COMPUTER SCIENCE PLAN

CONTENTS

APPENDICES

ABSTRACT

This report puts forth a preliminary ten-year plan for the newly established Department of Computer Science at Kansas State University. The plan establishes the baseline of current departmental status, proceeds to key objectives for meeting projected social requirements for computer science, and then describes milestones to achieve these objectives for faculty, physical resources, curriculum and students. The joint KU/KSU program for doctoral candidates is highlighted as a unique requirement of this plan. The method borrows from key concepts in the Planning, Programing, Budgeting System approach (PPBS), with special emphasis on cost and performance evaluation.

A basic goal is to meet the challenge of swift advances in computer science and technology culminating in public use of computer services in the 1980's in the form of mass information utilities. To meet this challenge in the KSU context, the following major milestones are anticipated.

- 1971: Initiate joint KU/KSU Ph.D. program
- 1973: Expand the effective scope of the department from computer science to computer and information science
- 1975: First Ph.D.'s receive their doctorates from the joint program
- 1977: All undergraduates receive at least one introductory course in computer science at KSU--no computer illiterates on campus
- 1979: KSU graduates and KSU faculty make a major impact on computer research and technology--KSU becomes a leading center for computer studies
- 1981: Full spectrum of computer and information science skills and related interdisciplinary skills are taught and developed at KSU for mass use and specialized social applications of computers

During this ten-year period, growth in the student body, faculty, and budget is projected as follows to meet the above planning requirements. Graduate students progress from 30 in 1971, to 50 in 1976, to 70 in 1981; undergraduate majors and minors in computer science increase from 200 in 1971, to 425 in 1976, to 600 in 1981; other students taking computer science courses grow from only about 100 in 1971, to 4000 in 1976 when all undergraduates are required to have some familiarity with computer science, to 5000 in 1981 as KSU grows in total student body. The Computer Science faculty increases from 8.5 in 1971, to 21 in 1976, to 30 in 1981 with commensurate diversification in curriculum and research. Student and faculty performance will be measured by standardized evaluative instruments. The departmental budget, including computer services which is roughly 40 percent of the total, rises from some $200,000 in 1971, to $780,000 in 1976, to slightly over one million dollars in 1981. The million-dollar goal in 1981 is believed sufficient to serve the projected requirement of 5000 students taking introductory courses, 600 majors and minors in computer science, research and teaching requirements for the equivalent of 30 full-time faculty, with necessary supporting staff and computer services. At that point we expect KSU to be a leading national center for theoretical and applied interdisciplinary work in computers and computer services to meet rapidly burgeoning social needs.

I. INTRODUCTION AND KEYNOTE

This report covers current status and preliminary plans of the newly formed Computer Science Department at KSU. Since this Department is less than one month old at this writing, long-range plans are unavoidably tentative and await further corroboration among principals within the University and between KSU and KU in regard to the recently projected joint Ph.D. program offered by both universities.

The body of the report encompasses four basic areas: objectives, faculty and resources, curriculum, and students. Each of these four sections describes current status of the Department of Computer Science to establish a baseline for projections, objectives for desired evolutionary growth, and a ten-year summary plan listing major milestones in departmental development. Supporting data and evidence are placed in the Appendix, listed in order of appearance in the text.

This introductory section is primarily devoted to an overview of computer science, a forecast of key trends, and the development of basic roles and objectives to meet university needs in the growing application of computers to social affairs. Accordingly, the introduction is cast in the form of a keynote to set the stage for more detailed planning in the body of the report.

Computers have been with us since man used his hand as a digital computer. The position of the sun in the sky was probably the first analog computer. The ancient abacus was a major computational improvement over the human hand, and sundials and clocks were significant advances over subjective estimates of the position of the sun. In a mystic revelation of things to come, Pythagoras proclaimed, 2500 years ago, that all things are numbers.

With the advent of the modern electronic digital computer, spawned only one human generation ago in World War II, Pythagoras' cryptic dictum is realized as computers weave a binary web about virtually all phases of human affairs.

In the short span of this last human generation, computers have proliferated at an almost unbelievable rate, accompanied by severe growing pains and much chaos and disorder. There are over 100,000 computers throughout the world. Computer power and computer hardware cost-effectiveness have doubled every two to three years over the 1950's and 1960's. Computational speeds have progressed from tenths of a second to trillionths of a second; size has been cut down exponentially from vacuum tube computers in large block houses, as with the AN/FSQ-7 used in SAGE air defense, to room-size transistorized computers, to head-sized spaceborne computers with advanced integrated circuits; and the storage of information has progressed from 150 words in the ENIAC to over one million words (or 8 million bytes) of high-speed memory in our largest computers today.

Computer applications started with such tasks as the computation of ballistic missile trajectories and nuclear reaction equations in World War II, with the computer playing the role of high-speed number cruncher (calculators). The advent of the real-time command and control systems in all the major armed services in the 1950's highlighted Pythagoras' dictum with brilliant clarity --computers were not merely gigantic number crunchers, they were essential for national survival, and could be applied, in principle, to virtually all human affairs. Real time systems permit positive control over events at the time of their occurrence; they represent a major evolutionary advance in social control of human affairs. Subsequent to interactive man-computer communication in real-time command and control, time-sharing appeared in the 1960's. With time-sharing, different users could share the same computer with independent tasks, entering and leaving the system at different times, as with a public utility. Online and offline computer applications in the 1960's spread rapidly through the aerospace industry, the sciences, the business world, and later through the arts. Mass information utilities--the universal extension of interactive computer services to the general public in the natural environment of the user--will appear in prototype form this decade, and will become established as a major social force in its own right in the 1980's.

The economic impact of computers is already massive. The computer industry operates at the annual rate of some 10 billion dollars per year for goods and services today, and many predict that it will be the largest single industry in the 1980's.

The 1960's also witnessed the emergence of computer science (and/or information science) as an academic discipline in its own right in major universities not only in the United States, but also throughout the world. The definition and scope of this infant science propelled by powerful economic and political forces has been the subject of hot dispute. Engineering, mathematics, and business schools, among others, have variously claimed to be lawful progenitors and rightful heirs to this new science.

The first departments of computer science were primarily concerned with justification of the field as a scientific academic discipline in its own right. Hence great emphasis was placed on academic respectability, particularly on mathematical, logical, and theoretical roots, generally in the direction of pure rather than applied science. Social problems and social requirements were not vital for survival of nascent computer science departments, and social payoff received short shrift when computer science applied for academic recognition. However, as indicated in this introduction, the manifest destiny of computers as a powerful socio-economic-political force in its own right, necessitates a redirection of academic values in computer science toward a more humanistic balance, with social benefits as the main theme.

The crux of the future of computer science is in social use. This fundamental axiom is based on the premise that everyone will soon become a significant user of computer services. In the first human generation of computer development from World War II to the present, the prime beneficiaries have been government, industry and other large institutional users. A generous estimate at this time would indicate that only one percent of the general population has significant interaction with computers in their daily affairs. However, with the new generation of college students, who will reach their prime about the year 2000, computer usage will spread from one percent to almost 100 percent, particularly with the rise and spread of cost-effective mass information utilities at home, in the office, and in schools. The computer elite, serving less than one percent of the population, will have to change its values, method, and practice to serve the information needs of all citizens in all walks of life. If not, the information rich will get richer, the information poor will get poorer, and democratic opportunity may disappear. Nothing less than a democratization of computer science is needed, not later, but now, for academic leadership in meeting the challenge of social excellence in the extension of computer services throughout society.

This democratization of computer science can assume a variety of new forms. Educationally, every college student could be exposed to basic instruction and use of computers so that there will be no computer illiterates on the campus. An individual ignorant of computers, their capabilities and limitations, will be at a crippling disadvantage in relation to his contemporaries. Thus, a basic strategic goal is the systematic extension of introductory computer science to meet the diversified needs of all college students.

As mathematics is handmaiden to the sciences, so is computer science handmaiden to the larger sphere of science, technology, and the new problem-oriented interdisciplines. Computers are revolutionizing scientific method, not only in practice, but also in spirit. Increasing experience with case histories of large-scale, long-term computerization in military, educational, scientific, and commercial settings have repeatedly demonstrated that the most effective utilization of computer services occurs as users become sufficiently educated and sophisticated to take over on their own. The ignorant user is the impotent user. Thus, the goal of computer science in this area is to learn the necessary interdisciplinary skills by working on cooperative teams with the full spectrum of computer users, to help such users to help themselves so that they can become relatively independent of computer specialists.

It is not recommended that computer scientists plan for their own extinction by helping users to become self-sufficient. The state of the art in computer science is swiftly changing with new advances springing from all sides. Developments such as natural language processing--computer recognition of conversational voice input and generation of intelligible verbal output--are bound to revolutionize the method and spirit of computer science. Continuing research is needed in basic computer science on all fronts to keep up with rising demands for more diversified and more cost-effective information services.

However, the current bias in computer science toward pure science to the neglect of applied science needs to be corrected. The traditional courses in logic, hardware architecture, programing, numerical analysis, languages and compilers, simulation, heuristics, and automata theory need to be supplemented by more applied courses in system design and development, empirical test and evaluation (e.g., statistics and experimental design), and the scientific study of the human use of computers (e.g., the intersection of computers and social science). These areas represent a systematic extension of scientific method to computer theory, making computer science more scientific in the empirical sense of the term, and humanizing computer science by adapting its theory and findings to human parameters. Both the computer industry and academia have been derelict in the past in putting forth untested, shoddy hardware and software for widespread application to gullible users. Computer technology has been guided by arbitrary procrustean principles rather than scientifically verified human use. With the universalization of computer services, higher quality control standards will be required, particularly for mass information utilities.

Within the university structure, computer science will have to demonstrate a high degree of cooperation with virtually all other disciplines. Computer science departments will need to train professionals of all callings in generalized computer techniques and concepts relevant to advances in each calling. Cross-fertilization of computer science with other disciplines should be encouraged to keep up with new problems and growing demands from all fields. Such cross-fertilization could occur through a variety of mechanisms--split appointments, interdisciplinary grants, mission-oriented institutes, interdisciplinary departments and degrees, and community projects. New computer-related developments could be pioneered either by interdisciplinary teams, computer scientists alone, or the object discipline alone. Flexibility and pragmatic use of available interdisciplinary resources should be pursued. The problem and its solution should define the disciplinary mix. For example, development of mass information utilities requires close cooperation of many diverse skills such as: computer scientists, communications engineers, municipal government, CATV operators, vendors of peripheral equipment, regulatory agencies, vendors of user services, banks, management teams, information specialists, and many others.

