recommendations specified that individual courses should be examined, Schooley, based upon his findings, designated the need for an examination of fourth generation languages' effect on the curriculum. All facets of a systems analysts' educational background will be altered by fourth generation languages.

CHAPTER III

RESEARCH METHODOLOGY

After a review of literature was conducted, the need for a study determining fourth-generation language usage's effect on the information systems environment and educational practices in industry and its related effect at the university was apparent. The procedures used in this study were:

1. Review of Literature
2. Population Identification
3. Questionnaire Design
4. Cover and Follow-up Letter Preparation
5. Data Collection
6. Statistical Procedures
7. Findings, Conclusions, and Recommendations

Population Identification

Opinion data reflecting fourth-generation's industrial impact on current educational practices and programming techniques were gathered from questionnaires sent to two populations. Accredited members of the American Assembly of Collegiate Schools of Business were identified as the first population. Membership in this population group consisted of 247 members. Names and addresses were obtained from the 1986-1987 membership list.

Opinion data were gathered from information systems instructors located in the College of Business to identify the changing educational and programming practices at the university level resulting from fourth-generation language utilization.

The Fortune 500 companies were identified as the second population. A membership listing was taken from the April 27, 1986 issue of the Fortune magazine. Information was gathered from senior systems analysts in these companies so that the changes resulting from fourth-generation language inclusion could be gauged and related to the changing curriculum practices resulting at the university level.

Since both populations were small and their sizes were manageable, the decision to use population data rather than randomly collected sample data was made so that all population members would have the opportunity to contribute to the study.

Questionnaire Design

AACSB Questionnaire

The AACSB questionnaire was designed to collect data specifically relating to four areas: (1) demographic data; (2) current programming practices used as a result of fourth-generation language utilization; (3) fourth-generation language characteristics, uses, or results being incorporated into information systems classrooms; and (4) types of instructional techniques used as a result of fourth-generation language incorporation into the curriculum.

The questionnaire was divided into four sections. Section I was completed by all recipients; section II was completed by recipients who acknowledged incorporation of the fourth-generation language topic into

existing courses; section three was completed only by those recipients who had designed new courses to teach the fourth-generation language topic. Section IV was completed by respondents who had not included the fourth-generation language topic in any existing courses or designed any new courses specifically to teach the fourth-generation language topic.

Section I was designed to collect demographic data from all AACSB recipients. Topics included in this section related to the number of information-systems classes currently existing within the curricula, types of information-systems classes offered, school size, number of instructors presently teaching information-systems classes, and presence of an undergraduate information systems degree program.

Section II dealt with the content of the information systems classes offered at the AACSB institution in which the fourth-generation language topic was covered by one or more information systems classes. The primary focus of this section was to gather information specifying the presence of fourth-generation language instruction. If fourth-generation language instruction was present, the following information was collected from the AACSB information systems instructors: the different instructional methods, identification of courses where fourth-generation languages are examined, length of class time spent on the discussion of fourth-generation language concepts, and which of the 12 fourth-generation language characteristics, uses, or results were discussed and deemed most important.

Section II also gathered information that was used to determine if the instruction offered in the present information systems classes was being altered. An examination of this alteration was conducted in order to identify the emphasis which is being placed on the presentation of

the fourth-generation lanaguage topics relating to the selected 12 characteristics, uses, or results. Also, the study examined which fourth-generation languages were being utilized, the changing programming practices, and the development of new courses to cover fourth-generation language topics.

As indicated, pertinent data were gathered concerning the fourth-generation language characteristics, uses, or results deemed most important as perceived by educators. The data was gathered by asking the instructor to rank the 12 charateristics based upon his/her perception.

Section III's purpose was to collect data regarding the development and design of new courses which covered the fourth-generation language topic. Identification of programming class titles, programming languages used, ranking of the fourth-generation language characteristics, uses, results, and length of time that the newly developed course had been taught were identified.

Section IV collected data from users who were presently not implementing the fourth-generation language topic into existing or newly developed courses. Pending plans for incorporation of a fourth-generation language, ranking of the 12 characteristics, uses, or results and identification of particular fourth-generation language data were collected in this section.

The questionnaire was printed on 8 1/2 x 11 canary yellow paper, helping to distinguish the questionnaire from other papers which may have been on the instructor's desk. The color was also chosen to help the researcher distinguish between the AACSB questionnaires and the

Fortune 500 questionnaires. To encourage a response, an abstract of the study's findings was offered to all recipients who chose to respond.

Fortune 500 Companies Questionnaire

The questionnaire to be sent to the industrial Fortune 500 senior systems analysts was designed to parallel closely the AACSB questionnaire. The parallel design was used to gather data concerning five areas: (1) demographic data; (2) fourth-generation languages' effect on current industrial design practices; (3) identification of the most and least beneficial fourth-generation language characteristics, uses and results; and (4) instructional practices used in industry.

Section I collected demographic data. Data collected in this section reflected the systems analyst's title, firm size, location of firm, and department size.

Section II collected data from the firms which had incorporated a fourth-generation language into one or more of the organization's departments. Length of time that the firm had been utilizing a fourth-generation language, method of instruction used to teach end-users about the fourth-generation language, and length of training time were concerns of this section. Also, opinion data indicating areas in which an increase or decrease in the amount of time spent working as a result of implementation of a fourth-generation language were identified. Finally, the analysts were asked to rank on a Likert-type scale the 12 fourth-generation language characteristics, uses, or results. This section sought to identify how industry was providing instruction in the fourth-generation language area. For example, instruction may have been provided by requiring potential users to

attend seminars, workshops, university classes, or by on-the-job training.

The questionnaire was prepared using 8 1/2 x 11 light blue paper. The color choice was chosen to help the recipient distinguish the questionnaire from other materials which may have been on the systems analyst's desk. The blue questionnaire also aided the researcher by distinguishing the Fortune 500 questionnaires from the canary yellow questionnaires which were received from the AACSB instructors. To encourage a response, an abstract of the study's findings were offered to all recipients who chose to respond.

Cover Letter Preparation

The cover letters to be used in this research project were typed on Oklahoma State University letterhead. The letterhead was chosen to project an official image and the necessity of the survey. Cover letters were sent to deans of AACSB accredited college of business, requesting that the questionnaire be forwarded to the information systems department head or to a faculty member who taught in the information systems area.

To enhance the return rate, this study's relevancy to education was addressed in a brief, yet informative manner. Follow-up letters were sent to nonrespondents requesting that further consideration be given to the completion of the questionnaire.

Cover letters sent to Fortune 500 companies were addressed to the firm's senior systems analyst. The initial letter discussed the study's relevancy to both industry and education and encouraged the analyst to respond. The industrial cover letter and follow up letter were also

typed on Oklahoma State University letterhead in order to stress the need to and offer a more formal approach. After an approximate one-month time lapse, a follow-up letter was mailed requesting that additional consideration be given to the completion of the questionnaire.

Data Collection

Two questionnaires were developed by the researcher. One questionnaire was developed to gather information from the AACSB population, while the other was developed to gather information from the members in the Fortune 500 group. A questionnaire was mailed to all the members in the AACSB-accredited population and the Fortune 500 population.

Questionnaire mailing dates for both populations were as follows:

1. First Mailing - February 1, 1988
   Requested Return Date - March 1, 1988
2. Follow-up Mailing - March 8, 1988
   Requested Return Date - March 28, 1988

As described previously in the questionnaire section, each questionnaire was coded with an identification number. The identification number was used only to facilitate the second mailing. By utilizing the identification numbers on the AACSB and Fortune 500 questionnaires, members of the populations who had not responded as of the specified return date could be mailed a follow-up questionnaire. Therefore, questionnaires sent out in the second mailing process were sent only to population members who had not responded before or on the first mailing due date.

The questionnaire packet contained a cover-letter explaining the study's necessity, the questionnaire, and a business reply envelope. As indicated in Tables I and II respectively, the first mailing generated 88 AACSB responses and 91 Fortune 500 responses.

A sheet containing the names and identification numbers of each population group was developed. The identification sheet was used to check off the population member's address as the individual member's response was received. By utilizing this procedure, the number of packets mailed during the second round was reduced, accuracy was preserved since recipients could not respond twice, and nonrespondents could be identified.

By utilizing the identification sheet to identify nonrespondents from the populations, a second mailing list was prepared. One hundred fifty-nine AACSB and four hundred nine Fortune 500 nonrespondents were the target of the March 8, 1988 second mailing. The responses received from this mailing were 32 AACSB responses and 78 Fortune 500 responses.

TABLE I

AACSB RESPONSES TO INITIAL AND FOLLOW UP QUESTIONNAIRE MAILINGS

Mailing Dates	Number of Respondents	Response Percentages
February 1, 1988	88	35.63
March 8, 1988	32	12.96
Total Respondents	120	48.59
	N = 247	

TABLE II

FORTUNE 500 RESPONSES TO INITIAL AND FOLLOW UP QUESTIONNAIRE MAILINGS

Mailing Dates	Number of Respondents	Response Percentages
February 1, 1988	91	18.2
March 8, 1988	78	15.6
Total Respondents	169	33.8
	N = 500	

Statistical Procedures

The responses from both populations were used to identify response frequencies, response percentages, and a comparison of the frequencies of selected items from the AACSB and Fortune 500 populations. Responses received from the two populations concerning the perceived most and least beneficial characteristics were compared using the Chi-square statistical test. The Chi-square statistic was chosen since the data was collected and was evaluated in a frequency format. Isaac and Michael (1985) indicate that Chi-square should be used to evaluate the data when frequencies are involved. Further support is lent to the statistical technique by Linton and Gallo (1975). Linton and Gallo suggest that the Chi-square statistic is appropriate when an analysis of deviations from a priori expected frequencies is sought. On the selected items which necessitated the use of the Chi-square statistic, deviations occurring in the responses provided by the two populations were sought.

Two independent variables, attitude and group classification, were identified for this study. Specifically, the independent variables were identified as membership in the AACSB and Fortune 500 groups and the accredited AACSB attitudes concerning fourth-generation language utilization and the Fortune 500 attitudes concerning fourth-generation language utilization. The twelve dependent variables for this study were identified as follows:

Prototyping	Application Generation
Nonprocedural Programming	End-user Programming
Automated Data Dictionaries	Maintenance Reduction
Data Modeling	Decision Support System

Documentation automation	Automated design Tools
Training Time Reduction	Security Concerns

A two-way Chi square was used to test the twelve hypotheses at the .05 significance level. A two-way Chi square is needed when two or more independent variables are involved. Cramer's statistic was used to report the strength of association. According to Jaccard (1983), the Cramer's statistic is one of the more popular strength of association measures. The range of this statistic is from 0 to 1. The closer the value is to 1, a closer relationship may exist. The lower the value or the closer the value is to 0, the more likely a relationship does not exist.

Findings, Conclusions, and Recommendations

The findings are presented in Chapter IV. The conclusions and recommendations are presented in Chapter V.

CHAPTER IV

DATA ANALYSIS, FINDINGS, AND INTERPRETATION

AACSB and Fortune 500 Questionnaire Results

Members of the Fortune 500 companies and 247 accredited AACSB populations were asked to complete and return a questionnaire designed to gather information concerning the usage and instruction of fourth-generation languages. This chapter focuses on the responses which were given. Also, the two-way Chi square statistic was utilized in order to analyze the characteristics, results, and uses rankings provided by the two populations.

Information was gathered from both populations so that insights could be gained from both an industrial and educational perspective and are reported in the form of frequencies and percentages. Selected responses utilizing the data on such items as geographic location, enrollment status, presence of an information systems undergraduate degree program, information systems courses, and the curricula areas in which the Chi square statistic were compared in order to identify deviations in the ideologies of the two populations. The findings are presented in the sections which follow. To enhance the readability of the findings, each questionnaire section is discussed in relation to the findings; then a comparison of selected questions is presented.

AACSB Questionnaire -- Section I

Section I of the AACSB questionnaire was designed to collect demographic data on such items as geographic location, enrollment status, presence of an information systems undergraduate degree program, information systems courses, and the curricula areas in which the fourth-generation language topic had been incorporated. All respondents were asked to complete this section so that insights can be gained on the current status of information systems courses as a whole and the infiltration of fourth-generation languages into the present and future information systems curricula.

Undergraduate Degree Program. Of the 120 AACSB institutions supplying information, ninety offer an undergraduate program. Institutions from 43 states supplied answers to the questions which were asked. A listing of the states and the frequency of responses associated with each state is provided in Appendix E, Table LV.

Information systems curricula full time enrollment is included in Table III. Thirty-five respondents indicated that the full-time enrollment within the college of business was between 1501 - 2500 students. Following closely, thirty-four indicated that the enrollment was over 2500 students.

Information Systems Classes Currently Offered. Information was collected on the number of information systems classes currently being offered in the college of business. Table IV lists the frequencies associated with each number of courses. Thirty-nine of the 129 respondents indicated that more than ten information systems courses existed in the college of business information systems curricula.

Courses Offered Within the College of Business. The most frequently occurring information systems course offered within the college of business is management information systems. One hundred thirteen respondents indicated that this courses was offered within the college. Ninety-four respondents indicated that a database course is offered, while 97 participants indicated that a systems analysis and design course was offered. Introduction to data processing generated 73 responses. Third-generation programming classes were indicated as being offered through the college of business by 75 institutions. Presented in Table V provides a listing of information systems courses and the frequency of offerings associated with each.

Courses Specified by Respondents. Information systems courses other than those listed on the questionnaire are currently being offered by 64 institutions. A listing of the course titles and frequencies is presented in Table VI.

Information Systems Personnel. The number of personnel currently teaching information systems classes was reported to be four to six by forty-five of the respondents. Thirty-one indicated that ten or more personnel were teaching the information systems classes, while twenty-four of the respondents indicated that only one to three instructors were needed. Eighteen of the participants reported that their information systems personnel were classified in the seven to nine category. Table VII illustrates the frequencies associated with the number of information systems instructors teaching at the AACSB institutions. Table VIII shows the exact frequencies for those indicating that ten or more instructors taught information systems classes. One respondent indicated that 42 full-time personnel,

part-time personnel, and graduate teaching associates were teaching information systems courses. Values ranged in this category from the highest which was 42 personnel to 10 personnel being indicated by the respondents as teaching information systems classes.