This brief introduction is aimed at the spirit, not the letter of the new roles expected of computer science in the future. Subsequent sections spell out in greater detail alternative plans for realizing the foregoing philosophy in the KSU and the KU/KSU context. Many of the recommended changes are rather substantial, and will require much cooperative experimentation to adjust means and ends to resources. It is in this experimental spirit that our plans are offered.

BIBLIOGRAPHY

1. Atchison, William F., and John W. Hamblen, Status of Computer Sciences Curricula in Colleges and Universities, Communications of the ACM, Vol. 7, No. 4, April 1965, pp. 225-227.

2. Computing Reviews - updated from year to year.

3. Computers and Automation - updated from year to year.

4. Parsons and Williams, Forecast of 1968-2000 of Computer Developments and Applications, Copenhagen, Denmark, 1968.

II. GOALS

1. PURPOSE

Computer science is difficult to define, but its concern is with machines for computing and information handling and the ways and means by which they can be made to carry out their work. This is admittedly vague and is subject to a variety of emphases reflected by the different patterns among the schools offering programs in this field. Certainly the field is an evolving one with a need to be responsive to new directions. Unlike entomology or geography, computer science is likely to be part of the curriculum of students majoring in a wide range of disciplines. In this sense it has the universality of English or of mathematics, which are essentials to scholarship in many fields. Thus, in addition to being concerned with computer science in its own right and as a field with its own majors, we must be sensitive to the need for and applications of computer science in such fields as engineering, mathematics, statistics, the physical, biological and social sciences, the humanities, business and medicine.

Taking these applications into account, we are able to distinguish four different purposes to which computer science should address itself. We will list these briefly here, and then expand upon each in turn in this section, before giving a more detailed justification, in Section 2, of each purpose.

The KSU Computer Science Department should provide:

a. An introductory course in computer science which gives every KSU student some insight into the nature of computer programming, the scope of computer science, and the impact of computers on technology and society.

b. A variety of programs for students in other (non-computer science) fields which give them the ability to apply computer science to their own fields.

c. Training for computer science majors, at both the undergraduate and graduate levels, in the core courses of computer science, so that each student can play a role in developing a more sophisticated, humane, and useful computer technology to meet the pressing needs of a computer-serviced society.

d. A unique joint Ph.D. program for graduate students, allowing them to utilize the resources of both Kansas State University and the University of Kansas, while developing cooperative computer networks aimed at large-scale regional use.

These goals imply expansion of the scope of the department to place computer science in a more flexible posture allowing free adaptation to interdisciplinary studies and mission-oriented social problems as they arise.

In an era in which computers are assuming an ever increasing burden of the routine work of our society, an understanding of the capabilities and limitations of computers is becoming an increasingly important element in the equipment of an educated person. In earlier days, the "three R's" were considered sufficient education for a man making a place in society. By the 21st century, however, computers will be used so much in our society that some knowledge of them will be as essential as knowledge of the three R's was at an earlier time.

Even people who do not work with computers will require some understanding of them in order to avoid the bewilderment that is the lot of the illiterate today. The Computer Science Department should help to fill the educational needs of the non-technical non-specialist just as the more established sciences fill the need of non-science students. By so doing, computer science will serve both society and the computing science profession by increasing public knowledge about, and support for, computer technologies.

In order to fill these needs, our department has offered an introductory course to teach computer programming and basic computer science. This course has been divided into three sections i.e., business, scientific, and general, to make it meaningful to all university students. (See Student Achievement Section.)

Because computers have modified the professional activity of individuals in so many areas, and because the potential for effective application of computing technology to many disciplines is still being explored, large numbers of people trained in an interdisciplinary region between an applications area and computer science should be educated. The department has been alert to this need, and we have responded with a series of possible programs (see Curriculum Section) which majors in other departments might wish to combine with a computer science minor (see b.), or which majors in computer science might wish to combine with minors in other disciplines. An example is a computer science major with a minor in business.

The third principal goal of the Computer Science Department is to provide training for computer science majors, and to support research effort by the faculty and the graduate students. This training will transmit the knowledge at the heart of computer science to students, and this research will extend the knowledge which is at the heart of the discipline. The corps of students trained in computer science will become increasingly necessary for the development and maintenance of computer systems which support data handling and problem solution by workers untrained in computer science. This role for specialists in computer science is the provision of a man-machine interface for users whose primary interest is outside of computer science. For example, specialists in computer languages might design languages which help people to use the computer if they are competent in their own field of learning, but do not want to develop the computer language they need. Specialists in data organization and management might design and implement large systems to aid potential users of data processing machines to handle large, unwieldy data bases. Specialists in hardware might use new integrated circuitry to develop more powerful computers and new types of computers. Specialists in computer systems might coordinate advances in languages, data organization, data management, and machine capability into organic units which might be employed profitably by users of the systems.

Our undergraduate majors receive the core of courses recommended by the Association for Computing Machinery (see Curriculum Section), and we will update this core as the field of computer science evolves in response to research advances and to the needs of society (see Computer Science Milestones, P. II-14).

A fourth principal goal of the Computer Science Department at KSU is successful operation of a joint Ph.D. Program with KU. Such an accomplishment will provide the computer science profession, ourselves, and our students with an opportunity and environment in which to extend the body of knowledge of the profession. But less obviously, it will also serve as a model for cooperative programs in other disciplines, which may be increasingly attractive, in these times of difficult financial circumstances, for institutions of higher education.

Since the joint Ph.D. program is unique, it seems appropriate to quote some passages from the proposal which led to its existence in order to impart some of its spirit.

"The determining principle for such a joint undertaking is that there is to be a single program operating on and making use of the resources of both campuses. The marshalling of talent under the plan will afford the student a much wider range of educational opportunity than either school would be able to provide separately. Moreover, the plan has great future significance in view of increasing emphasis on coordination of and cooperation between programs among the several Regents' institutions."

"In combining the resources of the University of Kansas and Kansas State University at the doctoral level, an important consideration is the division of labor within the field of computer science so that expected development may proceed without overt and wasteful duplication. A blueprint for such a division, arrived at by the faculties from the two campuses, serves as the point of departure for the doctoral program. Every effort has been made to achieve a rational differentiation of research specialties. The division of the field is neither unique nor exhaustive, however, but it illustrates agreement upon separate areas of emphasis and takes into account current faculty research activity. It is understood that, in any intellectual effort, it is difficult to identify one subspecialization as being totally independent of another and that it is undesirable, if not impossible, to prohibit mental excursion into related areas. Therefore, in maintaining differentiation it is important to emphasize the current spirit of faculty determination to shape the growth of the program on each campus in distinct ways, allowing for readjustment as the program evolves. Certainly in a new field such as computer science allowance must be made for the dynamic and evolutionary character of individual interests and of the field itself. Perhaps more significant than formal agreements or legalism is the consideration of evidence of good faith and of demonstrable differentiation to be adduced from the experience of the coming years. <u>To this purpose it is essential that there be a mechanism for review, evaluation, and redirection as provided for under the Steering Committee. This committee shall have the basic responsibility to provide for differentiation and to assess the uniformity of practices and the degree of reciprocal action between the campuses, always being guided by the principle that a single program exists to best serve the student.</u>"

GENERAL PRINCIPLES

"A plan for a common doctoral program offered by the University of Kansas and Kansas State University can be based on the following principles."

"1) The computer science resources of each school should be uniformly available to doctoral students and faculty with full reciprocity.

2) There should be a single program in computer science with common academic policies and standards for the fulfillment of degree requirements.

3) Although parallel offerings will be necessary to serve students from other programs, each school will maintain complementary and differentiated research emphases in computer science so as to provide a broad choice of specializations to the doctoral student and to identify the unique areas of competence to be developed on each campus, both in current faculty effort and in future recruitment.

4) As a relatively novel undertaking which might pave the way for future joint institutional effort in certain other areas, care should be used in identifying and developing effective ways of communication between and within the student and faculty populations. That computers themselves might be an important part of such communication lends unusual potential to the present plan."

(See Curriculum for Current Classification of Doctoral Research Specialties in Computer Science.)

"Faculty Meetings. There will be a meeting of the faculty at least once each semester, alternating between the campuses. Each person may cast one vote, with voting and other parliamentary procedures to be determined by the faculty. The authority for setting degree requirements and for similar academic policies belongs to the faculty. As suggested by experience and convenience the faculty may rely on the Steering Committee to identify and develop recommendations for such matters, and, indeed, to decide them in the absence of subsequent revocation by the faculty."

2. STATEMENT OF ROLE IN THE COMMUNITY

The role of the Computer Science Department has been defined in the foregoing discussion. The widespread impact of the technology on society forces computer science to pay particular attention to educating the University's students of the possibilities, both realized and potential, which computers have engendered. If one regards the purposes as a four-tiered hierarchy, then the broadest but shallowest tier, the non-computer scientists, is the one which concerns us first. A current discussion of the profound implications of computer science to society, most of which consists of non-computer-scientists, is available in the introduction.

At the second tier (joint majors) and third tier (computer science undergraduates) of the heirarchy, narrower populations are given increasing in-depth educations in computer science and technology. The role played by the department in these levels corresponds in every regard to the roles assumed by each academic department in training students in its respective discipline, and requires no special comment. It may be re-emphasized that the very widespread applicability of the computer technology to other, sometimes quite distant, disciplines places a special requirement on computer scientists that they be particularly alert to the opportunities to encourage interdisciplinary activity by being open to educational innovations involving cooperation with experts in other fields.

In addition to training workers who can serve their community, nation, and world, our Department of Computer Science will offer educational institutions a model for an unusual Ph.D. program in the fourth tier of our hierarchy. The role of the Computer Science Department at Kansas State University as a partner with the Computer Science Department at the University of Kansas in offering a joint Ph.D. is a unique one on our campus. In addition to offering training to students, the program offers a model for other inter-university degree programs to be implemented in the future. In any event, the experience we will gain from this two-campus program will be valuable to others in our state system in planning similar future programs.

As this report is being written, the joint Ph.D. program is only two months old; the Steering Committee has met only once; much of the detail which will evolve to support the cooperative effort has not yet been conceived. Accordingly, very little can be said about the viability of the arrangements which have been sketched. Intense and determined effort will be required for the next several years to ensure that the potential of the program be fully realized, and a major portion of faculty effort in the departments on the two campuses will necessarily be directed toward making the joint effort succeed.

3. PRIORITIES TO GUIDE GROWTH

We have two priorities, 1) to build an excellent Ph.D. program and 2) to maintain a sound undergraduate program. The highest priority is to build the graduate faculty. This does not imply that the graduate program is intrinsically of more importance than the undergraduate program, but rather that our relative strengths are most in need of improvement at the graduate level. The areas of Data Organization, Business Applications, Programming Systems, Realtime Systems, Computer Networks, Man-Computer Communication, Computer-Aided Planning, and Large-Scale System Development have been identified as areas which would be appropriate ones for early graduate faculty additions.

We should at the same time guard the excellence of our undergraduate program in computer science, and make sure that it serves students outside of computer science, students with joint majors which include computer science, and computer science majors. This will necessitate continual surveillance of the excellence of our undergraduate curriculum, as well as of its relevance both to computer science and to society.

Although the faculty are concentrating their efforts in various areas, they are all unified in supporting our purposes as outlined previously. Their diverse interests support these goals in the aggregate, even though each individual faculty member's inclinations may favor one aspect of the total picture more than other aspects. Since the department of computer science is so new, many organizational details are still in the process of being worked through, and the department cannot be said to have established a routine in which faculty have settled into individual roles which are integrated into an overall effort.

4. SUPPORT OF PURPOSES FROM FACULTY

H. Sackman, the new Head of the Department of Computer Science, runs the department as a participatory democracy, a plan of operation derived from his professional work in studying the effectiveness of various planning techniques. Although it requires a dedication which some faculty members find onerous, it is an effective way of ensuring faculty participation in establishment and achievement of departmental goals. This participation should surpass other planning and management approaches in producing in the faculty a high degree of agreement, and of coherent effort.

This approach, so important to our departmental development, is explained in the following quotes from Dr. Sackman's paper.*

"Participatory planning refers to mutual expectations in social creation of a plan--the attitudes, beliefs, values, goals, priorities, judgments and supporting rationalizations that enter into social consensus for defining and initiating an authorized plan...."

"First, the emphasis is not evenly distributed over the entire planning process from the gleam in someone's eye to the completed final plan. The focus is primarily on the early normative stage of planning--the creation of a concurred and accepted mandate for planning in the specified planning community (the computer science faculty). Thus, the planning techniques for the earliest stages of planning (normative planning) and the earliest stages of system development (system goals), are the starting point for participatory..... planning....."

"In principle, participatory.....planning can be applied wherever human evaluation is invoked, and wherever there is a difference of opinion on explicit issues, which can occur at any point throughout the entire planning cycle."

This integration is facilitated by our participatory planning approach which allows participation by our faculty in establishment of departmental goals.

5. PROVISIONAL PLANS FOR THE DEPARTMENT

The current state of planning for the new Computer Science Department can best be illustrated by quoting extensively from a report to the Vice President for Academic Affairs by a planning committee prior to formation of the department.

These preliminary plans are subject to continuing modification and reinterpretation as gaps are filled and as new agreements are reached among the principals at KU and KSU.

"It is clear that there are many faculty members and students who may make extensive use of computers at a highly sophisticated level and who are not

---

*SP-3480, H. Sackman, System Development Corporation, April 6, 1970.

necessarily identified as practicing nor aspiring computer scientists. Thus the Committee distinguishes between those interested in computing concepts alone and the larger number interested in computing applications."

"It is recommended that the Department of Computer Science have direct responsibility for a) all freshman-sophomore work in computer science, including programming courses, and b) upper level and graduate work in computer science where the emphasis is not on applications to some specific field. After basic work in computer programming, languages, and algorithmic structures has been acquired in the Department of Computer Science, it is altogether proper, the Committee believes, that advanced instruction in computing applications in several disciplines may be carried out by the faculties in the departments concerned."

"Although recognizing the varying needs of computer users in applications unique to their fields, the Committee believes in a basic efficiency and jurisdictional unity which should characterize the University's instructional program in Computer Science. We believe that the concentration of computer science instruction in the Department is justified both by its academic soundness and its conservation of university resources. Although the identification of duplication may be a matter of judgment and style, it is hoped that the spirit of the foregoing principles is plain enough to serve as a future guide."

Computer Science Faculty. Current members of the departmental faculty are shown in Part III, Resources. The following areas are ones in which additional faculty appointments might be made in the near future: Data Organization, Business Applications, and Programming Systems. The Department believes that joint appointments will be exceedingly useful and that, with proper understandings having been established between departments, they are an effective means of representing mutual academic interests.

We have already initiated this policy of joint appointments by appointing Drs. Ahmed and Calhoun jointly with the Department of Electrical Engineering. We will continue to reach out to other departments in this way.

Courses. The introductory computer science courses in both FORTRAN and PL/1 will be subdivided into separate courses so that students from different disciplines may obtain the knowledge that they need.

Graduate Teaching Assistants. There are currently 2.4 full-time-equivalent graduate teaching assistants (6 assistants, each working four-tenths of full time) assigned to the Department. With current and prospective instructional demand, this number should be increased to 19.2 within the next 10 years.

Inasmuch as computer science is a field currently in great demand, and its courses show growing enrollments, normal growth can be expected to furnish the base for needed faculty additions. Indeed, by virtue of the cooperative program, the State of Kansas will thus truly be able to assemble and capitalize upon an impressive and diversified staff to serve the needs of students majoring both in computer science and in related fields. As experience is gained the groundwork can be laid for involvement of other schools in the state through networks and for extension of the cooperative pattern to other programs.

6. PROGRAMS FOR EVALUATING EFFECTIVENESS

Our main means of evaluating our effectiveness will be to see whether we meet the goals that we set ourselves. a) Have we given insight to non-computer science majors? b) Have we given computer scientists and non-computer science students the ability to use computer science interdisciplinary projects? c) Have we given computer science majors a knowledge of their own disciplines? d) Have we developed a viable Ph.D. program?

- In order to know whether we are reaching non-computer science majors, we can examine the courses directed to this audience to determine whether these courses draw students from other departments on the campus. In addition to this test of their popularity, we can test these students to determine whether they do have a knowledge of the basics of computer science upon completing the course.

- In order to know whether we have provided training applicable to interdisciplinary projects, we can refer to the computing center records or projects in other disciplines involving computer use. Also, we can see whether non-computer scientists are taking second level computer science courses, and whether computer scientists are taking sets of courses outside of the department allowing them to carry out such projects. Other departments will provide informal feedback on their student responses to our courses.

- In order to know whether we have developed a core of computer science courses, we can compare our course content with the content of other departments, and with the content recommended by organizations like the Association for Computing Machinery.

- In order to know whether we have developed a viable Ph.D. program, we can examine both the number and the quality of Ph.D. candidates who complete their dissertations. Since these dissertations are filed, and since we are involved in a joint Ph.D. program with the University of Kansas, we can also put the dissertations up for the scrutiny of the computer science faculty from the University of Kansas.

In addition to seeing whether we meet our goals, we can determine the cost-effectiveness of our teaching and research. How many students of each level does each faculty member teach? How much does he make? How much is paid by outside grants? How much does he publish? We can use all of these figures to determine the cost-effectiveness of a faculty member.

As the student enrollment grows, the department will consider more cost effective devices such as utilizing large lecture sections to replace the current small class sections, using canned computer programs to judge students' computing capabilities. Furthermore, we will continue to use student-oriented compilers such as WATFIV and PLC which are comparatively cheap to use. Using the computer to grade tests and student programs, are also cost effective. Although interactive programs on the computer are not cost effective on this campus, they are an example of an expensive procedure we must maintain in order to introduce the students to important current computer techniques. Quite often, similar comments may be made about dedicated faculty teaching essential courses.

Another cost effective techniques which we should introduce are multiple choice exams with an optical Mark scorer for grading.

Not only each individual faculty member, but also the group comprising the department, should be subject to analysis and evaluation. Group activities, such as committee projects, should be written up, and the man-hours spent on the projects should be compared to the production by the committee. The many committee activities should be summarized by man-hours spent, positive results, and the summaries should be used as a guide for future committee organizations.

From committees, we proceed to the class room, where we will teach experimental classes in order to evaluate possible classes. We may teach experimental classes on occasion in order to test alternative ways of teaching acourse.

Since evaluation is so important, one faculty member should devote four-tenths of his time to it, and should have available both $500 per year and two-tenths of the secretary's time in order to carry out the evaluation. He should write an annual report evaluating the success of the department in meeting its goals.

Finally, we can evaluate our effectiveness in serving national needs by observing whether our students find jobs, keep them, and achieve success on them.

Our main goal for the next ten years is to keep abreast of current developments in computer science, and to teach these developments to our students. Although it is impossible to predict the exact nature of or time of appearance of these developments, specific examples of the kinds of events we envision are listed.

COMPUTER SCIENCE DEPARTMENT MILESTONES

1972 Microprogramming speeds efficiency of program.

1973 Parallel processing computers allows weather prediction, epidemiological models, to be implemented.

Metacompilers in wide use to allow individually designed compilers for specialized uses.

1974 Automated theater bookings, dentist appointments, health surveillance, flexible, reschedule as directed.

1975 Real time simulation enables urban planners to walk through simulated cities before the real cities are built.

Grid of computers to obtain programs, data and the processing power of remote specialized machines. Local computer interrogating a directory computer to find out where it can find the services it needs. One huge organism of linked computers which help each other.

1976 Urban planning by computer, using simulation, to see city before it is built.

1977 Computer terminal in kitchen, living room.

1978 Computerized traffic direction and work schedules.

1979 Kindergarten use of touch type terminals.

1980 Data banks on individuals, available, but not used to oppress. Used for crime prevention.

1981 Artificial intelligence in computers increases their adaptability in performing tasks.

Multipurpose screen used for television, picturephone, and computer data.