TABLE III

FULL-TIME ENROLLMENT AS INDICATED BY SURVEY RESPONDENTS EXISTING WITHIN THE COLLEGE OF BUSINESS

Present Enrollment	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1 - 500 students	9	7.7	9	7.7
501 - 1000 students	17	14.5	26	22.2
1001 - 1500 students	22	18.8	48	41.0
1501 - 2500 students	35	29.9	83	70.9
Over 2500 students	34	29.1	117	100.0
Missing Value	3			
		N = 117		

TABLE IV

NUMBER OF INFORMATION SYSTEMS COURSE OFFERINGS EXISTING WITHIN THE COLLEGE OF BUSINESS

Number of Courses Offered	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1-3	19	16.7	19	16.7
4-6	24	21.1	43	37.7
7-10	32	28.1	75	65.8
More than 10	39	34.2	114	100.0
Missing Values	6			

TABLE V

INFORMATION SYSTEMS COURSES WHICH ARE CURRENTLY OFFERED WITHIN THE COLLEGE OF BUSINESS

Course Title	Frequency
Management Information Systems	113
Database	94
Systems Analysis and Design	97
Introduction to Data Processing	73
Third Generation Language Programming Classes:	
COBOL	66
Fortran	10
RPG	11
Pascal	17
BASIC	30
PL/1	5
Ada	2
Advanced BASIC	1
Advanced COBOL	2
Assembler	1
C	4

TABLE VI

INFORMATION SYSTEMS COURSES CURRENTLY BEING OFFERED WITHIN THE COLLEGE OF BUSINESS AS INDICATED BY SURVEY RESPONDENTS IN THE 'OTHER' COURSE CATEGORY

Course Title	Frequency
Accounting Information Systems	4
Administrative Problems in Information Systems	3
Advanced MIS	2
Advanced Data Management and Computer Analysis	1
Advanced Topics in Systems Development	1
Advanced Topics	1
Analysis Design and Implementation of Information System	1
Applications Development and Projects	17
Applied Software Development	1
Artificial Intelligence	4
Assembly and Computer Organization	2
Business Information Systems Design	1
Computer Based Information Systems	2
Computer Model and Decision Analysis	1
Computer Security Management	1
CICS	1
Current Topics	5
Database Systems	3
Data Structures	3
Decision Support Systems	32
Economics of Computers	1
EDP Auditing	1
End User Computing	5
Expert Systems	16
File Organization Methods	2
Fourth Generation Language Programming Classes	
Lotus 1-2-3	2
LISP	1
Prolog	1
Focus	1
RBASE	1
DBASE III+	1
Survey	1

TABLE VI (Continued)

Course Title	Frequency
Hardware and Software Evaluation	2
Human Factors in MIS	2
Information Resource Management	2
Information Systems Automation	1
Information Systems Technology	1
Integrated Systems	1
Internship	1
Introduction to Information Management	1
Information Systems Applications	3
Information Systems Techniques	1
Information Resource Management	4
Information Systems Planning Operating Systems	1
Information Systems Management	1
Information Systems Concepts	2
Information Systems Planning	2
Information Systems Productivity	1
Local Area Networks	1
Legal Issues	2
Management Information Processing	4
Management of MIS	6
Management Science Methods	1
Office Automation	1
Office Information Systems	2
Operating Systems	1
Small Business Computers	1
Systems Operations	2
Systems Simulation	1
Systems Development	1
Simulation and Modeling	6
Software Engineering	1
Strategic Information Systems	1
Seminar	3
Systems Analysis	2
Systems Design	2
Technology Implementation in Organizations	1
Technical Problems in Information Systems	1

TABLE VI (Continued)

Course Title	Frequency
Technology of Computer Based Business Systems	1
Telecom/Distributed Processing	21
Teleprocessing Networks	2
Total Information System	1

TABLE VII

INFORMATION SYSTEMS PERSONNEL CURRENTLY TEACHING
INFORMATION SYSTEMS CLASSES

Number of Information Systems Instructors	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1 - 3	24	20.3	24	20.3
4 - 6	45	38.1	69	58.5
7 - 9	18	15.3	87	73.7
10 or more	31	26.3	118	100.0
Missing Values	2			

N = 120

TABLE VIII

COLLEGE OF BUSINESS PERSONNEL CURRENTLY TEACHING INFORMATION SYSTEMS CLASSES WHERE THE NUMBER OF PERSONNEL TOTALS TEN OR MORE

Number of Information Systems Instructors	Frequency
10	6
11	6
12	8
14	2
15	1
16	1
17	1
18	1
20	4
22	1
25	1
26	1
30	1
42	1

Fourth-Generation Language Placement. Section II of the AACSB questionnaire was completed if the fourth-generation language topic had been incorporated into existing courses. Section III was completed if new courses had been designed to introduce the fourth-generation

language or fourth-generation language topic. The possibility existed for institutions to have incorporated the fourth-generation language topic into existing courses as well as to have established new courses specifically to introduce or discuss the fourth-generation language topic. Respondents falling into this category were asked to complete both Sections II and III. Section IV was completed by those institutions which had not incorporated the fourth-generation language topic into their existing curricula and had not developed new courses specifically for the fourth-generation language topic. As indicated in Table IX, sixty-one of this study's participants indicated that the fourth-generation language topic had been incorporated into existing courses. Eight respondents indicated that no existing courses had been modified to incorporate the fourth-generation language topic; however, new courses had been designed to discuss the fourth-generation language topic. Both Sections II and III were completed by 22 respondents who stipulated that both new courses had been developed and that existing courses were including the fourth-generation concept. The fourth-generation language topic had not been incorporated into the classroom by 25 of the responding institutions.

TABLE IX

FOURTH-GENERATION LANGUAGE
CLASSROOM INCORPORATION

Curriculum Placement	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Only Existing Courses	63	52.5	63	52.5
Only New Courses	7	5.8	70	58.3
New and Existing Courses	22	18.3	92	76.6
Has Not Been Included	28	23.3	120	100.0
		N = 120		

AACSB Questionnaire -- Section II

Incorporation of the Fourth-Generation Language. Existing courses within the college of business which embodied the fourth-generation language topic ranged from 63 that had incorporated the topic into one to three classes to two responses indicating that the fourth-generation language topic had been incorporated into more than eight courses. Of the two who specified the more-than-eight category, one indicated that seventeen classes were utilizing the fourth-generation topic; the other respondent supplied only the answer that more than eight classes were utilizing this topic. For classes incorporating the fourth-generation language topic, frequencies, percentages, cumulative frequencies, and cumulative percentages are provided in Table X.

TABLE X

FOURTH-GENERATION LANGUAGE
CLASSROOM INCORPORATION
IN EXISTING COURSES

Existing Courses Using the 4GL Topic	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1 to 3	63	76.0	63	76.0
4 to 5	16	19.2	79	95.2
6 to 8	2	2.4	81	97.6
More than 8	2	2.4	83	100.0
Missing Values	2			
		N = 85		

Courses Implementing Fourth-Generation Languages. When asked to identify courses which were presently implementing the fourth-generation language topic, 57 of the 85 respondents to Section II indicated that the management information systems course was the area which was most frequently utilized to discuss this topic. By referencing Tables XI, frequencies and percentages are given for the classes identified as incorporating the fourth-generation topic. Pascal, Fortran, and PL/1 courses were not identified as incorporating the fourth-generation language topic. C programming, was the only 'other' third-generation language programming class specified as incorporating the fourth-generation language topic.

Identities and frequencies for those responses indicated in the 'other' courses option, which were used to introduce the fourth-generation language topic, are provided in Table XII. Decision Support Systems was the most frequently reported course in the 'other' category as being utilized to incorporated the fourth-generation language topic.

TABLE XI

COLLEGE OF BUSINESS COURSES IN WHICH THE FOURTH-GENERATION LANGUAGE TOPIC IS BEING IMPLEMENTED

Course Incorporating A Fourth-Generation Language	Frequency	Percent
Management Information Systems	57	67
Introduction to Data Processing	21	24.7
Systems Analysis and Design	36	42.3
Database Concepts	49	57.6
3GL Programming Classes	16	18.8
COBOL	6	7
BASIC	1	1
RPG	1	1
Other 3GL Programming Classes	2	2.3

N = 85

TABLE XII

FREQUENCY OF OCCURRENCE OF THE FOURTH-GENERATION LANGUAGE TOPIC IN COURSES AS SPECIFIED IN THE 'OTHER' COURSE CATEGORY

Course Title or Course Equivalent	Frequency
Applications Development and Projects	6
Artificial Intelligence	1
Computer Modeling and Decision Analysis	1
Current Topics	2
Database Systems	1
Decision Support Systems	23
End User Computing	5
Expert Systems	6
Fourth Generation Languages	2
Human Factors	1
Information Systems Management	1
Seminar	3
Simulations	1
Total Information Systems	1

Class Time Devoted to Fourth-Generation Language Topics. Courses specified as incorporating the fourth-generation language topic were further analyzed to determine the amount of class time devoted to the topic. Table XIII shows the percentage of respondents indicating the particular time allotment and the frequency that each time allotment was specified for each course. The responses ranged from less than one week to more than two weeks being devoted to the fourth-generation language topic. An 'other' category was provided on the questionnaire so that any deviations from the responses provided or comments could be recorded in order to clarify answers. Responses recorded in the 'other' category indicated that projects were established as either a semester project and included as part of the course or established as a semester project and no class time was devoted to the project. The frequencies and percentages are based on the eighty-five respondents to this section. FORTRAN, RPG, PL/1, and PASCAL did not receive any comments regarding the possible inclusion of a fourth-generation language in the course; therefore, Table XIII does not illustrate percentages and frequencies for these courses since the frequencies and percentages would equal zero.

TABLE XIII

FREQUENCY OF TIME ALLOTMENTS ASSOCIATED WITH THE INCLUSION OF A FOURTH-GENERATION LANGUAGE TOPIC IN INFORMATION SYSTEMS CURRICULA

Time allotments	Frequency	Percent
Management Information Systems		
Less than 1 week	19	22.4
More than 1 week but less than two	21	24.7
More than two weeks	15	17.6
Other (Project)	1	1.2
Introduction to Data Processing		
Less than 1 week	11	12.9
More than 1 week but less than two	4	4.7
More than two weeks	7	8.2
Other	0	0.0
Systems Analysis and Design		
Less than 1 week	6	7.1
More than 1 week but less than two	13	15.3
More than two weeks	13	15.3
Other (Project)	1	1.2
Did not Incorporate	52	61.2

TABLE XIII (Continued)

Time allotments	Frequency	Percent
Database Concepts		
Less than 1 week	3	3.5
More than 1 week but less than two	13	15.3
More than two weeks	28	32.9
Other (Project)	1	1.2
COBOL		
Less than 1 week	2	2.4
More than 1 week but less than two	0	0.0
More than two weeks	1	1.2
Other	0	0.0
BASIC		
Less than 1 week	1	1.2
More than 1 week but less than two	0	0.0
More than two weeks	0	0.0
Other	0	0.0

TABLE XIII (Continued)

Time allotments	Frequency	Percent
Other 3GL Programming Classes		
Less than 1 week	0	0.0
More than 1 week but less than two	2	2.4
More than two weeks	5	5.9
Other	0	0.0
	N = 85	

Programming Classes and Fourth-Generation Languages. Institutions indicating that other programming classes were offering instruction in the fourth-generation language topic indicated that more than two weeks or more than one week, but less than two weeks were being devoted to the fourth-generation language concept. Courses falling into this category were the C programming class and operating systems. One respondent checking the more than one week, but less than two did not specify to which course this applied.

Class Time Devoted to the Fourth-Generation Language Topic. When asked to stipulate the amount of time associated with the courses specified in the 'other' category, the majority indicated that more than two weeks was devoted to the fourth-generation language topic. The response frequencies are displayed in Table XIV. The category, more than one week, but less than two weeks, was indicated for the courses entitled as follows decision support systems; applications development, and projects. Decision support systems was specified for this category twice; applications development, and projects was also checked twice. The classification, 'other', was selected four times. Case studies, outside assignments, tutorials, and a personal computer project were stipulated as a way of associating the fourth-generation language topic with the specified class, but the topic itself did not receive class time.

TABLE XIV

MORE THAN TWO-WEEK TIME ALLOTMENTS ASSIGNED FOURTH-GENERATION LANGUAGE DISCUSSION AS SPECIFIED IN THE 'OTHER' COURSE CATEGORY

Course Title or Course Equivalent	Frequency
Applications Development and Projects	4
Artificial Intelligence	1
Computer Modeling and Decision Analysis	1
Current Topics	1
Database Systems	1
Decision Support Systems	23
End User Computing	4
Expert Systems	6
Fourth-Generation Languages	2
Human Factors	1
Information Systems Management	1
Seminar	3
Simulations	1
Total Information Systems	1

Methods of Presentation. The method of presentation used to incorporate the fourth-generation language topic into the courses which were indicated as including the fourth-generation language topic were categorized into lecture, software application, classroom discussion,

programming assignment, or into an other category. The teaching methods associated with each course and the frequencies associated with the corresponding teaching method are presented in tabular format in Table XV. The frequency information for the table is based on the eighty-five respondents who completed Section II. Since identification of teaching methods used to present the fourth-generation language topic was sought, multiple answers were permitted. Teaching methods were not identified as being associated with the Fortran, PL/1, and Pascal programming classes; therefore, these courses are not included in the table since the associated frequencies were zero.

Teaching Methods and 'Other' Programming Classes. Included in Table XV is a frequency distribution constructed to indicate the associated frequencies for the 'other' programming classes. A database project course and operating systems course were specified as utilizing the software application teaching tool, while the C programming course was stipulated as utilizing the lecture, classroom discussion, and software applications teaching techniques. Several respondents indicated that other programming classes utilized the fourth-generation language topic and used differing teaching methods; however, the exact course titles were not specified. A determination can only be made that the lecture, software application, classroom discussion, and programming assignment teaching methods were utilized in these other programming classes.

TABLE XV

METHODS OF FOURTH-GENERATION LANGUAGE PRESENTATION AND ASSOCIATED FREQUENCIES FOR INFORMATION SYSTEMS CURRICULA

Course Title	Lecture	Software Application	Classroom Discussion	Programming Assignment
MIS	56	25	33	23
IDP	20	13	7	9
SAD	24	22	20	17
Database Concepts	32	29	29	36
COBOL	5	1	2	3
BASIC	2	0	0	0
Other Programming Classes	4	3	3	4

N = 85*

*Respondents could indicate more than one method of presentation.

'Other' Courses and Presentation Methods. Courses that were categorized as incorporating the fourth-generation language topic were examined to determine which method or methods were used by the instructor to present the topic. Multiple answers were acceptable; therefore, any one class could incorporate the lecture, software application, classroom discussion, programming assignment, and other teaching methods. The courses recorded under the 'other courses' category on the questionnaire which were specified by the instructors are listed in Table XVI. The applications development and projects

courses were indicated by one respondent as utilizing the case study approach as an 'other' presentation method. Tutorials and project assignments were specified by two institutions as methods of including the fourth-generation language into the decision support systems course.

Rankings of the Characteristics, Results, and Uses. If existing courses were incorporating the fourth-generation language topic, instructors were asked to rank the twelve characteristics, uses, and results according to the perceived benefit of the characteristic, use, or result. Likert-type scales were constructed for the respondents to record their answers. In the instances where missing values were present, ranking means are based on the responses that were recorded and do not include the missing values. The ranking means are presented in Table XVII. Space was provided on the questionnaire for other characteristics, results, or uses to be recorded by the respondent for ranking. No respondents recorded possible characteristics, results, or uses.