III. FACULTY AND RESOURCES

The faculty of the Computer Science Department is quite diffuse in character, as might well be expected, for a field with such broad applications and so many ramifications in its nature. Faculty experience ranges from linguistics to nuclear physics and from chemistry to biological simulation, as well as the more usual backgrounds of mechanical engineering, electrical engineering, mathematics, statistics, and numerical analysis. These diverse backgrounds of the faculty allow them to mingle in a manner necessary for an evolving field which has a need to be responsive to change. Because of the broad range of responsibilities of the computer science department, the practice of joint appointments with other departments and divisions of the university will be strongly encouraged.

The faculty of the Computer Science Department has the opportunity to participate in a unique program for the granting of the Doctor of Philosophy degree. The Boards of Regents, State of Kansas, has approved a joint doctoral program in Computer Science between the University of Kansas, at Lawrence, and Kansas State University. The determining principle for such a joint program allows the marshaling of talent under the plan which will afford the student a much wider range of educational opportunity than either school would be able to provide separately. In combining the resources of the University of Kansas and Kansas State University at the doctoral level, a division of labor within the field of Computer Science has been made so that the expected development may proceed without overt and wasteful duplication. The current classification of doctoral research specialies in Computer Science is outlined in Section IV the Curriculum.

The present faculty of the department consists of one professor, four associate professors, and seven assistant professors. Ten different highly regarded institutions granted the terminal degrees to the faculty. The vitae are included in the KU/KSU Ph.D. proposal, and are reproduced at the end of this report. The faculty members at the University of Kansas who are participating in the joint Ph.D. program consist of three professors, four associate professors, and five assistant professors. The vitae for these members are also included in the KU/KSU Ph.D. proposal.

FACULTY EFFECTIVENESS

During the fall semester of 1970, educational resources group of the university prepared a questionnaire. This questionnaire was administered to certain students enrolled in computer science courses. It was the first attempt to advise the faculty of the student reaction to their instructional methods; the individual instructors received a composite of the students' reaction to their course, primarily as an aid for self-improvement. Because of the experimental nature of the program, and the emphasis on individual faculty confidentiality, the results of an individual instructor's performance were available only to that individual instructor. Elsewhere in the total report for the university, the compilation of student reaction to instructional methods will be given.

Another questionnaire (see Appendix III-A) was used within the Department of Statistics and Computer Science to aid in student reaction to faculty teaching methods. Each student is asked to rate his instructor on many items using a graduated 5-point scale. In addition, other information pertaining to mannerisms and habits of presentation which may distract from the total teaching environment is requested. These ratings are collected and tallied by the department secretary (without regard to students' names) and are made available to the individual instructors.

The Computer Science Department does not use any single instrument to evaluate the student reaction to faculty advising, but it assigns a faculty advisor to each student, guaranteeing personal contact. Although the choice of the advisor is arbitrary for beginning students, as students progress they can seek an advisor who is compatible both professionally and personally.

Faculty research effectiveness is based primarily on the number and quality of articles accepted by refereed journals. Certainly, another measure is the willingness of sources external to the university to support research activities.

ADEQUACY OF PHYSICAL PLANT

Present Facilities. The Computing Center has the charge of providing the academic community at Kansas State University with instructional and instructional-support computing service. Instructional computing includes formal classroom usage at the undergraduate and graduate levels, and computing support for masters reports and theses and doctoral dissertations. Instructional-support includes faculty and undergraduate research computing support, and administrative computing associated directly with instruction.

The computer is run using IBM's Operating System in a Multiprogramming environment with a Fixed number of Tasks (OS-MFT). The capability of OS is enhanced by two additional processors. The first of these, Houston Automatic Spooling Priority (HASP), is an input-output spooling program which provides accounting and services the job queue on a priority basis. The other, Baylor Executive System for Teleprocessing (BEST), is a time-sharing system system which runs under control of the Operating System.

Language Processors and Systems:

COBOL ANS (Common Business Oriented Language-American National Standard)
Coursewriter III CAI (Computer Assisted Instruction)
CSMP (Continuous System Modeling Program)
ECAP (Electronic Circuit Analysis Program)
FLOWCHART (Flowchart generator for OS)
FORTRAN IV E, G & H (Formula Translation Language)
GPSS (General Purpose System Simulator)
ICES (Integrated Civil Engineering System)
LISP 1.5 (List Processing Language)
MATLAN (Matrix Language)
MPA (Multiple Precision Arithmetic Package)
MPS (Mathematical Programming System)
NEATER2 (PL/I formatter)
PL/C (Cornell PL/I)
PL/I F (Programming Language I)
RASS (Remote Access Statistical System)
RPG (Report Program Generator)
SPASM (Single Pass Assembler)
SNOBOL4 (String Manipulation Language)
SORT/MERGE (Sorting Language)
TESTRAN (Assembler Debugging Package)
TEXT-360 (Text Processing System)
VSP (Vehicle Scheduling Program)
WATFIV (Waterloo FORTRAN IV)

In addition to the language processors and systems of programs listed above, the library contains a variety of application packages which provide for mathematical analyses, linear programming, simulation, statistical analyses, information retrieval, and structural analysis.

The computer in operation at the Kansas State University Computing Center is an IBM S 360/50. The configuration for the machine is shown in Figure 1. This computer has several associated pieces of peripheral equipment including an Express Terminal and five communication terminals. The Express Terminal, a

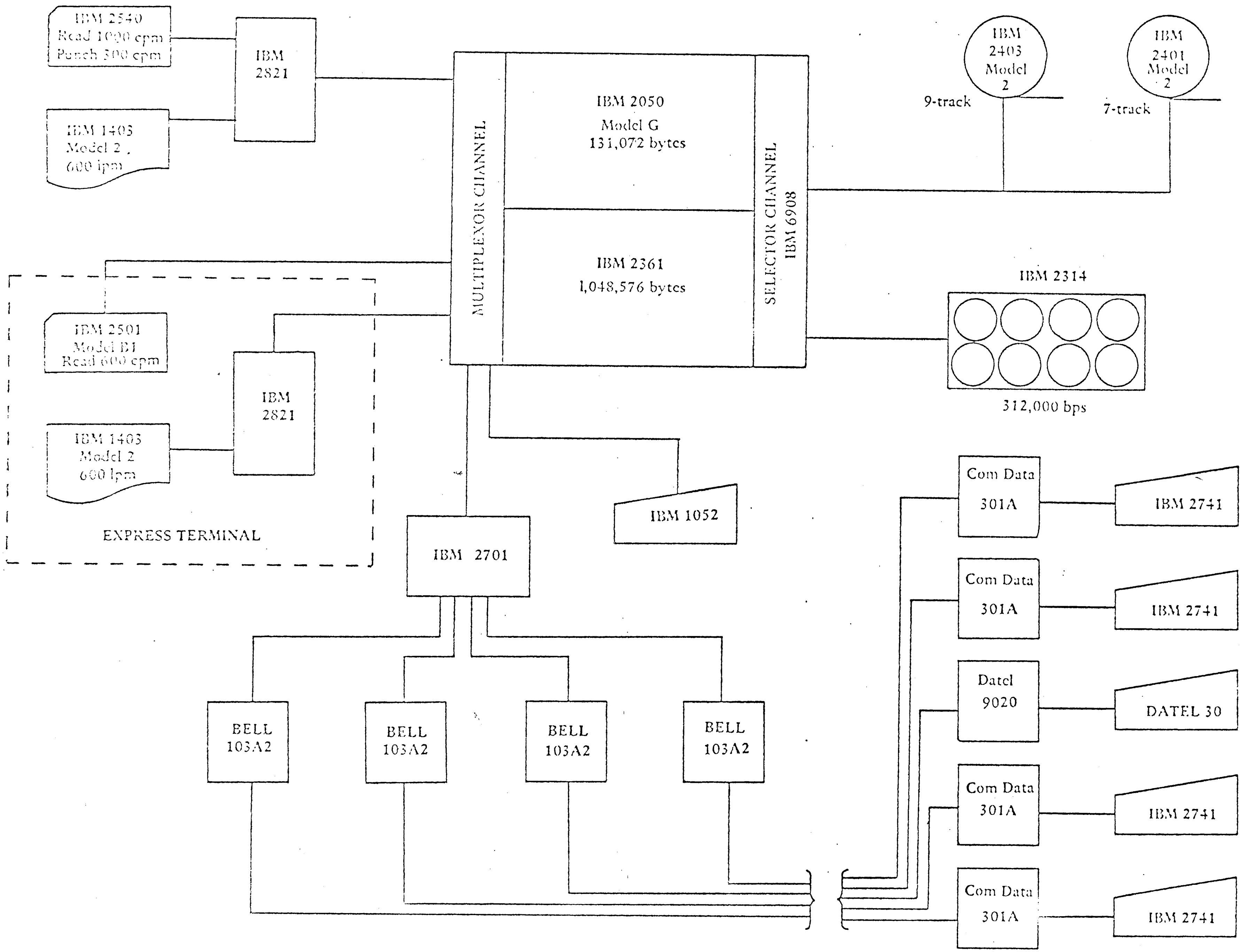

FIGURE 1. COMPUTER HARDWARE CONFIGURATION

self-service batch facility, consists of a six hundred card per minute reader for input and a six hundred line per minute printer for output. It serves one dedicated partition of the IBM S 360/50 and handles PL/C, WATFIV, SPASM, and a utility program to list decks. This facility is available to all users of the Center. The communication terminals include four IBM 2741 devices and one DATEL 30.

The Center maintains eighteen IBM 029 Keypunches, an IBM 059 Card Verifier, an IBM 082 Sorter, an IBM 552 Interpreter, an IBM 407 Accounting Machine, an IBM 514 Reproducing Punch, an IBM 1230 Optical Mark Sense Reader and its associated IBM 534 Punch. Some of these devices are located around the campus for the convenience of users.

Departments that used more than five percent of the total services rendered by the Center in Fiscal Year 1970-1971 are Statistics and Computer Science (18.4%), Industrial Engineering (11.0%), Physics (8.3%), Nuclear Engineering (7.1%), and Chemical Engineering (6.1%). It is estimated that computer science usage was approximately 14% of the total usage. Of this amount 87% was used for instructional purposes and 13% for research.

Future Facility Expansion. The expansion of computing facilities will, in a large part, be determined by the recommendations of the Board of Regents' statewide Computer Advisory Committee and the acceptance and support of the recommendations by the Council of Chief Academic Officers. The general goal for computing as proposed by the Computer Advisory Committe is -

> "to provide contemporary computing resources for the instructional and instructional-support responsibilities for all of the institutions under the governance of the Board of Regents, State of Kansas."

After a general goal is identified, the next step in planning requires the specification of the goal in terms of specific objectives. The objectives of the Computer Advisory Committee are included below:

"One may distinguish between instructional, which is defined as computer use directly related to specific class enrollment, and instructional support, which is the use of the computer in the areas of administration (including the library), research, public service, and computer center.

"The following objectives result from the process of describing the general goals for the two major areas:

A. Instructional Objectives:

1. To provide access to computing facilities for faculty and students for development of computer awareness (introductory courses)

2. To provide access for understanding the use of computing as a tool in all subject areas (instructional use in specific courses for every student level)

3. To provide access for training and teaching of professionals to use or design computers for their particular field (professional training in engineering, business management, pharmacy, medicine, education, law, journalism, etc.)

4. To assist students and faculty who are studying computing as an independent study area (the computer and its related technology as the object of instruction, e.g., computer science)

5. To provide access to adequate computing resources for graduate students in their required theses research projects (specialized and intensive use as a necessary research tool)

B. Instructional Support Objectives:

1. Administrative Objectives:

a. To provide services and facilities for processing information required for recording, reporting, and planning in the efficient operation of an educational institution and all of its related activities.

b. To assist in the design and implementation of compatible data bases and information systems to improve the quality of administrative support for all institutions

c. To Provide information dissemination services from available machine-readable data bases when requested for all institutions

2. Research Objectives:

   a. To provide a high level of service computing which includes the development of generalized and specialized application systems.

   b. To provide consultation and interaction with researchers concerning (a) special purpose computers, (b) research proposals, and (c) special research problems

   c. To provide necessary support for investigation of computer languages and systems, both hardware and software.

3. Public Service Objectives:

   a. To assist educational and governmental groups in areas, within our existing expertise, where service can be provided

   b. To cooperate with other educational institutions, agencies, and consortiums in regard to computing activities

   c. To provide low priority service on a contractual basis for special business and industry projects, when requested, if resources are available.

4. Computer Center Objectives:

   a. To provide computer system software maintenance, backup, and development adequate to serve the needs of the academic community.

   b. To maintain a software library of programs for general use of the computer center customers.

   c. To assist students, faculty, and staff in using the facilities available in the most effective and efficient manner.

The Board of Regents' universities and colleges have operated in an independent structure for computing activities on the campuses. This has resulted primarily from the varying rates of maturity of computer usage on the individual campuses. Federal grants have assisted some of the universities and colleges in obtaining the needed computing power, while other institutions have increased their computing capability through incremental increases in expenditures for instructional usage upon a center designed primarily for the administrative business of the university. Thus, the various institutions have organized their computing activities within a scheme which was most suited for that particular institution."

Department Facility Needs. The department's available computer resources could be determined largely by external sources as pointed out in the foregoing text. However, it is felt that access to virtual machine capability or "hands-on" experience is essential. A mini-computer in the price range of $100,000 is needed within two years to support adequately the hardware and system software design phases of the program. Physical proximity to the Computing Center is recommended and convenient access to data preparation equipment, remote batch terminals and interactive terminals is essential.

BOOKS AND PERIODICALS

Dr. R. Farley, Director of Libraries, made a survey of Farrell Library at KSU in the fall of 1970, for current holdings related to computer science. He used two lists of periodicals as a basis for his evaluation. These lists are:

1. "List of Periodicals Abstracted" Computer Abstracts (London, 1957-)

2. Sections on "Automation, Computers, Data Processing and Operations Research; Documentation" Ulrich's International Periodicals Directory 13th ed., 1969-70)

Updating this evaluation we found that the library has current subscriptions and substantial backfiles of 106 of the 145 journals abstracted on Item 1 and has current subscriptions to 59 of the 192 titles listed on Item 2. See Appendix III-B: Library Resources for a list of active subscriptions to periodicals on the lists mentioned above.

When technology is included, as in Item 1, the library resources are good. Item 2 points up the fact that library holdings in automation tend toward those produced in the United States. There has been little or no interest in the international journals, which are so important in many of the other disciplines. The library has standing orders for most monographs in the English language in computer science.

Due to the reduction of funds with the fiscal year 1971-1972, the Library was forced to terminate subscriptions to 39 periodicals from the two lists mentioned previously. This trend cannot continue without affecting the usefulness of the library to the computer science program. Back files of many of the journals are limited. Because the library lacks funds to purchase back files, Kansas State University depends on the Linda Hall Library in Kansas City and University of Kansas Library for these resources. There are no plans to purchase extensive back files.

The general collection of library books, reference works, and periodicals related to computer science is sound, offering strong support for doctoral research. Good representation is indicated from among pertinent periodicals identified by Computer Abstracts and Ulrich's Directory. It is felt that most of the publications in computer science which are important to a good doctoral and research program are available but steps are being taken to add a few journals. Kansas State University's significant history in technical research assures significant coverage in related areas of computer applications as well. Appendix III-A, Library Resources, provides a list of periodicals which should be added as money becomes available.

TEN YEAR BUDGET

Our present faculty and resources will be expanded during the next ten years (Appendices III-C through III-I) in order to handle our increased student enrollment (Appendix III-E). Since we expect more than five thousand students in the University to take at least one computer science course by 1981 (based on data from Hoyt Tarrant's research report, see Appendix III-E), we will need 30 faculty by that time, and a total budget of $1,103,000.

This million dollar budget is based on certain key assumptions on student enrollment and participation in computer science: 1) all undergraduates will be taking introductory computer science by 1977; 2) by 1981, there will be 30 doctoral candidates, 40 Master's candidates, 300 undergraduate computer science majors and 300 minors in computer science (see Appendix III-E). The other figures are derived from these basic assumptions extrapolating from current statistical data on faculty/student ratios, costs, and resource support.

IV. THE CURRICULUM

1. OBJECTIVES

The chief limitation to the use of electronic digital computers is the lack of highly trained and ingenious people to devise ways to utilize fully the potentialities of existing computers, to create still better ones, and to help educate all levels of society (and our young people in particular) to appreciate and to use these new machines. For this reason higher education in computer science at all levels is critically important today.

With the realization of the potential of the computer has come the development of an academic discipline. While its parameters are yet to be fully understood, an academically sound core of knowledge has been discerned and, to a great degree, agreed upon, by many institutions of higher education offering courses in computer science. The proposed curriculum, known as "Curriculum 68," was originally published by the Communications of the ACM, Volume 11, Number 3, March 1968. The Computer Science Department has fashioned a curriculum consistent with the guidelines outlined in "Curriculum 68."

Currently, the faculty in the department recognizes the need to train majors as well as non-majors. In the future, we fully expect that every student entering college will come to this department for at least one course in computer fundamentals. For those who wish to minor in computer science, we provide a wide range of options in programs of study.

For majors, depending upon the level at which the student is studying, the overall goal of educating students in Computer Science will receive different emphasis. At the undergraduate level the department strives to provide a broad, applied knowledge. The student is encouraged to look to related fields for information which will support his primary interest in computing. For example, a typical undergraduate major is expected to complete the following requirements for a major in this department in addition to the broad, flexible requirements of the College of Arts and Sciences.

MATHEMATICS & STATISTICS		Hours
Calculus I		4
Calculus II		4
Determinants and Matrices		0
or		3
Elements of Applied Linear Algebra		0
Introductory Statistics Course		3
	Total	14

COMPUTER SCIENCE		
Fundamentals of Computer Programming		3
Introduction to Algorithmic Processes		3
Computer Organization and Programming		6
Numerical Analysis		4
Data Structures		3
Programming Languages		3
	Total	22

ELECTIVES	
Two additional courses in Science or Engineering	6
Electives from supporting area(s)	15

It is obvious from this list that the student can select courses from a wide spectrum of subjects.

When the twenty-two hours of computing courses are completed the student will have had two years (four semesters) of studies in high-level languages. In addition, the student will have had one year of assembly language programming which provides a clear understanding of the why and how of computing. Over and above these requirements the department suggests to the student that he also take a business-oriented data processing course to give him additional capabilities in the business world.

The two courses, Numerical Analysis and Data Structures, are designed to provide the student with both new factual information as well as an environment where his knowledge of programming can be used. The remaining course in Programming Languages serves both as a review of features of previously encountered languages, and also as an introduction into other concepts of both formal and actual programming languages.

The student should utilize the twenty-one hours of electives to gain information from departments such as electrical engineering, industrial engineering, mathematics, linguistics, statistics, business and economics, as well as computer science. Hopefully, the courses selected in these departments will contain information pertaining to the application of computers to their areas. Unfortunately, too little joint effort has as yet taken place between this department and others to encourage joint and/or cross-listings as well as elimination of duplicate offerings.

At the Masters level, the emphasis may shift from a broad education to a more narrow area of interest. At this level the requirements stated by the Graduate School stipulate that 18 hours must be taken in a major area of concentration, while 12 are to be taken in a minor area. Depending on the interests of the student and upon the recommendation of the major professor, the student may elect to remain very broad in his scope or begin to concentrate within the department. It is suggested that each Masters level student consider a course from the following specialties of the faculty; simulation, systems and programming languages, artificial intelligence, numerical analysis, and hardware design and construction. However, for the most part, a student will usually complete at least one course

"Identified with Kansas State University

- Machine Languages--Language processors, conversational languages, extensible languages
- Computer Design and Architecture--Computer logic, switching theory
- Programming Systems
- Biological and Ecological Systems Simulation
- Data Organization and Manipulation--File management and data processing, information storage and retrieval, text processing

Areas of Current and Essential Interest to Both Campuses

- Numerical Analysis
- Artificial Intelligence

Identified with the University of Kansas

- Formal Language Theory--Theory of grammars, formal languages, formal semantics
- Natural Languages and Symbol Systems--Computational linguistics, pattern generation in the humanities and fine arts, sound synthesis and analysis
- Automata and Mathematical Logic--Theory of automata, computability, recursive function theory
- Machine Systems
- Information Systems Theory and Design--Analysis of information networks, information acquisition, social implications of information systems"

Currently, the department is formulating the exact requirements for this degree under the general requirements of the Graduate School along with any additional constraints imposed by the joint program. A tentative Ph.D. examination program is currently under development within the department and preliminary conclusions are shown in Appendix IV-A.