Coverage Rankings of the Characteristics, Results, and Uses. Coverage of the twelve characteristics, results, and uses was rated using a Likert-type scale. Instructors were asked to rank the characteristic, result, or use based upon their perception of how much coverage should be given to the characteristic, result, or use. Table XVIII illustrates the associated means for the characteristic, result, or use. In most of the courses a combination of the lecture, software application, classroom discussion, and programming assignments were made to include the fourth-generation language topic into the course.

TABLE XVI

METHODS OF FOURTH-GENERATION LANGUAGE PRESENTATION AS SPECIFIED IN THE 'OTHER' COURSE CATEGORY

Course Title	Lecture	Software Application	Classroom Discussion	Programming Assignment
Application Development and Projects	4	5	5	4
Artificial Intelligence	0	0	0	1
Computer Modeling and Decision Analysis	1	1	1	1
Current Topics	0	1	1	0
Database Systems	4	3	3	4
Decision Support Systems	18	20	17	20
End Usere Computing	5	4	4	4
Expert Systems	4	4	2	6
Fourth-Generation Languages	2	2	2	2
Human Factors	1	1	1	1
Information Systems Management	1	0	0	0
Seminar	1	0	1	2
Simulations	1	1	1	1
Total Information Systems	1	1	1	1

N = 85

TABLE XVII

WEIGHTED MEANS OF THE CHARACTERISTIC, RESULT, OR USE BASED ON THE PERCEPTIONS OF AACSB INSTRUCTORS INCORPORATING THE FOURTH-GENERATION LANGUAGE TOPIC INTO EXISTING COURSES

Characteristic Result or Use	Mean
Prototyping	4.30
Application Generation	4.25
Nonprocedural Programming	4.14
End User Programming	4.08
Automated Data Dictionaries	3.59
Maintenance Reduction	3.42
Data Modeling	3.54
Decision Support System	4.14
Documentation Automation	3.48
Automated Design Tools	3.55
Security Features	2.88
Training Time Reduction	3.51

Note: Likert-type Scale values for this table were as follows:
Not Beneficial - 1 Slightly Beneficial - 2
Moderately Beneficial - 3 Very Beneficial - 4
Extremely Beneficial - 5

TABLE XVIII

WEIGHTED COVERAGE MEANS OF THE CHARACTERISTIC, RESULT, OR USE BASED ON THE PERCEPTIONS OF AACSB INSTRUCTORS INCORPORATING THE FOURTH-GENERATION LANGUAGE TOPIC INTO EXISTING COURSES

Characteristic Result or Use	Mean
Prototyping	3.80
Application Generation	3.92
Nonprocedural Programming	3.66
End User Programming	3.68
Automated Data Dictionaries	3.26
Maintenance Reduction	3.15
Data Modeling	3.46
Decision Support System	3.77
Documentation Automation	3.27
Automated Design Tools	3.46
Security Features	3.16
Training Time Reduction	3.13

Note: Likert-type Scale values for this table were as follows:
Not Beneficial - 1 Slightly Beneficial - 2
Moderately Beneficial - 3 Very Beneficial - 4
Extremely Beneficial - 5

Programming Instruction Alteration. Thirty-five of the 85 respondents to Section II indicated that programming instruction had been altered. Twenty-six of the 35 respondents, when asked if the alteration was a positive change, stated that it was. A subpart of this question was directed at identifying the areas which had been affected the most as a result of the incorporation of the fourth-generation language topic into the curricula. A list of items, which were provided on the questionnaire, was indicated by seventy-four of the 85 respondents as altering programming instruction the most. The frequencies of these items are presented in Table XIX.

Fourth-Generation Language Identification. One goal of the study was to determine which fourth-generation languages were being implemented into the AACSB curricula. Participants were asked to specify which fourth-generation languages they were currently using in their classes. More than one language was being utilized by most of the respondents. Frequencies associated with each language are included in Table XX. IFPS and Focus were the most frequently used languages. If the fourth-generation language was not listed, respondents were able to write the language(s) which were currently being used in the 'other' category. These frequencies are also included in Table XX. DBASE and SQL were the most often reported languages which were designated by the respondents in the write-in category.

TABLE XIX

AREAS IN WHICH ALTERATIONS ARE OCCURRING IN THE CLASSROOM BASED ON THE PERCEPTIONS OF THE AACSB INSTRUCTORS INCORPORATING THE FOURTH-GENERATION LANGUAGE TOPIC IN THE CLASSROOM

Perceived Alterations	Frequency
Coding Requirements	17
Procedural Programming	7
Nonprocedural Programming	15
Program Design	9
Length of Instruction	15
Program Documentation	7
Corrective Maintenance	2
Adaptive Maintenance	1
Enhancement Maintenance	1
Other	0

TABLE XX

LANGUAGES CURRENTLY BEING INCORPORATED INTO THE EXISTING CURRICULA AT THE AACSB INSTITUTIONS (Listed in Descending Order)

Language	Frequency
IFPS	39
FOCUS	23
NOMAD	6
NATURAL	5
SPECTRA	5
RAMIS II	4
SYSTEM W	4
ADS	3
IDEAL	2
MANTIS	2
POWERHOUSE	1
EXPRESS	1
QTIME	1
Other:	
DBASE	16
SQL	8
RBASE:5000	6
LOTUS 1-2-3	5
SAS	4
EXCELERATOR	3
DATATRIEVE	2
EXPERT SYSTEM SHELLS	2
LEVEL 5	2
INFO	1
EXCEL	1
ENABLE	1
KDS	1
UPEXPERT	1
PROLOG	1
FOXBASE	1
CLOUT	1
PERSONAL CONSULTANT	1

Table XX (Continued)

Language	Frequency
INGRES	1
ORACLE	1
XDB	1
W/P	1
S/S	1
DB	1
GRAPHICS	1
TELECOM	1
MAGER	1
APPLICATION FACTORY	1
CORVISION	1
PROCEDURAL LANGUAGE	1
PARADOX	1
PROTOS	1
FPS	1
DSS/F	1
DSS/A	1
REPORTWRITER	1

AACSB Questionnaire -- Section III

Section III was completed by 29 of the 120 respondents. Twenty-two of the study's participants completed both sections two and three indicating that these twenty-two have incorporated the fourth-generation language topic into the existing curricula and have created new courses specifically to introduce the fourth-generation language topic into the curricula. Seven of the respondents to this section had not incorporated fourth-generation languages into the existing curricula but had developed new courses specifically to introduce the topic into the curricula. A discussion of the information collected in Section III of the AACSB questionnaire follows.

Specifically Designed Fourth-Generation Language Classes. One area targeted for investigation was the inclusion of a fourth-generation language programming class into the information systems curricula. The percentage of the instructors completing Section III indicating that a fourth-generation language programming class existed within their curricula was 75.9 percent or 22 respondents. Only 7 of the 29 respondents stipulated that a programming class specifically designed to incorporate a fourth-generation language did not currently exist within their curricula. Courses which have been developed to cover different aspects of fourth-generation language topics consisted of courses which had been developed but had not been taught to courses which had been taught for more than two completed school years. These results are presented in Table XXI.

TABLE XXI

FREQUENCIES AND PERCENTAGES OF THE LENGTH OF TIME THAT COURSES WHICH COVER DIFFERENT ASPECTS OF FOURTH-GENERATION LANGUAGE TOPICS HAVE BEEN TAUGHT

Length of Time	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Developed, but not taught yet	7	30.4	7	30.4
Less than 1 Completed School Year	2	8.7	9	39.1
One Completed School Year	2	8.7	11	47.8
More Than One Completed School Year But Less than Two	2	8.7	13	56.5
Two Completed School Years	2	8.7	15	65.2
More Than Two Completed School Years	8	34.8	23	100.0
Have Not Developed a Course	0	0.0	23	100.0
		N = 29		

Fourth-Generation Language Identification. When asked to identify which fourth-generation languages were being used in the courses that had been specifically designed to incorporate the fourth-generation language topics, nine respondents indicated that they were using FOCUS, while eight respondents indicated that they were using IFPS. Two of the study's participants indicated that they were utilizing SYSTEM W; RAMIS II and QTIME were chosen once. Participants were able to specify the fourth-generation language if it was not listed in a category called 'other.' Table XXII shows the fourth-generation languages which were written in this category and the frequencies associated with each. DBASE, DBASE III+ and SQL were chosen most often with each having a frequency of four.

Characteristics, Uses, and Results Ranking Values. The characteristics, uses, and results which were ranked in this study were assigned ranking values by the respondents who completed Section III. The means based on the assigned ranking values are presented in Table XXIII. An 'other' category was provided for those instructors who wished to indicate different characteristics, results, or uses as being beneficial; however, none were specified. Prototyping was ranked the highest and security features was ranked the lowest on the Likert-type scale which was constructed to capture the perceived beneficiality rankings of the respondents who completed this section.

TABLE XXII

FOURTH-GENERATION LANGUAGES CURRENTLY BEING UTILIZED IN COURSES SPECIFICALLY DESIGNED TO INCORPORATE THE FOURTH-GENERATION LANGUAGE TOPIC

Language	Frequency
DBASE and DBASE III+	5
SQL	4
ORACLE	3
LOTUS 1-2-3	2
APPLICATION FACTORY	1
CORVISIA	1
DECISION SUPPORT SYSTEMS	1
EXPERT SYSTEM SHELLS	1
EXSYS	1
FPS	1
INGRESS	1
PARADOX	1
PROCEDURAL LANGUAGE	1
PROLOG	1
QBE	1
RBASE 5000	3
RELATIONAL ALGEBRA	1
RELATIONAL CALCULUS	1
XDS	1

TABLE XXIII

CHARACTERISTIC, RESULT, OR USE BENEFIT WEIGHTED MEANS BASED ON AACSB INSTRUCTOR PERCEPTIONS WHO ARE INCORPORATING THE FOURTH-GENERATION LANGUAGE TOPIC INTO SPECIFICALLY DESIGNED 4GL COURSES

Characteristic Result or Use	Mean
Prototyping	4.47
Application Generation	4.35
Nonprocedural Programming	4.21
End User Programming	4.45
Automated Data Dictionaries	3.55
Maintenance Reduction	3.52
Data Modeling	4.05
Decision Support System	4.66
Documentation Automation	3.45
Automated Design Tools	3.61
Security Features	3.00
Training Time Reduction	3.15

N = 20

Note: Likert-type Scale values for this table were as follows:
Not Beneficial - 1 Slightly Beneficial - 2
Moderately Beneficial - 3 Very Beneficial - 4
Extremely Beneficial - 5

AACSB Questionnaire -- Section IV

Section IV Completion. One area of this research focused on the potential fourth-generation language incorporation into the curricula if the topic had not been incorporated into existing or newly developed courses. Of the 120 respondents to this survey, 28 participants completed Section IV. This section was designed to collect data about the plans that were currently under way to establish fourth-generation language courses or to implement the fourth-generation language topic into existing courses. If the development of courses or the utilization of existing courses was under contemplation, sought was information about the identification of those courses, how much time would be devoted to the topic, and what methods of presentation would be utilized to introduce the topic. Also the instructors completing this section were asked to rank the twelve characteristics, results, and uses on the perceived benefit of the characteristic, result, or use.

Fourth-Generation Language Inclusion. Incorporation of the fourth-generation language topic in the college of business curricula was under consideration for eleven of the respondents completing Section IV; seventeen stipulated that the incorporation of the fourth-generation language topic was not presently under consideration. Of the eleven who suggested that incorporation was under consideration, the length of time before the class will be embodied in the curricula is presented in Table XXIV. The most frequently occurring response was more than one school year, but less than two school years. This response was given by five of the eleven instructors completing this Section IV.

TABLE XXIV

POTENTIAL INCORPORATION OF THE FOURTH-GENERATION LANGUAGE TOPIC INTO THE AACSB CURRICULUM AS STIPULATED BY THE AACSB INSTITUTIONS

Incorporation Will Begin	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Less than 1 year	3	27.3	3	27.3
More than 1 year but less than 2 yrs.	5	45.5	8	72.7
Two school years but less than 3 school yrs.	1	9.1	9	81.8
Three School Years	1	9.1	10	90.9
More than Three School Years	1	9.1	11	100.0
		N = 11		

Fourth-Generation Languages Under Consideration. Powerhouse, Focus, and IFPS were chosen for future use in the developing fourth-generation language curricula. Powerhouse received one vote; Focus received three votes, IFPS received four votes. In addition to these languages, eight different fourth-generation languages were supplied for potential incorporation. Listed in Table XXV are the eight fourth-generation languages along with the frequencies associated with each. Four institutions indicated that curriculum development was still in the early developmental stages and a decision had not been made concerning the selection of a fourth-generation language at the time the questionnaire was completed.

TABLE XXV

FOURTH-GENERATION LANGUAGES AS INDICATED IN THE 'OTHER' CATEGORY WHICH WILL BE UTILIZED IN DEVELOPING THE FOURTH-GENERATION LANGUAGE CURRICULA

Language	Frequency
Do Not Know	4
ORACLE	2
SQL	2
E2	1
EXCELERATOR	1
RBASE	1
SMART	1
SMART STAR	1

Placement Within the Curricula. When asked if the fourth-generation language would be incorporated into an existing course, nine responses were positive; two responses were negative. The nine participants purporting that incorporation of the fourth-generation language would be implemented into the existing curricula were then asked to indicated in which courses the topic would be placed. Table XXVI displays the courses and the frequencies with which the respondents stipulated that the topic would be integrated. Management Information Systems was indicated most often to be the course into which the fourth-generation language topic would be incoporated.

TABLE XXVI

POTENTIAL FOURTH-GENERATION LANGUAGE PLACEMENT WITHIN EXISTING COURSES

Language	Frequency
Management Information Systems	5
Introduction to Data Processing	2
Systems Analysis and Design	2
Database Concepts	3
COBOL	3
Other Courses:	
Fourth-Generation Languages	1
Operations Research	1

Class Time and the Fourth-Generation Language. Identification of the amount of class time that would be devoted to the fourth-generation language topic in each of the courses stipulated as potential fourth-generation language incorporation candidates was sought. Time allotments associated with each course chosen to implement the fourth-generation language topic are presented in Table XXVII. New courses will be designed by two of the institutions; however exact time parameters for the discussion of the fourth-generation language topic were not identified. Respondents most often indicated that less than one week would be utilized to discuss the fourth-generation language. More than two weeks was designated the least often by the respondents as

the amount of class time which would be devoted to the fourth-generation language topic.