In developing courses in this department, as in all other departments the faculty is primarily concerned with development of a coherent curriculum as well as achievement of social awareness. Course offerings (see Appendix IV-B) at all levels are constantly reviewed and changed as situations demand (Appendices IV-C and IV-D outline the undergraduate requirements for a computer science major). One of the most significant forces for change is the change in numbers and interests by people taking courses. The following table presents the enrollments in computing courses through the past 7 school years and projects enrollment for the current year.

Table 1. Enrollment in Computing Courses 1963-1971

Year	63-64	64-65	65-66	66-67	67-68	68-69	69-70	Estimated 70-71
Under-graduate	111	214	367	443	507	831	1424	1800
Graduate	0	0	0	8	81	165	360	420

From this table we view not an unnatural phenomenon, but one which brings an even wider spectrum of requirements and backgrounds to the classes. As a result of increasing enrollment, the department has been able to subdivide the sections of the introductory course with emphasis in science, general and business. Periodically we discuss with other department faculties, using both questionnaires and meetings, the relevancy of our courses to their offerings. Sometimes, however, this has been difficult since such areas as numerical analysis are clearly not assignable to a particular department; even more fundamental is the question of who should teach introductory computer courses, particularly as such courses spread throughout the entire undergraduate student body as envisaged in our projections.

Course modifications, deletions and additions are a natural consequence of faculty growth. In the department, any changes recommended for existing courses are first carefully examined by a faculty subcommittee. The subcommittee's recommendations are then made to the entire department faculty from which any formal changes are forwarded to the administration. Suggestions for new courses are also passed upon by the subcommittee and the department faculty, after which if the majority are in agreement, the course will be offered first semester under a general number. Once the course has been taught in this manner, it is evaluated by the entire departmental faculty and considered for permanent addition as a new course under its own number.

In addition to this review procedure, if the course is proposed at the Ph.D. level then it is also subject to the review of the joint steering committee made up of three members of our faculty and three members of the corresponding department at the University of Kansas. In this way we prevent duplication of effort between the two departments.

In order to recognize and reward excellence in teaching, the Computer Science Department makes available a "Rating Sheet" to every student in every class taught by the department every semester. Each student is asked to rate his instructor on many items using a graduated 5-point scale. In addition, other information pertaining to mannerisms and habits of presentation which may distract from the total teaching environment is requested. These ratings are collected and tallied by the department secretary (without regard to students' names) and are made available to the individual instructors. Currently no overt public recognition of any instructor or instructors based on this rating is made; each instructor interprets and uses (or discards) the results as he desires. As familiarity with the evaluation process grows, we expect to standardize the evaluation and interpretation of the results. In addition, the Rating Sheets will be updated periodically to to reflect changing conditions in the department and in the curriculum. A sample copy of the rating questionnaire is included in Appendix III-A.

The department has no formal procedure for orienting new faculty. However, since the department itself is new (as of July 1971), perhaps this oversight can be excused. In future years we plan to at least provide a small packet of information and a sheet of check-off items to guide the efforts of new members in becoming acquainted with the department, the university, and the myriad rules, regulations, rights, and responsibilities appertaining to joining the faculty.

The members of the Computer Science Department are always on the lookout for people who, because of emminence in their field or other appropriate qualifications, would be an asset to the Department. Actual recruitment, of course, is based on the availability of funds for such an appointment. Recognizing the importance of Computer Science to the University, we anticipate great needs for additional faculty in both the immediate and intermediate futures and will do our best to meet these needs with new faculty of worthy report.

In general, insofar as appointment, retention, and promotion of faculty is concerned, the department follows the policy and procedures established for the University as stated in the <u>Faculty Handbook</u>, Paragraphs III-A through -D, pp. 11-14, (1968 edition).

The role of the faculty in the department is threefold:

1. He should engage in research and investigations which will enhance his own effectiveness as an educator and an authority in his chosen field(s), as evidenced by continuing publication and presentations of the results of his work.

2. He should be successful in imparting his knowledge to students who come to him, and

3. He should participate in university and departmental committees where such participation is beneficial to his own interests and to the interests of the University.

Graduate Teaching Assistants and Graduate Research Assistants are almost indispensable in the Computer Science Department (which has the charter of providing basic instruction and education in the art of computer usage for the entire University campus) in that they shoulder much of the responsibility of providing meaningful instruction and interaction with students that would not be possible for the numerically smaller, higher-rank faculty to provide by itself. Through a designated faculty coordinator, we try to provide guidance and assistance sufficient to ensure continuing high quality of instruction and yet exercise restraint in order that the personality of the individual instructor or graduate assistant not be overshadowed. Periodic meetings are conducted for those instructors teaching different sections of the same course, for example, to ensure that essentially the same material is being covered in all groups, but the method of presentation, etc., is left to the imagination and ingenuity of the individual instructor.

PROFESSIONAL GROWTH

The Computer Science Department feels that ongoing professional growth and development of each faculty member is absolutely necessary if we are to acquire and retain the expertise and knowledge needed to fulfill our responsibilities as educators. To this end, we hope to make provisions for attendance at professional meetings and conferences throughout the year. The local chapter of the ACM, for example, attempts to provide a highly qualified technical speaker at each of its meetings. As Kansas is the heart of the United States, many opportunities for attendance at conferences, etc., are made available each year; we hope to provide (subject to the budget, of course) some funds for such travel.

The course load per faculty member is adjustable to some extent. An individual who prefers teaching above research can assume more than the two courses per semester norm, while one who is heavily engaged in research, especially if partially or fully supported by grants, can arrange to teach fewer than the norm. The basic criteria to be followed in adjusting the teaching/research ratio is usefulness to the university and the department goals.

TEN-YEAR PLAN FOR CURRICULUM

Our ten-year plan for the curriculum in computer science is composed of the following major items:

1. By 1976, all KSU undergraduates should have some exposure to computing. To achieve this, new and improved introductory courses will be developed in our curriculum to meet diversified student needs.

2. Computer science is probably the most rapidly changing scientific field. To keep abreast of the field, the entire curriculum will be subject to continual modification to reflect the current and projected state of the art. In particular, the ACM Curriculum '68 is already obsolete for KSU planning and will be updated in 1972.

3. In the future, various other disciplines will rely more and more on computers and related technology. To satisfy the needs of people in these areas, it is essential for us to develop and offer interdisciplinary service courses in computer science. The first of these courses will appear in 1972.

4. The success of the joint Ph.D. program with the University of Kansas should be realized by 1975 with the graduation of our first Ph.D.'s. To successfully implement this program we need to establish the requirements for the Ph.D., develop graduate level courses in the above designated areas, and formulate innovative policies on the operation of the joint program.

5. Good teaching and relevant courses will continue to be emphasized and improvement encouraged. To recognize and reinforce good teaching, improved and standardized rating questionnaires will be filled out by students. The curriculum will be systematically evaluated together with teaching style and course organization. Longitudinal trend lines will be established by 1981.

6. By 1981, the KSU curriculum in Computer Science will have undergone sufficient evolutionary change to meet the challenge of mass computer utilities for hardware, software, telecommunications, systems management, and diversified information services for specialized users and the general public.

V. STUDENT ACHIEVEMENT

1. Undergraduate Academic Progress

"a. <u>General Service Courses of the Department</u>. Computer science offers three service courses: 1) Introduction to Computer Programming, 2) Introduction to Algorithmic Processes and 3) COBOL.

The beginning course, Introduction to Computer Programming (315), is required of all computer science majors, but it can be seen by our Fall, 1971 enrollment that this course serves a far broader segment of the student body than is represented by computer science majors. More than 40 percent of the students are business majors, who take it because it is required of all business majors. Of the remainder, about half are physical science majors (including mathematics, computer science, and engineering) and half are considered general students from all other disciplines.

The second course, an Introduction to Algorithmic Processes (400), is a second level course which has a number of non-majors who want to learn computer science, but these non-majors are from various disciplines. The third course, COBOL (410) appeals to business majors because it is the language most businesses use for data processing.",

A recent effort to redistribute the students in the beginning course according to interest area, using the three divisions of business, scientific and general, has met with considerable success. Although students sign up for one course and are originally assigned sections without any distinction, we have arranged to offer multiple sections at most times of the day when the course is offered. The availability of special sections is then announced and students are urged (not required) to attend the section most appropriate to their interest area. All sections are assumed to teach the same basic material, the major difference being in the nature of the assignments, which are flavored according to the type of section. Thus most problems in the business section represent accounting and business transactions. The science sections use mathematical and other scientifically oriented assignments. A somewhat greater emphasis upon text processing is found in the general sections.

Rather than present an exhaustive discussion of each service course, we will give some information on a single one. This is the introductory course, numbered 315. Our records show the following enrollment and breakdown by grades:

Table 1

Year	Total Students	A	B	C	D	F	WD	INC	CR	NCR
1970-71	849	194	200	224	73	43	80	15	19	1
1969-70	867	245	227	200	49	39	102	4	1	-

These figures are for two semesters each of this course. In the Fall of 1970 a breakdown study was done by major area for students enrolled in CS 315. This showed the following:

Table 2

Student's Area of Interest	Number Enrolled in CS 315	
Agriculture	21	(6%)
Architecture & Design	13	(4%)
Arts and Sciences (except CS majors)	84	(26%)
Arts and Sciences (CS majors)	29	(9%)
Business Administration	135	(41%)
Education	5	(2%)
Engineering	34	(10%)
Home Economics	5	(2%)
Veterinary Medicine	none	

Several notes might be appended to this data. The high proportion of business majors is attributable to the fact that this course is required for students in all parts of the business curriculum. Indeed, the subsectioning effort mentioned earlier is in large part a response to the special needs of this large group of consumers of this course. The low number of students from engineering is due to the fact that the College of Engineering still maintains a duplicate faculty and course offering in this area. In fact, this duplicate course is required by number in many of the departments of the College of Engineering. It is expected that this situation will be corrected in the not too distant future.

Since an exposition of the grade distributions for courses given by the department is deemed desirable, these are presented below in graphic form. These distributions are all for recent offerings of these courses. Many of these courses have only recently been added to the curriculum. The others, primarily service courses, have inadequate records available due to the recent major transitions which have taken place in the department and the computer science program.

With the exceptions which were noted specifically, the majority of the courses offered by computer science have no appreciable service aspect at this time. There is a small but growing trend, perhaps represented best by two groups, physics majors and electrical engineers, in the direction of taking more courses in computer science

Table 3, indicates the grades given in the undergraduate courses the last two years.

2. Program for Undergraduate Majors

The undergraduate major in Computer Science has existed at Kansas State University for three years. During this period, the program existed under

Table 3

UNDERGRADUATE COURSES

Year	Course	Title	# Student	A	B	C	D	F	WD	INC
1970-71	286 400	INT ALG PRO	152	54	46	16	-	6	22	8
69-70	"	"	141	42	36	32	4	12	12	3
1970-71	286 410	COBOL	63	14	13	10	1	6	13	6
69-70	"	"	85	35	19	12	2	5	12	-
1970-71	286 425	COMP ORG PRO	98	17	18	39	8	4	12	-
69-70	"	"	92	62	10	3	-	11	6	-
1970-71	286 505	MATH COMP I	49	17	15	10	3	-	2	2
1970-71	286 506	MATH COMP II	38	7	8	17	4	2	-	-
1970-71	286 525	INT INF STRN	60	18	14	21	2	1	5	2
69-70	"	"	49	41	7	-	-	1	-	-
1970-71	286 600	DISC STRUCT	9	5	3	1	-	-	-	-
1969-70	286 610	LIST PRO LAN	15	5	4	2	2	-	2	-
1970-71	286 615	COMP LOGIC	6	1	3	2	-	-	-	-
69-70	"	"	14	4	2	6	1	1	-	-
1970-71	286 620	PROG SYST	16	4	3	1	-	-	3	5
69-70	"	"	8	7	-	-	-	1	-	-
1969-70	286 635	NON-NUM PROG	10	-	3	5	1	-	-	1
1970-71	286 640	PROG LANG	5	2	1	-	-	-	2	-
69-70	"	"	5	-	2	2	-	1	-	-
1970-71	286 798	TOPICS CSCI	13	10	1	-	-	-	-	2
69-70	"	"	8	7	-	-	-	-	-	1

the aegis of the Department of Statistics, then known as the Department of Statistics and Computer Science. On July 1, 1971, the Department of Computer Science became a separate operating unit in the university structure. Because of this very special situation, very few records are complete enough to yield accurate and useful statistics concerning the development and achievement of students enrolled in the university as computer science majors. Hence the discussion on these subjects will be highly qualitative in nature.

The growth of the undergraduate major program during these three years has been a satisfying demonstration of the need within the university for such an offering. Table 4 shows the population figures for undergraduate majors in computer science by classification and as a whole.

Table 4

	Freshman	Sophomore	Junior	Senior	Total
1970-71	30	29	43	43	145
1969-70	29	19	27	17	92
1968-69	17	15	20	8	60

(Some of the information in this table is from departmental advising records.)

The data for the academic year 1968-69 is from counseling records in the main office of the College of Arts and Sciences. It is thought that the figures for all three years are taken from major declarations by students during enrollment for the spring semester. These figures are more accurate than data from the fall registration.

One apsect of the change in the computer science program, as reflected in our students, is that many poor engineering students have turned to computer science as a field that appealed to their basic interests, fit in with their capabilities, and seemed less demanding. The same has perhaps been true of students in other fields, such as mathematics and physics. Casual observation of student records will show that in the past more students transferred into computer science with poor records than with good records. Since undergraduates may choose a major field without consultation with the department concerned, we are as helpless to prevent such a flow of students as the university as a whole is helpless in preventing poor but technically qualified (a diploma from a Kansas high school) students from entering. Our answer, and one which is showing increasing effectiveness, is the same as the university's. By maintaining high enough standards to assure a good education, we can match the influx with an outflow of students, who either fail and are dismissed or gravitate to fields more suited to their abilities. Recent marked upgradings of our courses are accomplishing this goal.

A major and intensive area of concern among the faculty in this department has been to provide adequate professional guidance for its undergraduate majors. Implementation of this goal takes several forms. First, emphasis in courses is placed wherever possible on developing good habits, in the sense of practices which are favored in a commercial environment, among students. Of particular importance here is the documentation of programs and of pre-program systems analysis work. To this end an informal committee of three faculty members has been working on a set of documentation standards which, it is hoped, will be adopted throughout the departmental course offerings. Second, members of the department maintain active contact with the non-university community of computer science workers and users by means of individual professional and consulting contacts and by talking with employment interviewers visiting the campus. This is done in order to ascertain on a continuing basis the employment needs of this non-university group in the area of computer science. It is the intention of the department to remain sensitive to these needs and consider them in our continuing efforts to improve the undergraduate curriculum. That we have been initially successful is indicated by the apparent ability of our new Bachelor's degree holders to obtain jobs in computing or related areas. While no exact statistics are available, data obtained by interviewing faculty members seems to indicate a placement success rate of about 80 to 90 percent.

3. Undergraduate Non-Academic Performance

There can be little doubt that the computer science students themselves are enthusiastic about the program. In the spring of 1971 a student chapter of the Association for Computing Machinery was formed at Kansas State University. At this time, which is before the expected influx of memberships for the fall semester, the chapter contains about 20 members, about one-half of whom are undergraduates, with a high percentage of these being active and contributing to the growth and goals of the chapter. In the few short months of its existence the chapter has accomplished the following.

- Organized a highly productive meeting between students and faculty in the department for the purpose of discussing goals and means of obtaining them, settling grievances, and generally establishing paths of communication between these groups. More of these meetings are contemplated in the future.
- Sponsored a series of faculty and student talks on topics of professional interest at their monthly meetings. These have been well attended.
- Drawn an ACM national lecturer to the campus. The Association for Computing Machinery each year supports a group of men with national reputations in some area of interest to computing so that they may tour the country discussing recent advances in their area of competence.

Thus obtaining the services of one of these speakers is equivalent to obtaining a small grant.

- Also started a strong effort to attract more membership. Members of the chapter maintained a booth at the Fall Student Activities Carnival this year which featured one of the school's time-sharing terminals and arranged to have it used by the general public. The Activities Carnival is an event held early each academic year to apprise persons new to the campus of the various club and other extracurricular activities open to them.

Undergraduate computer science majors also have a normal interest in extracurricular activities, and through this, contribute their share to an important part of the university community. The undergraduates of this department are active in fraternity and sorority organizations, work in campus theatre productions, and participate in intramural sports. Some of them contribute along more professional lines by tutoring, both with and without pay, in computer science areas, and by holding computer science related jobs on campus.

> "Thus there are many indications that the undergraduate major programs in computer science at Kansas State University are successful. Our students are vigorous and viable, in both the commercial and scholastic sense. Furthermore the present faculty is dedicated to maintaining this success, and to improving the program to the limit of our resources."

4. Graduate Academic Achievement

At present, the Department of Computer Science has 27 graduate students, two of whom have attained the Master's degree in computer science and 25 who are working toward that degree. Many of these students are seeking admission into the Ph.D. program. Since the program was granted to the department in July of this year, the department has yet to formalize the candidacy requirements and therefore has not formally accepted any students as candidates.

Currently seven graduate students hold graduate teaching assistantships in the department. One student holds a graduate research assistantship in another department doing computer research. Five graduate students hold computer related jobs with the University, most of them at the Computing Center. Four others are supporting themselves in graduate school with computer-related part-time jobs.

Table 5 indicates the graduate grade distribution in computer science courses for the last two years except in those cases in which the course was not offered both years.

5. Graduate Professional Achievement

As has been mentioned, seven graduate students are presently engaged in teaching computer science courses as graduate teaching assistants. Five are teaching two sections each (3 hours of lecture per week per section) of the introductory programming course and one graduate student is teaching one section of the introductory course and the one section of COBOL, a second level course. One student is teaching two sections (3 hours each) of the third level course, Computer Organization and Programming (425). In all cases the instructors are given considerable freedom to organize and handle the course as they see fit with a minimum of direction. Coordination through group meetings, directed by one of the faculty, is achieved with decisions made by the group. We feel that these students are gaining invaluable training and job experience that will help them in determining their careers. Academically the experience promotes better work habits on the part of the instructors due to the emphasis they must place on certain types of performance in their students.

Table 5

GRADUATE COURSES

Year	Course	Title	# Student	A	B	C	D	F	WD	INC
1970-71	286 400	INT ALG PRO	2	2	-	-	-	-	-	-
1970-71	286 410	COBOL	3	1	2	-	-	-	-	-
69-70	"	"	6	4	1	1	-	-	-	-
1970-71	286 425	COMP ORG PRO	12	4	4	3	-	-	-	1
69-70	"	"	8	3	3	1	-	-	1	-
1970-71	286 506	MATH COMP II	3	2	-	1	-	-	-	-
1970-71	286 525	INT INF STRN	4	2	1	1	-	-	-	-
69-70	"	"	4	3	1	-	-	-	-	-
1970-71	286 600	DISC STRUCT	11	6	2	2	-	-	-	1
1969-70	286 610	LIST PRO LAN	10	7	3	-	-	-	-	-
1970-71	286 615	COMP LOGIC	13	8	2	3	-	-	-	-
69-70	"	"	6	5	1	-	-	-	-	-
1970-71	286 620	PROG SYST	12	4	-	-	-	-	2	6
69-70	"	"	6	6	-	-	-	-	-	-
1969-70	286 635	NON-NUM PROG	7	5	2	-	-	-	-	-
1970-71	286 640	PROG LANG	10	5	2	-	-	-	1	2
69-70	"	"	11	4	3	-	-	1	1	2
1970-71	286 810	COMP SIM	15	15	-	-	-	-	-	-
1970-71	286 811	SIMULATION	8	6	1	-	-	-	-	1
1970-71	286 815	SP TOP CS	2	1	-	-	-	-	-	1

5. Graduate Alumni Performance

The first Master of Science degree in Computer Science was awarded in 1969. Since then, fifteen additional Master of Science degrees have been awarded. The feedback received from the alumni indicates that they all found employment in the area of computer science without difficulty.