TABLE XXVII

CLASS TIME THAT WILL BE DEVOTED TO THE FOURTH-GENERATION LANGUAGE TOPIC TO THE FOLLOWING INFORMATION SYSTEMS COURSES

Class Time	Frequency
Management Information Systems	
Less Than 1 Week	2
More Than 1 Week But Less Than 2 Weeks	3
More than 2 Weeks	0
Introduction to Data Processing	
Less Than 1 Week	0
More Than 1 Week But Less Than 2 Weeks	1
More than 2 Weeks	1
Systems Analysis and Design	
Less Than 1 Week	2
More Than 1 Week But Less Than 2 Weeks	0
More than 2 Weeks	0

TABLE XXVII (Continued)

Class Time	Frequency
Database Concepts	
Less Than 1 Week	2
More Than 1 Week But Less Than 2 Weeks	0
More than 2 Weeks	1
COBOL	
Less Than 1 Week	0
More Than 1 Week But Less Than 2 Weeks	0
More than 2 Weeks	1

Presentation Methods and Fourth-Generation Language Topics. The presentation methods and frequencies associated with each course indicated as potentially incorporating the fourth-generation language topic are presented in Table XXVIII. Only those courses that were specified as utilizing the fourth-generation language topic have tables showing the frequencies associated with each presentation method. Although two courses were identified as being under construction, the presentation methods which were utilized in these courses were not identified.

TABLE XXVIII

PRESENTATION METHODS THAT WILL BE USED TO INCORPORATE THE FOURTH-GENERATION LANGUAGE TOPIC INTO INFORMATION SYSTEMS COURSES

Class Time	Frequency
Management Information Systems	
Lecture	4
Software Application	2
Classroom Discussion	2
Programming Assignment	3
Other	0
Introduction to Data Processing	
Lecture	2
Software Application	1
Classroom Discussion	2
Programming Assignment	1
Other	0
Systems Analysis and Design	
Lecture	1
Software Application	1
Classroom Discussion	1
Programming Assignment	1
Other	0

TABLE XXVIII (Continued)

Class Time	Frequency
COBOL	
Lecture	1
Software Application	1
Classroom Discussion	1
Programming Assignment	1
Other	0

Characteristics, Results, and Uses Rankings. Section IV respondents were asked to rank the twelve characteristics, results, and uses. The means for each characteristic, result, and use was calculated and is displayed in Table XXIX. Application generation received the highest mean score, while security features received the lowest mean score. Since additional characteristics, results, or uses were not specified by the users, no table was constructed.

TABLE XXIX

WEIGHTED BENEFICIALITY MEANS OF THE CHARACTERISTICS, RESULTS, AND USES BASED ON THE PERCEPTIONS OF AACSB INSTRUCTORS WHO ARE PLANNING TO INCORPORATE THE FOURTH-GENERATION LANGUAGE TOPIC INTO THE CLASSROOM

Characteristic Result or Use	Mean
Prototyping	4.33
Application Generation	4.67
Nonprocedural Programming	4.44
End User Programming	4.56
Automated Data Dictionaries	3.22
Maintenance Reduction	3.66
Data Modeling	3.11
Decision Support System	3.67
Documentation Automation	2.67
Automated Design Tools	2.89
Security Features	2.11
Training Time Reduction	3.67

N = 9

Note: Likert-type Scale values for this table were as follows: Not Beneficial = 1
Slightly Beneficial = 2 Moderately Beneficial = 3
Very Beneficial = 4 Extremely Beneficial = 5

Fortune 500 Questionnaire Findings

The questionnaire mailed to the senior systems analysts in the Fortune 500 companies was designed to gather information that would aid in the development of higher education curricula concerning the incorporation of the fourth-generation language. A discussion of sections I, II, and III follows. A comparison of selected responses from the Fortune 500 with AACSB responses was completed; the comparisons are presented after the Fortune 500 questionnaire discussion.

Fortune 500 Questionnaire--Section I

Section I was designed to collect demographic data from the respondents. Identification of the state, number of employees associated with the organization, number of information systems department employees, and the incorporation of the fourth-generation language into the organization was sought in this section. A breakdown of the states in which the responding Fortune 500 companies who completed the questionnaires are found in Appendix F, Table LVI.

Organization Size and Number of Employees. The sizes of the organizations responding varied from under 10,000 employees to organizations which employed over 25,000. Table XXX presents the sizes of the organizations and the corresponding frequencies as reported on the returned questionnaires. Data concerning the number of information systems department employees were collected. The results reported in the form of frequencies, percentages, cumulative frequencies, and cumulative percentages are reported in Table XXXI. Ninetyl-one respondents indicated that more than 30 employees worked in the

information systems department. Only 21 indicated that the information systems employees ranged from 1 to 10.

TABLE XXX

APPROXIMATE SIZE OF THE RESPONDING FORTUNE 500 COMPANIES

Size of Organization	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Under 10,000	79	47.6	79	47.6
10,000 - 15,000	33	19.9	112	67.5
15,001 - 20,000	14	8.4	126	75.9
20,001 - 25,000	13	7.8	139	83.7
Over 25,000	27	16.3	166	100.0
Missing Values	3			
		N = 169		

TABLE XXXI

APPROXIMATE NUMBER OF INFORMATION SYSTEMS DEPARTMENT EMPLOYEES IN THE RESPONDING FORTUNE 500 COMPANIES

Employees within IS Department	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1 - 10	21	12.8	21	12.8
11 - 20	29	17.7	50	30.5
21 - 30	23	14.0	73	44.5
More than 30	91	55.5	164	100.0
Missing Values	5			
		N = 169		

Fortune 500 Questionnaire--Section II

Section II Completion. Section II was completed if the Fortune 500 organization had incorporated a fourth-generation language into one or more departments. One hundred twenty organizations indicated that existing departments had included a fourth-generation language. Forty-nine organizations indicated that no fourth-generation language had been incorporated at the time the questionnaire was completed.

The purpose of this section was to collect data from organizations which had included a fourth-generation language within a single department or multiple departments. Reported results are based on the 120 Fortune 500 companies stipulating that a fourth-generation language was used in their organization.

Fourth-Generation Language Incorporation Time. Information was sought about the length of time the institutions have been incorporating fourth-generation languages into their organization. A percentage of 61.5 (or 72) of the Fortune 500 companies reported that the fourth-generation language had been used by the organization for three or more years. The other possible answer frequencies consisted were similar. Table XXXII reports the frequencies, percentages, cumulative frequencies, and cumulative percentages associated with the length of time that a fourth-generation language had been incorporated within the organization. The majority of respondents indicated that the fourth-generation language had been incorporated into the organization for three or more years. Fourteen stated that the language had been utilized for one to two years, while 16 indicated that the language had been included for less than one year.

TABLE XXXII

LENGTH OF TIME FOURTH-GENERATION LANGUAGES
HAVE BEEN INCLUDED WITHIN
FORTUNE 500 COMPANIES

Time Length	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Less Than 1 year	16	13.4	16	13.4
1 - 2 Years	14	11.8	30	25.2
More Than 2 Years But Less Than 3 Years	17	14.3	47	39.5
3 or More Years	72	60.5	119	100.0
Missing Values	1			

N = 120

Fortune 500 Training Methods. The different teaching methods of the fourth-generation language were requested. Since all teaching methods utilized by the Fortune 500 companies were needed, multiple answers were permitted. In the case of multiple answers, respondents were asked to rank the answers based on the frequency of use. A ranking of one was assigned to the most frequently used; a ranking of two was assigned to the second most frequently used; etc. Focus of this study was on the presence of training methods--either the training methods which were listed on the questionnaire or additional teaching methods that were written on the questionnaire. Rankings were not required if the method was not used. The frequencies associated with each training method are reported in Table XXXIII. All training methods received rankings ranging in values from one to five with the exception of two training methods. University training was ranked sixth by three institutions and on-the-job training was ranked sixth by one institution.

Most and Least Often Used Methods. Vendor-supplied training and on-the job training had the highest frequencies of being used most often when training for fourth-generation language usage. When examining the most frequently used methods, the least often used were the university with three votes and an outside consulting firm with six votes.

Additional Training Methods. Since respondents were asked to write in additional training methods and to record the rankings for these, Table XXXIV demonstrates the frequencies associated with these training methods. Computer based training, a write in, received a ranking of six by one institution.

TABLE XXXIII

RANKING MEANS ASSIGNED BY THE FORTUNE 500 COMPANIES TO FOURTH-GENERATION LANGUAGE TRAINING

Training Method	Means
Lecture	2.42
OJT	1.84
Seminar	2.49
Outside Consulting Firm	2.00
Vendor Supplied	2.02
University	1.00

Most often used = 1
Second most often used = 2, etc.

TABLE XXXIV

WEIGHTED MEANS ASSIGNED BY THE FORTUNE 500 COMPANIES TO 'OTHER' FOURTH-GENERATION LANGUAGE TRAINING

Training Method	Means
Computer Based Training	1.66
Computer Aided Instruction	2.00
Deltak	1.00
In-House Supplied Training	1.33
In-House Seminars	2.00
In-House Technology Exchanges	3.00
Training Classes	1.00
Video Courses	3.00

Most often used = 1;
Second most often used = 2, etc.

Training Time Required. Length of training time required by employees in order to work with the fourth-generation language was reported most frequently to be three to five days. Training time needing more than 30 days was the least frequently recorded response with only two companies indicating that training time lasted more than 30 days. The frequencies, percentages, cumulative frequencies, and cumulative percentages are displayed in Table XXXV.

TABLE XXXV

LENGTH OF TRAINING TIME REQUIRED BY EMPLOYEES TO WORK WITH A FOURTH-GENERATION LANGUAGE

Time Length	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1 - 2 days	15	12.5	15	12.5
3 - 5 days	62	51.7	77	64.2
6 - 7 days	21	17.5	98	81.7
8 - 14 days	14	11.7	112	93.3
15 - 30 days	6	5.0	118	98.3
More than 30 days	2	1.7	120	100.0
		N = 120		

Training Time Reduction. When asked if the length of training time had diminished as a result of fourth-generation language usage, one-half of the respondents indicated that training time had diminished. While 57 participants indicated that training had diminished, 57 survey participants indicated that training time had not diminished. Of the respondents specifying that training had not diminished, only 15 indicated that training had increased as a result of fourth-generation language implementation.

Working Time Increases. Identification of areas in which the fourth-generation language had increased the amount of time working was sought, as well as areas in which the fourth-generation language had diminished the amount of time spent working in that area. Participants were asked to indicate if working time had increased in the area. If multiple answers were given, the participants were asked to assign ranking values with the number one assigned to the area viewed as having increased the most. The possibility existed for no rankings to be assigned to the areas if no perceived increases had occurred in the amount of work time as well as no answers being assigned to the areas concerning decreases in the amount of work time devoted to specific areas. An 'other' category was included so that respondents would have the option of including additional areas which they felt deserved mention. Table XXXVI was constructed to demonstrate the ranking means associated with the areas specified as increasing the time working in the designated area. Ranking values could range from one to ten. Procedural programming had a ranking mean of 2.10, while the majority of areas which were specified in the other category recieved a mean ranking of 1.0.

Table XXXVII includes the areas which were specified as areas in which the amount of time working decreased as a result of fourth-generation language usage. In the 'other' category, total project time was specified as decreasing by one respondent; however, a rank was not assigned. User documentation had a reported mean of 6.00. The majority of responses in the 'other' category had mean values of 1.0.

TABLE XXXVI

RANKING MEANS ASSIGNED BY THE FORTUNE 500 COMPANIES TO AREAS IN WHICH THE AMOUNT OF WORKING TIME HAS INCREASED

Training Method	Means
Coding Requirements	1.89
Procedural Programming	2.10
Nonprocedural Programming	1.65
Program Design	1.56
Length of Instruction	1.88
Program Documentation	2.70
Corrective Maintenance	2.47
Adaptive Maintenance	2.30
Enhancement Maintenance	2.29
Other:	
Ad Hoc Query	1.00

TABLE XXXVI (Continued)

Training Method	Means
Ad Hoc Reporting	1.00
Application System Design	1.00
Custom Reports	1.00
Database Design (File Design)	1.00
Data Integrity	1.00
Debugging Code	1.00
End User Time (Developing and Implementing)*	
Performance Enhancement	1.00
Proper Tool Selection (Design Phase)	2.00
Requirements Information	2.00
Testing	1.00

Most often used = 1;
Second most often used = 2, etc.
* Ranking Value Not Assigned

TABLE XXXVII

RANKING MEANS ASSIGNED BY THE FORTUNE 500 COMPANIES TO AREAS IN WHICH THE AMOUNT OF WORKING TIME HAS DECREASED

Training Method	Means
Coding Requirements	1.36
Procedural Programming	2.00
Nonprocedural Programming	3.13
Program Design	3.23
Length of Instruction	3.25
Program Documentation	3.28
Corrective Maintenance	2.95
Adaptive Maintenance	2.97
Enhancement Maintenance	3.83
Other:	
Ad Hoc Query	1.00
Debugging Program	2.00
Decrease of System Staff*	
End User Phase	1.00
Everything Is Easier	1.00
Prototyping	1.00
Quality Assurance	1.00
Testing	5.20
Total Project Time*	
User Documentation	6.00

Rank of 1 = most often used; etc.
*Ranking value was not assigned

Languages Currently Being Utilized. Survey participants were asked to specify which language or languages their organizations were currently using. Languages currently being utilized and their associated frequencies are presented in Table XXXVIII. Focus and IFPS were the most frequently reported languages with 45 and 28 responses respectively. An 'other' classification was provided so that respondents could indicate languages which were not included in the possible selection list. These languages are presented, along with the associated frequencies in Table XXXIX. In this category, SAS was reported by ten respondents to be used within their organizations.

Ranking Values of the Characteristics, Results, and Uses. The systems analysts were asked to rank the study's twelve characteristics, results, and uses according to the perceived benefit of the characteristics, results, and uses. Upfront design, user involvement in systems development, quality, and implementation time were specified by the user as other characteristics, results, and uses that should be given consideration. The means for the frequency rankings are presented in Table XL. Prototyping had the highest mean of 3.98, while documentation automation and automated design tools had the lowest mean of 2.77.

Expansion Plans. Ninety-seven respondents indicated that plans were currently under consideration to expand fourth-generation language usage into other departments. Twenty respondents indicated that no plans for fourth-generation language expansion into other departments were being regarded at this time. Several respondents stipulated that the fourth-generation language had been incorporated into all departments and could not be expanded.

TABLE XXXVIII

FREQUENCIES OF LANGUAGES CURRENTLY BEING USED IN THE FORTUNE 500 COMPANIES (Listed in Descending Order)

Language	Frequency
FOCUS	45
IFPS	28
Natural	15
Nomad	15
Express	14
Ramis II	13
Ideal	11
ADS	10
Mantis	9
Powerhouse	6
System W	5
Qtime	1
Spectra	1

TABLE XXXIX

FREQUENCIES OF LANGUAGES CURRENTLY BEING USED IN THE FORTUNE 500 COMPANIES AS CLASSIFIED IN THE 'OTHER' CATEGORY (Listed in Descending Order)

Language	Frequency
SAS	10
LINC	5
GENER/OL	4
ORACLE	3
SQL	2
PACE	2
QMF	2
ADRS	1
ADVANCED REVELATION	1
ALL	1
AS	1
AS APPLICATION SYSTEM	1
AS-IST	1
AVERAGE	1
CAP	1
CREATE A SYSTEM	1
DATATRIEVE	1
DB2 (IBM Database 2)	1
DB2/SQL	1
DBASE III	1
EASYTRIEVE	1
EASYTRIEVE/PLUS	1
ENGLISH	1
EIS	1
ESS	1
FCS (THORNE, EMI)	1
FINANCIAL MODELING	1
FINSIM	1
IBM CROSSSYSTEM PRODUCT	1
IBM DB2	1

TABLE XXXIX (Continued)

Language	Frequency
INFO	1
INFORM	1
INGRES	1
INTELLECT	1
Internally Developed	1
LOUIS II	1
MAPPER	1
MARK IV	1
M204	1
Oracle-SQL	1
PANASONIC PRODUCTS	1
PATAFLGX	1
PILOT COMMAND CENTER	1
PROCESS	1
PROIV	1
QMF	1
RBASE	1
SAS/AF	1
SAS SOFTWARE SYSTEM	1
STRATAGEM	1
SYST 1032	1
S/38 QUERY	1
SQL/DS	1
SYL250	1
SYSTEM R:BASE	1
TELON	1
UNISYS	1
XGEN (COGEN)	1

TABLE XL

WEIGHTED MEANS OF THE CHARACTERISTICS, RESULTS, AND USES BASED ON SENIOR SYSTEMS ANALYST PERCEPTIONS OF FORTUNE 500 COMPANIES PRESENTLY INCORPORATING A FOURTH-GENERATION LANGUAGE

Characteristic Result or Use	Mean
Prototyping	3.98
Application Generation	3.79
Nonprocedural Programming	3.50
End User Programming	3.47
Automated Data Dictionaries	3.29
Maintenance Reduction	3.44
Data Modeling	3.09
Decision Support System	3.21
Documentation Automation	2.77
Automated Design Tools	2.77
Security Features	2.99
Training Time Reduction	2.95

N = 120

Fortune 500 Questionnaire--Section III

Section III Completion. Section III was completed by respondents who had not implemented a fourth-generation language into one or more of their organizational departments. Of the forty-nine participants indicating that a fourth-generation language had not been included into a department, only nineteen stipulated that incorporation of a fourth-generation language was under consideration. Thirty respondents indicated that incorporation of the fourth-generation language was not under consideration.

Timeframe for Incorporation. If incorporation was under consideration, an approximation of the timeframe in which the usage would begin was sought. Four survey participants indicated that incorporation would begin in zero to four months; three respondents stipulated that utilization would be more than four months but less than eight months. Four participants suggested that incorporation was from eight months to one year away, while three participants stated that utilization was one year, but less than two years away. One respondent indicated that his organization was looking at a timeframe of two - three years. The category, more than three years, was checked by two respondents. In both of these cases, the time period was unknown at the time the questionnaire was completed.

Fourth-Generation Langauge Identification. The nineteen senior systems analysts specifying that they were considering a fourth-generation language were asked to identify which fourth-generation languages were currently under consideration. Table XLI displays the languages and frequencies associated with the specific language. FOCUS was reported by five respondents to be under

consideration; ORACLE was reported by three to be under consideration; however, three indicated that at the present time which language would be used had not been decided.

Characteristics, Results, and Uses Rankings. The nineteen survey participants who indicated that incorporation was under consideration were asked to rank the fourth-generation language characteristics, results, and uses according to the perceived beneficiality of each. The associated means based upon the ranking values are presented in Table XLII. Standardization of information systems around the world was indicated by one participant as being very beneficial. Prototyping had the highest mean and automated design tools received the lowest mean.

TABLE XLI

FOURTH-GENERATION LANGUAGES CURRENTLY UNDER CONSIDERATION FOR INCORPORATION

Language	Frequency
FOCUS	5
ADS	1
IDEAL	1
IFPS	1
MANTIS	1
SYSTEM W	1
Other:	
ORACLE	3
Undecided	3
SQL	2
AS	1
DEC BASED FGLs	1
FLEXGEN 4	1
INGRES	1
PACE	1
REVELATION	1
Z-FOUR	1

TABLE XLII

WEIGHTED MEANS OF THE CHARACTERISTICS, RESULTS, AND USES BASED ON SENIOR SYSTEMS ANALYST PERCEPTIONS OF FORTUNE 500 COMPANIES CONSIDERING FOURTH-GENERATION LANGUAGE INCORPORATION

Characteristic, Result or Use	Mean
Prototyping	4.35
Application Generation	4.05
Nonprocedural Programming	3.81
End User Programming	3.83
Automated Data Dictionaries	3.94
Maintenance Reduction	3.94
Data Modeling	3.71
Decision Support System	3.58
Documentation Automation	3.61
Automated Design Tools	3.39
Security Features	3.50
Training Time Reduction	3.39

N = 19

Note: Likert-type Scale values for this table were as follows: Not Beneficial = 1
Slightly Beneficial = 2 Moderately Beneficial = 3
Very Beneficial = 4 Extremely Beneficial = 5

Hypotheses Section

To test the hypotheses, a two-way Chi square SAS program was written. This study tested the following 12 hypotheses at the .05 significance level. If a hypothesis was rejected, the Cramer's V statistic was used to test the strength of association.

H_1: There is no significant difference between the ranks assigned to the prototyping use's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_2: There is no significant difference between the ranks assigned to the application generation use's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_3: There is no significant difference between the ranks assigned to the nonprocedural programming characteristic's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_4: There is no significant difference between the ranks assigned to the end user programming result's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_5: There is no significant difference between the ranks assigned to the automated data dictionaries result's beneficiality by the members of the accredited AACSB

population and the Fortune 500 population who incorporate a fourth-generation language.

H_6: There is no significant difference between the ranks assigned to the maintenance reduction characteristic's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_7: There is no significant difference between the ranks assigned to the data modeling use's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_8: There is no significant difference between the ranks assigned to the decision support systems use's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_9: There is no significant difference between the ranks assigned to the documentation automation result's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_{10}: There is no significant difference between the ranks assigned to the automated design tools use's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_{11}: There is no significant difference between the ranks assigned to the security feature result's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

H_{12}: There is no significant difference between the ranks assigned to the training time reduction characteristic's beneficiality by the members of the accredited AACSB population and the Fortune 500 population who incorporate a fourth-generation language.

Discussion of Hypotheses Findings

Hypothesis One. Table XLIII illustrates the observed frequencies, expected frequencies and cell Chi squares that were used in the statistical calculation for the hypothesis concerning the prototyping use based on a comparison of AACSB instructors' perceptions who had incorporated a fourth-generation language and the Fortune 500 senior systems analyst's perceptions who had incorporated a fourth-generation lanuguage. The researcher failed to reject hypothesis one, since the calculated Chi square was 6.008. The probability of receiving a Chi square of this size is 0.199. In order to be significant, a probability of .05 was needed. A significant difference was not found to exist between the two populations based upon their beneficiality perceptions of the prototyping use.

Hypothesis Two. A significant difference was found to exist between AACSB and Fortune 500 rankings concerning the application generation use's beneficiality. Since a significant difference was

observed, the researcher rejects the null hypothesis. The probability of obtaining a Chi square of 11.000 had a probability of .027. The AACSB instructors who incorporated a fourth-generation language into the classrooms tended to rank the application generation use higher than did the Fortune 500 senior systems analysts who had incorporated a fourth-generation language. Implicit with this finding is that more beneficiality is placed on the application generation use by the AACSB instructors than by the Fortune 500 senior systems analysts. The Cramer's V statistical value was 0.241. Results of the Chi square test are presented in Table XLIV.

Hypothesis Three. The perceptions of the of the AACSB instructors and the perceptions of the Fortune 500 senior systems analysts were analysed based on the rankings of the nonprocedural programming characteristic. A significant difference was found with a resulting Chi square of 17.970; therefore, the null hypothesis was rejected. The resulting value for the Cramer's V statistic was 0.322. This Chi square had an associated probability of .0001. The trend which was identified with hypothesis two is also apparent in the findings associated with hypothesis three. The AACSB instructors who have incorporated the fourth-generation language into the classroom tended to rank the nonprocedural programming characteristic higher than did the Fortune 500 senior systems analysts. The higher rankings of the AACSB instructors imply that the instructors place more beneficiality on the nonprocedural programming characteristic than do the Fortune 500 senior systems analysts who have incorporated a fourth-generation language into one more or more of their organizational departments. Presented in Table XLV are the findings associated with hypothesis three.

TABLE XLIII

PROTOTYPING CHI SQUARE RESULTS BASED ON THE PERCEPTIONS OF FORTUNE 500 SENIOR SYSTEMS ANALYSTS AND AACSB INSTRUCTORS WHO ARE CURRENTLY INCORPORATING A FOURTH-GENERATION LANGUAGE

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Total
F500						
Frequency	5	12	16	30	53	116
Expected	3.6	8.5	15.2	31.6	57.1	
Cell X^2	.504611	1.43858	.043936	.079162	.292875	
AACSB						
Frequency	1	2	9	22	41	75
Expected	2.4	5.5	9.8	20.4	36.9	
Cell X^2	.780465	2.225	.067954	.122438	.452981	

$X^2 = 6.008$ $p = 0.199 > .05$ $N = 191$ Cramer's $V = 0.177$

TABLE XLIV

APPLICATION GENERATION CHI SQUARE RESULTS BASED ON THE PERCEPTIONS OF FORTUNE 500 SENIOR SYSTEMS ANALYSTS AND AACSB INSTRUCTORS WHO ARE CURRENTLY INCORPORATING A FOURTH-GENERATION LANGUAGE

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Total
F500						
Frequency	7	7	24	41	35	114
Expected	4.2	4.8	20.4	45.0	39.6	
Cell X^2	1.86667	1.00833	.635294	.355556	.534343	
AACSB						
Frequency	0	1	10	34	31	76
Expected	2.8	3.2	13.6	30.0	26.4	
Cell X^2	2.8	1.5125	.952941	.533333	.801515	

$X^2 = 11.000$ $p = 0.027 < .05$ $N = 190$ Cramer's $V = 0.241$

TABLE XLV

NONPROCEDURAL PROGRAMMING CHI SQUARE RESULTS BASED ON THE PERCEPTIONS OF FORTUNE 500 SENIOR SYSTEMS ANALYSTS AND AACSB INSTRUCTORS WHO ARE CURRENTLY INCORPORATING A FOURTH-GENERATION LANGUAGE

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Total
F500						
Frequency	2	17	29	34	19	101
Expected	1.2	12.8	21.6	37.9	27.4	
Cell X^2	.593373	1.34483	2.53426	.410734	2.59562	
AACSB						
Frequency	0	5	8	31	28	72
Expected	0.8	9.2	15.4	27.1	19.6	
Cell X^2	0.83237	1.8865	3.555	.576168	3.64107	

$X^2 = 17.970$ $p = 0.001 < .05$ $N = 173$ Cramer's $V = 0.322$

Hypothesis Four. Fortune 500 senior systems analysts ranked the end user programming result lower on the Likert-type scale than did the AACSB instructors. The lower ranking resulted in a Chi square of 12.870 which has a probability of .012; therefore, the null hypothesis was rejected. The corresponding Cramer's V was 0.258. The majority of AACSB instructors tended to rate the end user programming result higher on the scale, and the systems analysts ranked the result lower on the scale. However, more systems analysts did rank end user programming as extremely beneficial than did AACSB instructors. Chi square results are displayed in Table XLVI.

Hypothesis Five. AACSB instructors and Fortune 500 senior systems analysts perceptions concerning the automated data dictionaries result differed significantly. The statistical analysis produced a Chi square of 10.322 with a probability of .035. Cramer's V was 0.239. Based on these values, the null hypothesis was rejected. Although the automated data dictionary result received more extremely beneficial rankings by the Fortune 500 senior systems analysts, the AACSB instructors ranked this result more toward the high end of the scale than did the Fortune 500 senior systems analysts. The analysts' rankings were more evenly distributed across the scale. The Chi square results are presented in Table XLVII.

TABLE XLVI

END USER PROGRAMMING CHI SQUARE RESULTS BASED ON THE PERCEPTIONS OF FORTUNE 500 SENIOR SYSTEMS ANALYSTS AND AACSB INSTRUCTORS WHO ARE CURRENTLY INCORPORATING A FOURTH-GENERATION LANGUAGE

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Total
F500						
Frequency	14	17	19	35	33	118
Expected	9.1	12.8	19.5	38.3	38.3	
Cell X^2	2.60621	1.3987	.011057	.287573	.738474	
AACSB						
Frequency	1	4	13	28	30	76
Expected	5.9	8.2	12.5	24.7	24.7	
Cell X^2	4.04646	2.17167	.017168	.446494	1.14658	

$X^2 = 12.870$ $p = 0.012 < .05$ $N = 194$ Cramer's $V = 0.258$

TABLE XLVII

AUTOMATED DATA DICTIONAIRiES CHI SQUARE RESULTS
BASED ON THE PERCEPTIONS OF FORTUNE 500
SENIOR SYSTEMS ANALYSTS AND AACSB
INSTRUCTORS WHO ARE CURRENTLY
INCORPORATING A FOURTH-
GENERATION LANGUAGE

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Total
F500						
Frequency	17	15	25	28	27	112
Expected	11.8	13.1	31.1	29.9	26.1	
Cell X^2	2.26771	.286054	1.2004	.116667	.028741	
AACSB						
Frequency	2	6	25	20	15	68
Expected	7.2	7.9	18.9	18.1	15.9	
Cell X^2	3.73505	.471148	1.97712	.192157	.047339	

$X^2 = 10.322$ $p = 0.035 < .05$ $N = 180$ Cramer's $V = 0.239$

Hypothesis Six. Hypothesis six failed to be rejected by the researcher. The Chi square value was 4.662 and had an associated probability of 0.324. The maintenance reduction characteristic was not perceived by the AACSB instructors who are incorporating a fourth-generation language into their classrooms and the Fortune 500 senior systems analysts who have included a fourth-generation language into their organization as having more or less beneficiality. Although this hypothesis did not produce a Chi square with a probability less than .05, more Fortune 500 senior systems analysts tended to rank this characteristic higher than did the AACSB instructors. Results of hypothesis six are presented in Table XLVIII.

Hypothesis Seven. The researcher failed to reject hypothesis seven. The resulting Chi square probability was 8.579 and 0.073 respectively. In order to be significant the probability needed to equal or be less than 0.05; therefore, a significant difference between the two populations concerning their data modeling beneficiality perceptions does not exist. The AACSB instructors and Fortune 500 senior systems analysts tended to assign similar values to the data modeling use's beneficiality. However, more Fortune 500 senior systems analysts rated the use as not benefical than did the AACSB instructors. Results are presented in Table XLIX.

Hypothesis Eight. The statistical analysis revealed a Chi square of 26.387 and an associated probability of 0.000. For purposes of this study, a probability of .05 or less was needed; therefore, hypothesis eight is rejected. Cramer's V was 0.375. The Fortune 500 senior systems analysts's rankings of the decision support system use were distributed across the Likert-type scale, while the AACSB instructor's

rankings of the decision support system use tended to cluster more toward the higher beneficiality rankings. Results are illustrated in Table L.