Approximately 80 percent of the alumni referred to above are presently employed by industrial organizations and the Federal Government. These include aerospace, defense and business. The remaining graduates are working toward the Ph.D. degree in Computer Science.

6. Student Achievement: The Next Decade

During the ten-year span from 1971 to 1981, the department will grow considerably both in the number of computer science majors and in the number of students taking the service courses but not majoring in computer science. Figure 1 shows the anticipated growth of the major groups. Furthermore, the range of backgrounds of the students taking service courses will come from a broader range of backgrounds.

Comprehensive and centralized records of the students in computer science are, for some categories of students, lacking. More complete individual records plus certain summaries or profiles will be kept and updated at regular intervals. Along with this move for more formalized record keeping, a more uniform and thorough acceptance procedure, preferably using such standard information as the graduate record exam, will be instituted for graduate school admissions. Figure 2 shows the anticipated timetable for the achievement of these goals.

For all students, the Computer Science Department objectives divide into four main areas: get good students initially; keep them once we have them; produce a high quality product in the end, and finally, aid the student in

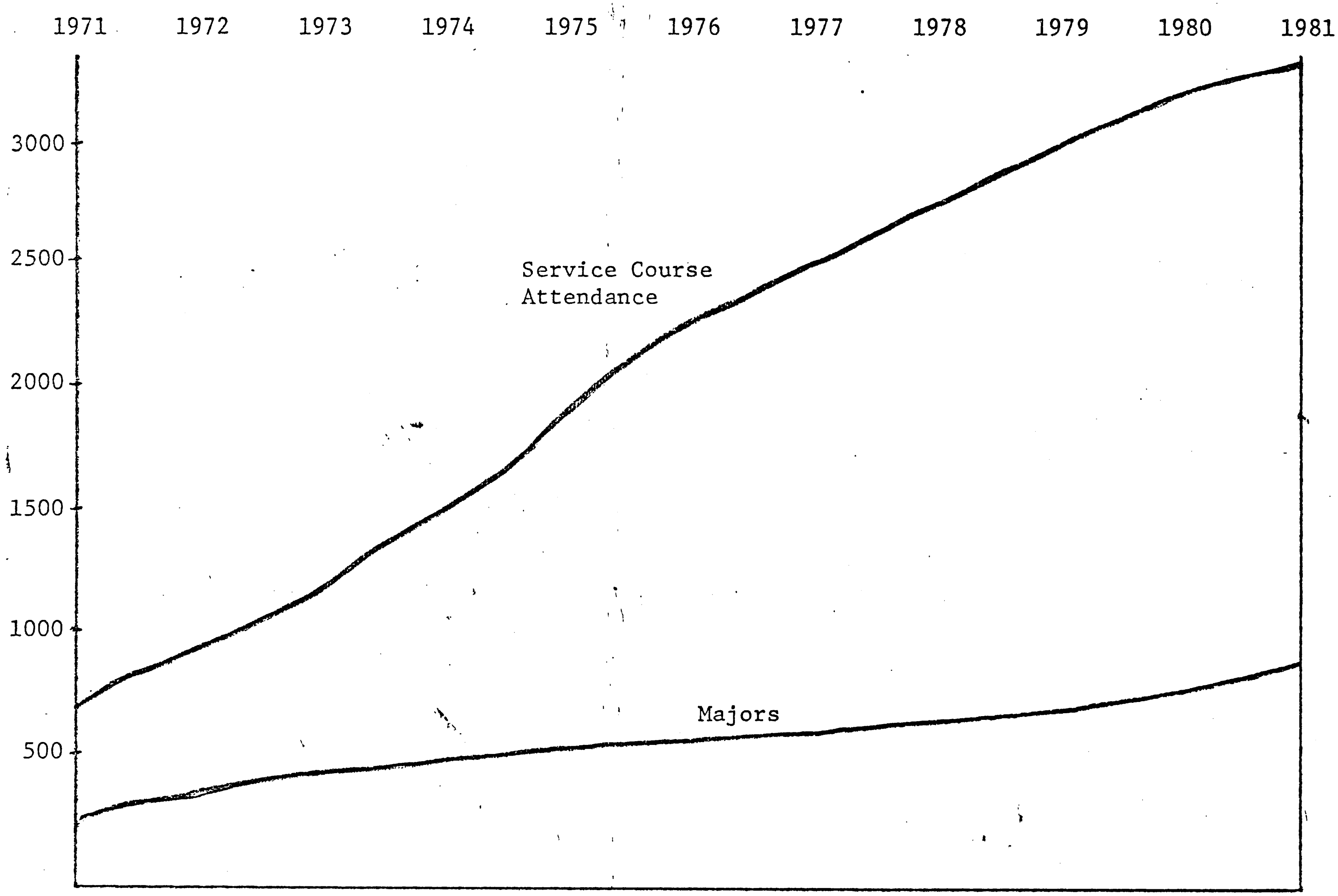

Figure 1. Anticipated Enrollment Changes

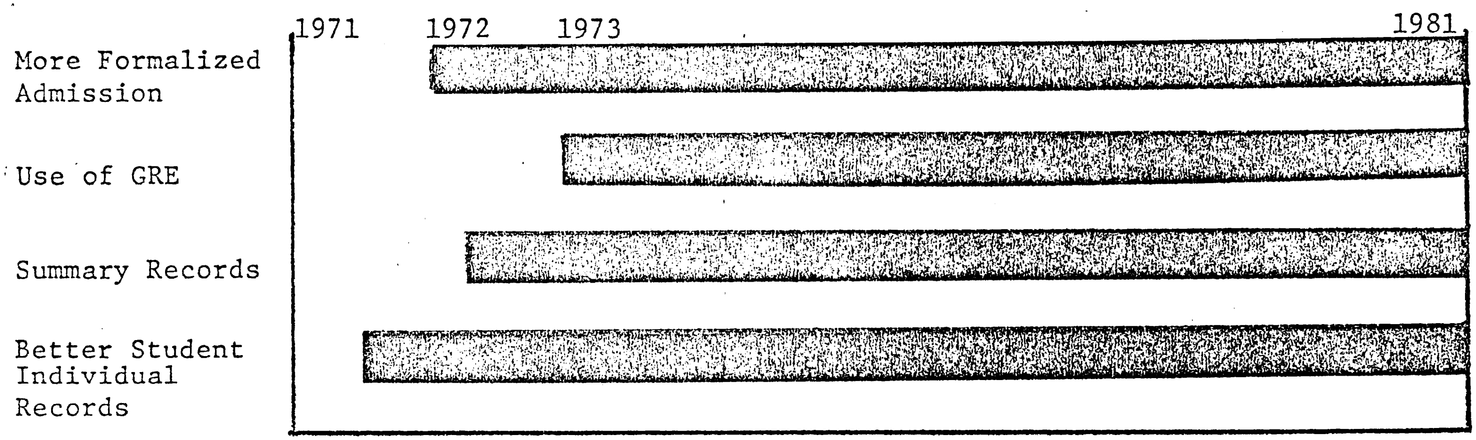

Figure 2. Chronology of Record Keeping Improvements

placement into a good job or into a good graduate school as he finishes his work at Kansas State University.

Attracting good undergraduates seems to be a difficult proposition. Traditionally, few academic departments make any effort to recruit undergraduate majors. The liberal admissions policy necessitated by this University's position at a state school means that many of our incoming students are academically poor. Perhaps the best way to ensure that the undergraduate program has a high percentage of quality students is through rigorous grading.

The implementation required to keep a good student and that required to turn a good student into a good computer scientist are very similar. It is much easier to learn in a course that is relevant, well taught, and part of a cohesive body of instruction. A student who learns, provided he learns the right material, is in the process of becoming an outstanding graduate. He should have available special projects on a resident mini-computer, which would be relatively inexpensive to establish and maintain. The other major effort toward these goals should be a continued insistence by the whole department upon good teaching by both faculty and graduate teaching assistants (see Part III, Faculty and Resources.

Just as there was a strong overlap between the second and third main objectives, there is one between the third and fourth. Since we want to maintain the relevance of courses to the outside world, we should communicate as much as possible with computer science users in industry and government, and students should be encouraged to seek summer positions outside the university.

Not only their temporary jobs, but also their permanent jobs after leaving our department, are indicators of our program's success. We will ask alumni how well our program has prepared them to achieve job success and job satisfaction.

from each of the five areas with the other course being taken in his area of interest.

In addition to course requirements, the student may elect to complete a publishable paper, a thesis, a report, or a course option. The department interprets this first option to mean that the student and his major professor will produce a technical paper to be submitted for publication listing the student as principal author. This option encourages both the faculty member and the student to engage in scholarly work which introduces current research into the department without all the formalities associated with a thesis.

Finally, at the Ph.D. level the primary objective is to produce a creative leader who is capable of contributing to the growth of knowledge in computer science by teaching, by engaging actively in research, or by excellence in applying computers to the problems of the world. Our goal at this level is to provide the student with tools capable of supporting his curiosity as it leads him into new areas. At this level it is expected that the faculty members associated with the student will provide him with the opportunity for self-direction in a rewarding research area.

The Ph.D. program is a joint program between Kansas State University and the University of Kansas. The primary purpose of this joint program is so that the students, will have, to some degree, the benefits to be derived from the faculties and curriculums of both universities. At the Ph.D. level the research activity, as well as the curriculum are divided between the two universities as described in Section II, Goals, and the following quote from the proposal for the joint Ph.D. program. The tentative nature of this division should be noted; the passage of time will undoubtedly serve to strengthen the bond of cooperation between the two universities.