TABLE XLVIII

MAINTENANCE REDUCTION CHI SQUARE RESULTS BASED ON THE PERCEPTIONS OF FORTUNE 500 SENIOR SYSTEMS ANALYSTS AND AACSB INSTRUCTORS WHO ARE CURRENTLY INCORPORATING A FOURTH-GENERATION LANGUAGE

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Total
F500						
Frequency	9	16	29	36	24	114
Expected	7.0	17.1	33.6	32.3	24.1	
Cell X^2	.593461	0.07076	.621284	.423839	2E-04	
AACSB						
Frequency	2	11	24	15	14	66
Expected	4.0	9.9	19.4	18.7	13.9	
Cell X^2	1.02507	.122222	1.07313	.732086	3E-04	

$X^2 = 4.662$ $p = 0.324 < .05$ $N = 180$ Cramer's V = 0.161

TABLE XLIX

DATA MODELING CHI SQUARE RESULTS BASED ON THE PERCEPTIONS OF FORTUNE 500 SENIOR SYSTEMS ANALYSTS AND AACSB INSTRUCTORS WHO ARE CURRENTLY INCORPORATING A FOURTH-GENERATION LANGUAGE

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Total
F500						
Frequency	11	28	31	26	17	113
Expected	7.5	24.3	31.2	31.2	18.7	
Cell X^2	1.64289	.547749	.001487	.871399	.159665	
AACSB						
Frequency	1	11	19	24	13	68
Expected	4.5	14.7	18.8	18.8	11.3	
Cell X^2	2.7301	.910229	.002472	1.44806	.265326	

$X^2 = 8.579$ $p = 0.073 < .05$ $N = 181$ Cramer's V = 0.218

TABLE L

DECISION SUPPORT SYSTEMS CHI SQUARE RESULTS BASED ON THE PERCEPTIONS OF FORTUNE 500 SENIOR SYSTEMS ANALYSTS AND AACSB INSTRUCTORS WHO ARE CURRENTLY INCORPORATING A FOURTH-GENERATION LANGUAGE

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Total
F500						
Frequency 112	13	21	29	28	21	
Expected	8.3	16.1	23.2	30.4	34.0	
Cell X^2	2.60318	1.50177	1.43093	0.1869	4.94429	
AACSB						
Frequency 76	1	6	10	23	36	
Expected	5.7	10.9	15.8	20.6	23.0	
Cell X^2	3.83627	2.21314	2.10874	.275432	7.28632	

X^2 = 26.387 p = 0.000 < .05 N = 188 Cramer's V = 0.375

Hypothesis Nine. Fortune 500 senior systems analysts and AACSB instructors differed significantly in their perceptions based on the documentation automation result's beneficiality. Since the Chi square and associated probability were 21.608 and 0.000 respectively, hypothesis nine was rejected. The results from the Cramer's V produce a value of 0.346. The majority of the Fortune 500 group ranked the decision support system's beneficiality as not beneficial, slightly beneficial, or moderately benefical, whereas the majority of AACSB instructors assigned rankings of extremely beneficial, very beneficial, and moderately beneficial. Twenty-four Fortune 500 senior systems analysts rated the use as not beneficial; in comparison, no AACSB instructors gave the not beneficial rating to the documentation automation use. Table LI illustrates the findings for Hypothesis nine.

Hypothesis Ten. The beneficiality of the automated design tools resulted in a Chi square value of 14.162. The probability of achieving a Chi square of this size is .007; therefore, the researcher rejected the null hypothesis. Cramer's V was 0.283. AACSB instructors gave higher rankings to the beneficiality of automated design tools, while the Fortune 500 senior systems analysts spread their rankings over the entire range. The Fortune 500 senior systems analysts were more likely; however, to assign lower rankings to this use than were the AACSB instructors. Findings pertaining to this hypothesis are presented in Table LII.

TABLE LI

DOCUMENTATION AUTOMATION CHI SQUARE RESULTS BASED ON THE PERCEPTIONS OF FORTUNE 500 SENIOR SYSTEMS ANALYSTS AND AACSB INSTRUCTORS WHO ARE CURRENTLY INCORPORATING A FOURTH-GENERATION LANGUAGE

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Total
F500						
Frequency	24	24	31	18	14	111
Expected	14.8	21.6	34.5	24.7	15.4	
Cell X^2	5.71892	.270592	.361519	1.8018	0.13018	
AACSB						
Frequency	0	11	25	22	11	69
Expected	9.2	13.4	21.5	15.3	9.6	
Cell X^2	9.2	0.4353	.581573	2.89855	0.20942	

X^2 = 21.608 p = 0.000 < .05 N = 180 Cramer's V = 0.346

TABLE LII

AUTOMATED DESIGN TOOLS CHI SQUARE RESULTS BASED ON THE PERCEPTIONS OF FORTUNE 500 SENIOR SYSTEMS ANALYSTS AND AACSB INSTRUCTORS WHO ARE CURRENTLY INCORPORATING A FOURTH-GENERATION LANGUAGE

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Total
F500						
Frequency	20	25	29	24	12	110
Expected	13.7	21.8	29.8	28.0	16.8	
Cell X^2	2.92851	.485179	.023122	.562465	1.36148	
AACSB						
Frequency	2	10	19	21	15	67
Expected	8.3	13.2	18.2	17.0	10.2	
Cell X^2	4.80801	.796562	.037962	.923451	2.23526	

$X^2 = 14.162$ $p = 0.007 < .05$ $N = 177$ Cramer's $V = 0.283$

Hypothesis Eleven. The researcher failed to reject hypothesis eleven since the resulting Chi square and probability of obtaining a Chi square of this size were 2.296 and 0.681 respectively. By referring to the data obtained in Table LIII, both groups tended to assign the majority of their rankings for the security feature results in the middle of the scale rather than at the extremities.

TABLE LIII

SECURITY FEATURES CHI SQUARE RESULTS BASED ON THE PERCEPTIONS OF FORTUNE 500 SENIOR SYSTEMS ANALYSTS AND AACSB INSTRUCTORS WHO ARE CURRENTLY INCORPORATING A FOURTH-GENERATION LANGUAGE

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Total
F500						
Frequency	17	22	36	23	16	114
Expected	15.8	26.0	35.5	21.5	15.2	
Cell X^2	.085965	.605948	0.00802	.099897	.042105	
AACSB						
Frequency	8	19	20	11	8	66
Expected	9.2	15.0	20.5	12.5	8.8	
Cell X^2	.148485	1.04664	.013853	.172549	.072727	

X^2 = 2.296 p = 0.681 < .05 N = 180 Cramer's V = 0.113

Hypothesis Twelve. The data collected for hypothesis twelve when analyzed resulted in a Chi square value of 15.538 and a probability of 0.004. Since 0.004 is less than the study's set probability level of 0.05, hypothesis twelve is rejected. Cramer's V was 0.300. By examining the data contained in Table LIV, the reader will notice that the Fortune 500 group more often ranked the training time reduction characteristic as moderately beneficial, while the AACSB group more often ranked this characteristic as very beneficial. The trend which

has been associated with other rejected hypotheses is evident with the rejection of this hypothesis as well. AACSB instructors tended to rank the characteristic higher than did the Fortune 500 senior systems analysts.

TABLE LIV

TRAINING TIME REDUCTION CHI SQUARE RESULTS BASED ON THE PERCEPTIONS OF FORTUNE 500 SENIOR SYSTEMS ANALYSTS AND AACSB INSTRUCTORS WHO ARE CURRENTLY INCORPORATING A FOURTH-GENERATION LANGUAGE

	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Total
F500						
Frequency	17	20	35	19	15	106
Expected	11.6	19.0	31.2	28.2	15.9	
Cell X^2	2.46635	.053258	.450368	2.99322	.054366	
AACSB						
Frequency	2	11	16	27	11	67
Expected	7.4	12.0	19.8	17.8	10.1	
Cell X^2	3.90198	.084259	.712522	4.73554	.086012	

X^2 = 15.538 p = 0.004 < .05 N = 173 Cramer's V = 0.300

Summary

Data were collected from the American Assembly of Collegiate Schools of Business and the Fortune 500 senior systems analysts. These data have been reported throughout this chapter in the form of frequencies, percentages, cumulative frequencies, and cumulative percentages.

Two questionnaires were designed to gather information concerning fourth-generation language utilization in both the collegiate and industrial atmosphere. The AACSB questionnaire was divided into four sections, each of which was created in order to collect specific data relating to both current fourth-generation language use and potential fourth-generation language use. Section I of the AACSB questionnaire gathered demographic data; section II collected data from those institutions specifying current fourth-generation language utilization which had been incorporated into existing courses. Section III of the AACSB questionnaire gathered information depicting classes which had been designed specifically to include the fourth-generation language topic. The AACSB questionnaire's last section, section IV, gathered data from those institutions stipulating that the fourth-generation language or fourth-generation language topic had not been included in any existing course or that a course had not been designed specifically to teach the fourth-generation language topic or include a fourth-generation language.

The Fortune 500 questionnaire was divided into three sections. Section I collected demographic data; section II collected current fourth-generation language utilization; and section III collected data on potential fourth-generation language usage.

This study tested twelve hypotheses, eight of which were significant at the .05 probability level. The Chi square values for hypotheses two, three, four, five, eight, nine, ten, and twelve had associated probability values which were equal to or less than .05.

A summary of the study, conclusions and recommendations is presented in Chapter Five.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Progression from one computer language generation to another has led to the implementation of the fourth generation of languages into not only our educational curricula, but also into our business world as well. The purpose of this study was to provide information that would help university instructors develop new materials, courses, course outlines, and appropriate teaching methods to facilitate the entrance of fourth-generation language instruction into curricula. A related purpose of this study was to provide information that would encourage the development of new programming courses and related development of programming instruction. As the emphasis on systems design tools changes, this reflection should be incorporated in the appropriate educational classes in order to reflect fourth-generation language's involvement in industry and curricula. Below is a summary of the review of related literature, research methodology, findings, and conclusions and recommendations.

Summary of Review of Related Literature

The review of related literature was divided into three factions: discovering fourth-generation languages; industrial impact of fourth-generation languages; and educational impact of fourth-generation languages.

The impetus for the fourth-generation language came with the development and usage of databases. Databases created program and data independence. One characteristic of the fourth-generation language is that it allows the user to specify 'what' is needed; thus, the language can be described as nonprocedural. The nonprocedural characteristic does not by itself classify a language as fourth-generation. Standards and a uniform fourth-generation language definition have not induced agreement from both the business and educational fields.

Maintenance reduction, documentation, hardware enhancements, increased user demands, and intense competition were several reasons identified through the review of literature that would aid in the entry of fourth-generation language into industry. However, COBOL is a large factor playing against the fourth-generation language inclusion. Added to the list of arguments against fourth-generation language were, the lack of standardization, impact on resources, and product quality.

The review of literature revealed that fourth-generation languages are being taught in development centers and are being incorporated in businesses offices. The learning time associated with fourth-generation languages has decreased when compared with third-generation languages. Aulgur (1982) and Schooley (1985) have made recommendations that the effects of computer technology on education be studied.

Summary of Research Methodology

Two questionnaires were developed to collect the necessary data for this study. The first questionnaire was developed and sent to the 247 accredited AACSB population.

The AACSB questionnaire was arranged into four sections. The first section gathered demographic data; the second collected data from institutions who had implemented the fourth-generation language topic into the existing curricula. The third section accumulated data from the accredited AACSB institutions that had designed courses specifically to cover the fourth-generation language topic or to offer instruction with a fourth-generation language. Section IV was designed to gather data from those accredited institutions which had not at the time the questionnaire was mailed implemented a fourth-generation language or the fourth-generation language topic into the existing curricula.

The second questionnaire was mailed to the Fortune 500 population which consisted of 500 members. Three sections were designed to collect the necessary data. Section I gathered demographic data. Only organizations having incorporated a fourth-generation language into one or more departments were asked to complete Section II. Potential fourth-generation language users were asked to complete the third section of the Fortune 500 questionnaire.

After the data was collected a two-way Chi square was used to analyze the perceived rankings of the two populations who had completed section II of the respective questionnaires. Cramer's V was used to report the strength of association.

Summary of Findings

Twelve hypotheses were tested at the .05 level of significance. As a result of the statistical analysis run on data which was used to test the twelve hypothesis, eight of the hypotheses produced Chi squares with probabilities equal to or less than .05. A trend was identified with

the hypothesis which produced significant Chi square values. The trend was that Fortune 500 senior systems analysts who had incorporated the fourth-generation language into one or more departments ranked the characteristic, result, or use lower than did the accredited AACSB instructor. Most Fortune 500 companies and AACSB institutions had incorporated the fourth-generation language into parts, if not all, of the institution or organization. Of those AACSB institutions queried about potential fourth-generation language usage, several indicated that courses were currently under design. These institutions indicated that the inclusion was more than one school year away. The Fortune 500 potential users, as a majority, indicated that fourth-generation language was currently not under consideration.

Although the majority of accredited AACSB institutions had incorporated the fourth-generation language into its curricula, the most-often recorded response for classes in which the language had been incorporated was one to three. Management Information Systems was the course which was chosen by the AACSB instructors most often when including the fourth-generation language or topic into the information systems curricula. The time span ranges for fourth-generation language inclusion into the curricula was less than one week to the entire semester. Lectures, software applications, classroom discussions, programming assignments, and other teaching methods such as tutorials and semester projects were selected as fourth-generation language teaching methods.

Of the AACSB institutions incorporating fourth-generation languages into the existing curricula, the prototyping use had the highest calculated mean, while security features had the lowest calculated mean.

Application generation received the highest coverage mean by the AACSB instructors who were incorporating the fourth-generation language into the existing curricula, while training reduction received the lowest coverage mean.

Most AACSB institutions have designed programming courses to incorporate the fourth-generation language. Having taught the course for more than two completed school years was the response given most frequently by participants who indicated that courses had been developed to teach the fourth-generation language topic. Potential AACSB fourth-generation language users most often indicated that incorporation of the fourth-generation language occurrence was more than one year but less than two years away.

The most-often cited languages by both AACSB institutions and Fortune 500 companies were IFPS and Focus. Vendor supplied training received the highest utilization from Fortune 500 companies when seeking fourth-generation language training, while university training received the lowest. The majority of Fortune 500 senior systems analysts indicated that training time on the average was three to five days. The least often designated time was more than thirty days. Receiving the most response concerning areas which had been altered the most were program design which had increased and coding requirements had decreased. Documentation automation had the lowest mean, while prototyping received the highest mean of the characteristics, results, and uses based on the perceptions of the Fortune 500 senior systems analysts who had incorporated the fourth-generation language into the company The systems analysts suggesting the fourth-generation language incorporation was under consideration, prototyping had the highest mean,

while automated design tools and training time reductions had the lowest means.

Conclusions

This section reports the conclusions which were drawn based on the study's findings. Data obtained through the information gathered from the accredited AACSB and Fortune 500 populations resulted in the following conclusions being made.

1. AACSB and Fortune 500 population members have opinion differences regarding their attitudes concerning fourth-generation language characteristics, results, and uses.
2. Teaching methods and time allotments vary in the information systems curricula and Fortune 500 learning environments.
3. A variety of instructional techniques and instructional educational sources relating to fourth-generation language training are available for Fortune 500 companies.
4. Training time and training methods are affected by fourth-generation languages.
5. Upon inclusion of a fourth-generation language into the information systems curricula or organization, AACSB educators and Fortune 500 senior systems analysts can expect the curricula or organization to be affected.
6. Fourth-generation language characteristics, results, and uses are viewed differently by accredited AACSB instructors and Fortune 500 companies.

7. Time devoted to fourth-generation language characteristics, results, and uses coverage is not affected by the perceived beneficiality of the characteristic, result, or use.

Recommendations

1. An examination of the content used in association with the various presentation methods discussed in the findings chapter should be conducted in order to identify what specific fourth-generation language areas are being incorporated within these presentation methods.
2. The identification of the timeframe during the semester in which the fourth-generation language is discussed within a specific course should be sought.
3. Investigations should be conducted in order to determine why certain fourth-generation languages were chosen to be incorporated into the information systems curricula and Fortune 500 company.
4. From education and industry, additional characteristics, results, and uses should be gathered and analyzed in order to determine the most and least beneficial characteristics, results, and uses.
5. Based upon fourth-generation language infiltration, an examination of information systems areas which have been altered and the degree to which these areas have been altered should be undertaken.

6. Coverage of fourth-generation language topics that industry would like to see the information systems curricula address should be sought.
7. A determination of why selected training methods are utilized to teach a particular fourth-generation language should be made.
8. A follow-up study should be carried out in order to identify trends which may have developed after this study wascompleted.
9. Fourth-generation language training time required by information centers and by development centers should be obtained.
10. Fourth-generation languages and topics relating to fourth-generation languages need to be placed within the information systems curricula.
11. Industry and education need to establish communication links concerning fourth-generation usage so that industry's educational needs can be provided by the information systems curricula.
12. Fourth-generation language selection and utilization in the curricula area should reflect industrial selection and utilization.
13. Coverage of the fourth-generation language characteristics, uses, and results should be based on the requirements of industry.

14. Courses should be designed to include fourth-generation language concepts, training, and access to a variety of fourth-generation languages.

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APPENDIXES

APPENDIX A

AACSB QUESTIONNAIRE

QUESTIONNAIRE ON
FOURTH-GENERATION LANGUAGE UTILIZATION

This questionnaire is a survey of information systems professors in accredited American Assembly of Collegiate Schools of Business. The questionnaire is designed to gather information that will be useful in the development and design of higher education information systems curricula. The information systems coordinator or department head should complete this questionnaire by indicating the most appropriate response(s).

Section I
Demographic Data

1. At present, what is your current full-time enrollment in the College of Business?

   _____ 1 - 500 students
   _____ 501 - 1000 students
   _____ 1001 - 1500 students
   _____ 1501 - 2500 students
   _____ Over 2500 students, please specify _____

2. In what state is your college located? _____

3. Do you currently offer an undergraduate degree program in the information systems area?

   _____ Yes, what is the title of the major? _____
   _____ No

4. How many information systems classes are currently offered in the College of Business?

   _____ 1 - 3
   _____ 4 - 6
   _____ 7 - 10
   _____ more than 10, please specify _____

5. Which of the following course titles or course equivalents is (are) offered in your College of Business?

_____ Management Information Systems
_____ Database Concepts
_____ Systems Analysis and Design
_____ Introduction to Data Processing
_____ Third Generation programming language classes
  _____ Cobol
  _____ Fortran
  _____ RPG
  _____ Pascal
  _____ Basic
  _____ PL/1
  _____ Other, please specify _____
_____ Other, please specify _____

6. How many people are presently teaching information systems classes? (Please include full-time personnel, part-time personnel, and graduate teaching associates.)

_____ 1 - 3
_____ 4 - 6
_____ 7 - 9
_____ 10 or more, please specify _____

7. In which of the following areas has the fourth-generation language topic been incorporated?

_____ Into existing courses (Please complete only Section II)
_____ New course(s) have been designed specifically to teach the fourth-generation language topic (Please complete only Section III)
_____ Into existing courses and new courses have been designed specifically to teach the fourth-generation language topic. (Please complete Section II and III)
_____ The fourth-generation language topic has not been included in any existing or newly developed courses. (Please complete only Section IV)

• • • • • • • • • • • • • • • • •

Section II
Fourth-Generation Language Instruction

• • • • • • • • • • • • • • • • •

Please complete this section only if you are incorporating the fourth-generation language topic into existing courses.

1. Approximately how many existing courses within the College of Business incorporate the fourth-generation language topic?

_____ 1 to 3
_____ 4 to 5
_____ 6 to 8
_____ more than 8, please specify _____

2. In which of the following business courses, or course equivalent, is the fourth-generation language topic being implemented?

_____ Management Information Systems (Introductory)
_____ Introduction to Data Processing
_____ Systems Analysis and Design
_____ Database Concepts
_____ Third-generation programming language classes
  _____ Cobol
  _____ Pascal
  _____ Fortran
  _____ Basic
  _____ RPG
  _____ PL/1
  _____ other programming classes, please specify
  _____
  _____
_____ other courses, please specify
  _____
  _____

3. Based on your answer for question 2, what is the amount of class time devoted to a fourth-generation language topic in each of these courses? (Please check all that apply.)

	Less than 1 week	More than 1 week but less than 2 weeks	More than 2 weeks	Other
Mgmt Info Systems				
Intro/Data Processing				
Systems Analysis & Design				
Database Concepts				
Cobol				
Fortran				
RPG				
PL/1				
Pascal				
Basic				
Other programming classes				
Other courses, please specify				

4. What method of presentation is used to incorporate the fourth-generation language topic into the course(s)? (Please check all that apply.)

	Lecture	Software Application	Classroom Discussion	Programming Assignment	Other
Mgmt Info Systems					
Intro/Data Processing					
Systems Analysis & Design					
Database Concepts					
Cobol					
Fortran					
RPG					
PL/1					
Pascal					
Basic					
Other programming classes					
Other courses, please specify					

5. Please indicate to what extent you consider the following fourth-generation language characteristics, uses, and results to be beneficial. (5 = extremely beneficial; 4 = very beneficial; 3 = moderately beneficial; 2 = slightly beneficial; 1 = not beneficial)

Prototyping	1	2	3	4	5
Application generation	1	2	3	4	5
Nonprocedural programming	1	2	3	4	5
End-user programming	1	2	3	4	5
Automated data dictionaries	1	2	3	4	5
Maintenance reduction	1	2	3	4	5
Data modeling	1	2	3	4	5
Decision support system	1	2	3	4	5
Documentation automation	1	2	3	4	5
Automated design tools	1	2	3	4	5
Security features	1	2	3	4	5
Training time reduction	1	2	3	4	5
Other, please specify _____	1	2	3	4	5

6. Please indicate to what extent you feel classroom coverage should be given to the following fourth-generation language characteristics, uses, and results than is currently provided. (5 = significantly more coverage; 4 = slightly more coverage; 3 = adequately covered; 2 = decrease coverage; 1 = should not cover.)

Prototyping	1	2	3	4	5
Application generation	1	2	3	4	5
Nonprocedural programming	1	2	3	4	5
End-user programming	1	2	3	4	5
Automated data dictionaries	1	2	3	4	5
Maintenance reduction	1	2	3	4	5
Data modeling	1	2	3	4	5
Decision support system	1	2	3	4	5
Documentation automation	1	2	3	4	5
Automated design tools	1	2	3	4	5
Security features	1	2	3	4	5
Training time reduction	1	2	3	4	5
Other, please specify _____	1	2	3	4	5

7. Has programming instruction been altered as a result of incorporating a fourth-generation language into the curriculum?

_____ Yes, please indicate in which area programming instruction has changed the most. (Please check only one answer.)

_____ Coding requirements
_____ Procedural programming
_____ Nonprocedural programming
_____ Program design
_____ Length of instruction
_____ Program documentation
_____ Corrective maintenance
_____ Adaptive maintenance
_____ Enhancement maintenance
_____ Other, please specify _____

Has this been a positive change: _____ Yes
_____ No

_____ No

8. Which fourth-generation languages have been incorporated in your classes? (Please check all that apply.)

_____ Ideal
_____ Spectra
_____ Powerhouse
_____ Mantis
_____ System W
_____ ADS
_____ Nomad
_____ IFPS
_____ FOCUS
_____ Express
_____ Ramis II
_____ Ctime
_____ Natural
_____ Other, please specify _____

• • • • • • • • • • • • • • • • •

Section III
Potential Fourth-Generation Use

• • • • • • • • • • • • • • • • •

Please complete this section only if you have designed new courses to teach the fourth-generation language topic.

1. Does your school presently offer a fourth-generation language programming class?

_____ Yes, please specify course title(s). _____
_____

_____ No

2. If you have developed a course specifically to cover different aspects of fourth-generation language topics, how long has this course been taught?

_____ developed, but has not been taught yet
_____ less than 1 completed school year
_____ 1 completed school year
_____ more than 1 completed school year but less than 2 completed school years
_____ 2 completed school years
_____ more than 2 completed school years
_____ have not developed a course

3. Which of the following languages are you using in your fourth-generation language classrooms? (Please check all that apply)

_____ Ideal
_____ Spectra
_____ Powerhouse
_____ Mantis
_____ System W
_____ ADS
_____ Nomad
_____ IFPS
_____ FOCUS
_____ Express
_____ Ramis II
_____ Qtime
_____ Natural
_____ Other, please specify _____

4. Please indicate to what extent you consider the following characteristics, uses, and results to be beneficial. (5 = extremely beneficial; 4 = very beneficial; 3 = moderately beneficial; 2 = slightly beneficial; 1 = not beneficial)

Prototyping	1	2	3	4	5
Application generation	1	2	3	4	5
Nonprocedural programming	1	2	3	4	5
End-user programming	1	2	3	4	5
Automated data dictionaries	1	2	3	4	5
Maintenance reduction	1	2	3	4	5
Data modeling	1	2	3	4	5
Decision support system	1	2	3	4	5
Documentation automation	1	2	3	4	5
Automated design tools	1	2	3	4	5
Security features	1	2	3	4	5
Training time reduction	1	2	3	4	5
Other, please specify _____	1	2	3	4	5

Section IV
Potential Fourth-Generation Use

Please complete this section only if the fourth-generation language topic has not been included in any existing or newly developed courses.

1. At the present time, is incorporation of the fourth-generation language topic in the College of Business curriculum under consideration?

_____ Yes
_____ No, please skip the remainder of the questions and return the questionnaire.

2. How soon will you begin incorporating the fourth-generation language topic into the curriculum?

_____ less than 1 school year
_____ more than 1 school year but less than 2 school years
_____ 2 school years but less than 3 school years
_____ 3 school years
_____ more than 3 school years, please specify _____

3. Which of the following languages do you plan to use in your classrooms? (Please check all that apply.)

_____ Ideal
_____ Spectra
_____ Powerhouse
_____ Mantis
_____ System W
_____ ADS
_____ Nomad
_____ IFPS
_____ FOCUS
_____ Express
_____ Ramis II
_____ Qtime
_____ Natural
_____ Other, please specify _____
_____
_____

4. Will the fourth-generation language be incorporated into an existing course?

_____ Yes

In which of the following business courses, or course equivalent, will the fourth-generation language topic be implemented?

_____ Management Information Systems (Introductory)
_____ Introduction to Data Processing
_____ Systems Analysis and Design
_____ Database Concepts
_____ Third-generation programming language classes
  _____ Cobol
  _____ Pascal
  _____ Fortran
  _____ Basic
  _____ RPG
  _____ PL/1
  _____ other programming classes, please specify
  _____
  _____
  _____ other courses, please specify
  _____
  _____

_____ No, please skip questions 5 and 6

5. Based on your answer for question 4, what is the amount of class time that will be devoted to a fourth-generation language topic in each of these courses? (Please check all that apply.)

	Less than 1 week	More than 1 week but less than 2 weeks	More than 2 weeks	Other
Mgmt Info Systems				
Intro/Data Processing				
Systems Analysis & Design				
Database Concepts				
Cobol				
Fortran				
RPG				
PL/1				
Pascal				
Basic				
Other programming classes				
Other courses, please specify				

6. What method of presentation will be used to incorporate the fourth-generation language topic into the course(s)? (Please check all that apply.)

	Lecture	Software Application	Classroom Discussion	Programming Assignment	Other
Mgmt Info Systems					
Intro/Data Processing					
Systems Analysis & Design					
Database Concepts					
Cobol					
Fortran					
RPG					
PL/1					
Pascal					
Basic					
Other programming classes					
Other courses, please specify					

7. Will a course be designed specifically to teach fourth-generation language programming?

_____ Yes
_____ No

8. Please indicate to what extent you consider the following characteristics to be beneficial fourth-generation language characteristics. (5 = extremely beneficial; 4 = very beneficial; 3 = moderately beneficial; 2 = slightly beneficial; 1 = not beneficial)

Prototyping	1	2	3	4	5
Application generation	1	2	3	4	5
Nonprocedural programming	1	2	3	4	5
End-user programming	1	2	3	4	5
Automated data dictionaries	1	2	3	4	5
Maintenance reduction	1	2	3	4	5
Data modeling	1	2	3	4	5
Decision support system	1	2	3	4	5
Documentation automation	1	2	3	4	5
Automated design tools	1	2	3	4	5
Security features	1	2	3	4	5
Training time reduction	1	2	3	4	5
Other, please specify					
_____	1	2	3	4	5

. . . . . .

Thank you for completing this questionnaire. Your responses will help shape our future information systems curricula. If you would like an abstract of the survey's results, please write your name and address in the space below.

_____

_____

_____

_____

_____

Please return this questionnaire to:

Lisa Miller
College of Business
Oklahoma State University
Stillwater, OK 74078

APPENDIX B

FORTUNE 500 QUESTIONNAIRE

QUESTIONNAIRE ON
FOURTH-GENERATION LANGUAGE UTILIZATION

This questionnaire is a survey of senior systems analysts in Fortune 500 companies. The questionnaire is designed to gather information that will be useful in the development and design of higher education curricula. The senior systems analyst should complete this questionnaire by indicating the most appropriate response(s).

Section I
Demographic Data

1. Please indicate in which state your firm is located. _____

2. Please indicate the approximate number of employees in your organization.

   _____ under 10,000
   _____ 10,000 - 15,000
   _____ 15,001 - 20,000
   _____ 20,001 - 25,000
   _____ over 25,000

3. Please indicate your title. _____

4. Please indicate the current number of employees within your information systems department.

   _____ 1 - 10
   _____ 11 - 20
   _____ 21 - 30
   _____ more than 30

5. Have you incorporated a fourth-generation language into one or more of your organization's departments? (If your answer is yes, please complete only Section II. If your answer is no, please complete only Section III.)

   _____ Yes
   _____ No

Section II
Fourth-Generation Language Utilization

Please complete this section only if you have incorporated a fourth-generation language into one or more of your organization's departments.

1. How long has your organization been using a fourth-generation language?

   _____ less than 1 year
   _____ 1 - 2 years
   _____ more than 2 years but less than 3 years
   _____ 3 or more years

2. How has your organization offered fourth-generation language training? (In the case of multiple answers, please assign the rank of 1 to the method that is used most often; assign a rank of 2 to the method that is used next; etc.)

_____ lecture
_____ on-the-job training
_____ seminar
_____ outside consulting firm
_____ vendor supplied training
_____ university
_____ other, please specify _____

3. On the average, what is the length of training time required by your employees in order to work with the fourth-generation language?

_____ 1 - 2 days
_____ 3 - 5 days
_____ 6 - 7 days
_____ 8 - 14 days
_____ 15 - 30 days
_____ more than 30 days

4. Has the length of employee training diminished as a result of fourth-generation language implementation?

_____ Yes
_____ No

If no, has the length of employee training increased as a result of fourth-generation language implementation?

_____ Yes
_____ No

5. In which of the following areas has the usage of a fourth-generation language increased the amount of time spent working in this area? (In the case of multiple answers, please assign a rank of 1 to the most affected; 2 to the second most affected; etc.)

_____ Coding requirements
_____ Procedural programming
_____ Nonprocedural programming
_____ Program design
_____ Length of instruction
_____ Program documentation
_____ Corrective maintenance
_____ Adaptive maintenance
_____ Enhancement maintenance
_____ Other, please specify _____

6. In which of the following areas has the usage of a fourth-generation language decreased the amount of time spent working in this area? (In the case of multiple answers, please assign a rank of 1 to the most affected; 2 to the second most affected; etc.)

_____ Coding requirements
_____ Procedural programming
_____ Nonprocedural programming
_____ Program design
_____ Length of instruction
_____ Program documentation
_____ Corrective maintenance
_____ Adaptive maintenance
_____ Enhancement maintenance
_____ Other, please specify _____

7. Which of the following fourth-generation languages is your organization currently using? (Please check all that apply.)

_____ Ideal
_____ Spectra
_____ Powerhouse
_____ Mantis
_____ System W
_____ ADS
_____ Nomad
_____ IFPS
_____ FOCUS
_____ Express
_____ Ramis II
_____ Ctime
_____ Natural
_____ Other, please specify _____
_____
_____

8. Please indicate to what extent you consider the following characteristics, uses, and results to be beneficial. (5 = extremely beneficial; 4 = very beneficial; 3 = moderately beneficial; 2 = slightly beneficial; 1 = not beneficial)

Prototyping	1	2	3	4	5
Application generation	1	2	3	4	5
Nonprocedural programming	1	2	3	4	5
End-user programming	1	2	3	4	5
Automated data dictionaries	1	2	3	4	5
Maintenance reduction	1	2	3	4	5
Data modeling	1	2	3	4	5
Decision support system	1	2	3	4	5
Documentation automation	1	2	3	4	5
Automated design tools	1	2	3	4	5
Security features	1	2	3	4	5
Training time reduction	1	2	3	4	5
Other, please specify _____	1	2	3	4	5

9. Does your organization plan to expand fourth-generation language usage into other departments within the organization?

_____ Yes
_____ No

.....

Section III
Potential Fourth-Generation Language Utilization

.....

Please complete this section only if you have not implemented a fourth-generation language into one or more of your organization's departments.

1. At the present time, is incorporation of a fourth-generation language in your organization under consideration?

_____ Yes
_____ No (Please skip the remainder of the questions and return the questionnaire.)

2. How soon will incorporation of the fourth-generation language in your organization begin?

_____ 0 - 4 months
_____ more than 4 months but less than 8 months
_____ 8 months but less than 1 year
_____ 1 year but less than 2 years
_____ 2 years - 3 years
_____ more than 3 years, please specify _____

3. Which of the following languages do you plan to use in your organization? (Please check all that apply)

_____ Ideal
_____ Spectra
_____ Powerhouse
_____ Mantis
_____ System W
_____ ADS
_____ Nomad
_____ IFPS
_____ FOCUS
_____ Express
_____ Ramis II
_____ Qtime
_____ Natural
_____ Other, please specify _____
_____

4. Please indicate to what extent you consider the following fourth-generation language characteristics, uses, and results to be beneficial. (5 = extremely beneficial; 4 = very beneficial; 3 = moderately beneficial; 2 = slightly beneficial; 1 = not beneficial)

Prototyping	1	2	3	4	5
Application generation	1	2	3	4	5
Nonprocedural programming	1	2	3	4	5
End-user programming	1	2	3	4	5
Automated data dictionaries	1	2	3	4	5
Maintenance reduction	1	2	3	4	5
Data modeling	1	2	3	4	5
Decision support system	1	2	3	4	5
Documentation automation	1	2	3	4	5
Automated design tools	1	2	3	4	5
Security features	1	2	3	4	5
Training time reduction	1	2	3	4	5
Other, please specify					
_____	1	2	3	4	5

. . . . . .

Thank you for completing this questionnaire. Your responses will help shape our future information systems curricula. If you would like an abstract of the survey's results, please write your name and address in the space below.

_____

_____

_____

_____

_____

Please return the questionnaire to:

Lisa Miller
College of Business
Oklahoma State University
Stillwater, OK 74078

APPENDIX C

AACSB CORRESPONDENCE

OSU

Oklahoma State University

COLLEGE OF BUSINESS ADMINISTRATION

STILLWATER, OKLAHOMA 74078-0555
BUSINESS 201
405-624-5064

February 1, 1988

Dear Dean:

SUBJECT: CURRENT FOURTH-GENERATION LANGUAGE INSTRUCTIONAL PRACTICES

Your help is needed! As computer technology evolves at a rapid pace, higher education's curricula will need to reflect this evolution. As a member of the accredited AACSB colleges and universities, your input can help shape our educational system. This study's purpose is to gather data that reflects the current trends and practices of our higher educational institutions and the Fortune 500 companies concerning their fourth-generation language instruction and usage. In order for this national survey of accredited AACSB colleges and universities and Fortune 500 companies to be meaningful, your participation is needed.

Please forward this letter, along with the enclosed questionnaire to the information systems department head or to a faculty member who teaches in the information systems area. If possible, the questionnaire should be returned by March 1, 1988. An addressed, postage-paid envelope is enclosed.

Results from this study will benefit higher education by providing an insight into current and future industrial and educational usage of fourth-generation languages. If you would like an abstract of this study's findings, please indicate this by placing your name in the space provided on the questionnaire. Thank you for your participation. Your responses will help shape our future higher education curricula.

Sincerely,

Lisa Miller
Graduate Teaching Associate

Richard Aukerman
Doctoral Dissertation Chairman

Enclosures

CENTENNIAL
1890 • 1990

Celebrating the Past . . . Preparing for the Future

OSU

Oklahoma State University

COLLEGE OF BUSINESS ADMINISTRATION

STILLWATER, OKLAHOMA 74078-0555
BUSINESS 201
405-624-5064

March 8, 1988

Dear Dean:

SUBJECT: CURRENT FOURTH-GENERATION LANGUAGE INSTRUCTIONAL PRACTICES

Last month a questionnaire gathering information on the instruction of the fourth-generation language topic was mailed to your office. The questionnaire was sent in order to collect data for a survey of the accredited American Assembly of Collegiate Schools of Business and Fortune 500 populations. At the time this letter was mailed, a response from your institution had not been received. If you have since completed the questionnaire, thank you for your responses.

Please forward this letter and the enclosed questionnaire to the information systems department head or to a faculty member who teaches in the information systems area. If possible, please return the questionnaire on or by March 28. In order to facilitate your response, a copy of the questionnaire and a business reply envelope are enclosed.

One of the survey's goals is to help bridge the gap between education and industry by providing information on fourth-generation language usage in accredited AACSB schools and Fortune 500 companies. As an accredited member of the AACSB population, your assistance is needed. Your responses are greatly appreciated and will be kept confidential.

Sincerely,

Lisa Miller
Graduate Teaching Associate

Richard Aukerman
Doctoral Dissertation Chairman

Enclosures

CENTENNIAL
1890 • 1990

Celebrating the Past . . . Preparing for the Future

APPENDIX D

FORTUNE 500 CORRESPONDENCE

OSU

Oklahoma State University

COLLEGE OF BUSINESS ADMINISTRATION

STILLWATER, OKLAHOMA 74078-0555
BUSINESS 201
405-624-5064

February 1, 1988

Dear Systems Analyst:

SUBJECT: CURRENT FOURTH-GENERATION LANGUAGE USAGE

Your help is needed! As computer technology evolves at a rapid pace, higher education's curricula will need to reflect this evolution. As a member company in the Fortune 500, your input can help shape our educational system. The purpose of this study is to gather data that reflects the current trends and practices of Fortune 500 companies and our higher educational institutions concerning their fourth-generation language instruction and usage. Your participation in this national survey of Fortune 500 companies and accredited AACSB colleges and universities is needed for the study to be meaningful.

Please forward this letter, along with the enclosed questionnaire, to the senior systems analyst in the information systems department. If possible, the questionnaire should be returned by March 1, 1988. An addressed, postage-paid envelope is enclosed.

Results from this study will benefit industry and higher education by providing an insight into current and future industrial usage and educational instructional practices of fourth-generation languages. If you would like an abstract of this study's findings, please indicate this by placing your name in the space provided on the questionnaire. Thank you for your participation. Your responses will help higher education to be responsive to the needs of industry.

Sincerely,

Lisa Miller
Graduate Teaching Associate

Richard Aukerman
Doctoral Dissertation Chairman

Enclosures

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OSU

Oklahoma State University

COLLEGE OF BUSINESS ADMINISTRATION

STILLWATER, OKLAHOMA 74078-0535
BUSINESS 201
405-624-5064

March 8, 1988

Dear Systems Analyst:

SUBJECT: CURRENT FOURTH-GENERATION LANGUAGE USAGE

Last month a questionnaire gathering information on the fourth-generation language topic was mailed to the senior systems analyst in your company. The questionnaire was sent in order to collect data for a survey of the accredited American Assembly of Collegiate Schools of Business and Fortune 500 populations. At the time this letter was mailed, a response from your company had not been received. If you have since completed the questionnaire, thank you for your responses.

One of the survey's goals is to help bridge the gap between education and industry by providing information on fourth-generation language usage in accredited AACSB schools and Fortune 500 companies. As a member company of the Fortune 500 population, your assistance is needed. In order to facilitate your response, a copy of the questionnaire and a business reply envelope are enclosed. Please return the questionnaire on or by March 28. Your responses are greatly appreciated and will be kept confidential.

Sincerely,

Lisa Miller
Lisa Miller
Graduate Teaching Associate

Richard Aukerman
Richard Aukerman
Doctoral Dissertation Chairman

Enclosures

CENTENNIAL
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Celebrating the Past . . . Preparing for the Future

APPENDIX E

STATES IN WHICH THE RESPONDING AACSB INSTITUTIONS ARE LOCATED

TABLE LV

RESPONDING AACSB INSTITUTIONS
STATE LOCATIONS

State	Frequency	Percent
Alabama	4	3.4
Arizona	1	0.8
Arkansas	1	2.5
California	11	9.3
Colorado	3	2.5
Delaware	1	0.8
District of Columbia	1	0.8
Florida	4	3.4
Georgia	3	2.5
Idaho	1	0.8
Illinois	3	2.5
Indiana	3	2.5
Iowa	2	1.7
Kansas	1	0.8
Kentucky	3	2.5
Louisiana	5	4.2
Maine	1	0.8
Maryland	2	1.7
Massachusetts	3	2.5
Michigan	3	2.5
Minnesota	1	0.8
Mississippi	2	1.7
Missouri	3	2.5
Montana	1	0.8
Nebraska	1	0.8
New Jersey	1	0.8
New York	5	4.2
North Carolina	2	1.7
North Dakota	1	0.8
Ohio	4	3.4

TABLE LV (Continued)

State	Frequency	Percent
Oklahoma	3	2.5
Oregon	3	2.5
Pennsylvania	6	5.1
South Carolina	1	0.8
Tennessee	3	2.5
Texas	5	4.2
Utah	2	1.7
Virginia	4	3.4
Washington	4	3.4
West Virginia	1	0.8
Wisconsin	5	4.2
Wyoming	1	0.8
Missing Values	2	

APPENDIX F

RESPONDING FORTUNE 500

STATE LOCATION

TABLE LVI

RESPONDING FORTUNE 500 COMPANIES
STATE LOCATIONS

State	Frequency	Percent
Alabama	4	2.4
Alaska	1	0.6
Arizona	1	0.6
Arkansas	2	1.2
California	7	4.3
Colorado	3	1.8
Conneticut	10	6.1
Georgia	6	3.7
Hawaii	1	0.6
Idaho	1	0.6
Illinois	14	8.5
Indiana	4	2.4
Iowa	3	1.8
Kansas	2	1.2
Louisiana	1	0.6
Maryland	2	1.2
Massachusetts	6	3.7
Michigan	7	4.3
Minnesota	3	1.8
Missouri	7	4.3
Nebraska	1	0.6
New Hampshire	1	0.6
New Jersey	6	3.7
New York	5	3.0
North Carolina	1	0.6
Ohio	18	11.0
Oklahoma	6	3.7
Oregon	3	1.8
Pennsylvania	11	6.7
South Carolina	1	0.6

TABLE LVI (Continued)

State	Frequency	Percent
Texas	15	9.1
Utah	1	0.6
Virginia	5	3.0
Washington	1	0.6
West Virginia	1	0.6
Wisconsin	3	1.8
Missing Values	5	

VITA v

Mary Lisa Miller

Candidate for the Degree of

Doctor of Education

Thesis: A COMPARISON OF FOURTH-GENERATION LANGUAGE USAGE IN FORTUNE 500 COMPANIES AND COLLEGIATE INFORMATION SYSTEMS CURRICULA

Major Field: Business Education

Biographical:

Personal Data: Born in Durant, Oklahoma, March 1, 1963, the daughter of James Harold and Joan Robinson Miller.

Education: Graduated from Bennington High School, Bennington, Oklahoma, in May, 1981; received Bachelor of Science in Education degree in Business Education from Southeastern Oklahoma State University, Durant, Oklahoma, in 1984; received Master of Education degree in Business Education from Oklahoma State University, Stillwater, Oklahoma, in 1986; completed requirements for the Doctor of Education degree at Oklahoma State University in July, 1988.

Professional Experience: Graduate Teaching Associate, College of Business, Oklahoma State University, 1986-1988. Graduate Assistant, College of Business, Oklahoma State University, 1985-1986.

Professional Organizations: Delta Pi Epsilon (President, 1987-1988; Vice President, 1986-1987); Pi Omega Pi (President, 1984; Historian, 1983).