A BROADENING OF MISSION

The Development of a Technological University

A Background Paper

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Case Study

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I. NEWARK COLLEGE OF ENGINEERING - AN OVERVIEW

Since its founding ninety years ago, Newark College of Engineering has served the citizens and industry of New Jersey by providing a technical education appropriate to the time. Originally established to strengthen the background of technicians in the burgeoning industry of the Newark area, the College has grown until it now offers a broad spectrum of programs ranging from technician training to doctoral study in engineering. The oldest institution of higher education in Newark, the College is located only a short distance from the site of its founding, just west of the central business district.

A. The College and the City

As the largest city in New Jersey and the largest suburb of New York City (10 miles east), Newark today is an extreme example of the problems and the challenges of modern urban America. After a long period of decline, the city shows some signs of recovery, as evidenced by substantial public and private construction and a better moral tone in government.

The College is located in an area in transition. Originally a prosperous neighborhood of light industry and housing, the area gradually decayed into a depressed part of the city. Urban renewal has provided new public and private housing as well as sites for four publicly-financed colleges. In the last decade, Newark College of Engineering has expanded into a 20 acre campus, and the Newark Colleges of Rutgers, the State University, have developed an adjacent campus. Within a short walk, campuses are under construction for Essex County College and the College of Medicine and Dentistry of New Jersey in Newark. Located in the midst of the NCE-Rutgers campuses is Central High School, serving the central residential area of the city. In the years ahead, the four colleges are expected to grow into a cooperative "center of learning," thus providing an economic and social impetus to their environment.

B. The Student Body

As a low-cost public institution, the College has traditionally attracted undergraduate students from working class families who are moving up the socio-economic ladder. Parents of the students typically have not attended college. The College has long served first or second generation Americans, although reduction in immigration has made this pattern less evident. The student body is approximately 66 percent Roman Catholic, 24 percent Protestant, 5 percent Jewish.

As available housing deteriorated or was demolished in the 1950's, and as the ethnic composition of Newark changed, a greater fraction of students began to come from the suburbs. Only about 3 percent of the student body is black. Women constitute about 2 1/2 percent. These figures are typical of enrollments in engineering colleges.

Nearly all students commute to the College from their homes in North Jersey. A small number of students live in apartments or fraternity houses near campus. Foreign student enrollment has been increasing, especially at the graduate level, but the percentage is still small.

Engineering students have been somewhat conservative politically and socially, but in recent years the College's student body has begun to demonstrate political and social awareness in common with students at other colleges. (Styles of dress and hair, for example, have altered radically in recent years.) The College's first student strike occurred after Kent State in the Spring of 1970. The faculty responded by suspending classes for two days, after which the College returned to a state of near normalcy.

Day students are involved in a wide range of extra-curricular activities, including intramural and varsity athletics. These activities range from a productive theatre club to a nationally ranking soccer team. Evening undergraduate and graduate students are usually older and employed full-time in industry; they participate very little in the extra-curricular life of the College.

The student enrollment for the Fall 1971 semester reflects the diverse technical programs offered:

Day Undergraduate (Nearly all full-time)	2897
Evening Undergraduate (Part-time)	955
Graduate (Including about 135 full-time)	851
Division of Technology (Part-time evening technician training)	705
Continuing Engineering Studies (Various non-credit short courses)	550

In common with engineering colleges across the country, NCE suffered a significant drop in freshmen enrollment in the Fall of 1971. This development is attributed partly to adverse publicity concerning job opportunities in engineering and partly to changing attitudes within the college-bound generation.

C. The Faculty

Because the College has traditionally offered only engineering-oriented programs, the faculty in all departments has focused its attention on the education of engineering students. The typical engineering curriculum indicates substantial components in humanities, social science, and physical science, as well as in engineering. As a result, the number of faculty in each of these areas is large. Faculty growth in the last ten years reflects expansion of the student body:

	1961	1971
Chemical Engineering	10	13
Chemistry	15	20
Civil and Environmental Engineering	8	26*
Computer Science	-	7
Electrical Engineering	25	36
Humanities	17	36
Industrial and Management Engineering	12	15
Mathematics	17	36
Mechanical Engineering	17	40**
Organizational and Social Science	13	15
Physics	32	29
Total	166	273

* Includes 6 persons in applied mechanics, part of the physics staff in 1961.
**Includes 7 persons in engineering graphics, a separate department in 1961.

In addition to these full-time faculty members, there are a number of part-time staff and graduate teaching fellows.

During the last decade, a major effort was made to recruit staff with the doctorate to support the developing graduate and research programs. At the present time, 50 percent of staff have the doctorate, and 25 percent are pursuing the degree.

The College recognizes the importance of having its engineering and science faculty maintain contact with industrial practice. Academic year and summer consulting is encouraged. The industrial complex of North Jersey makes considerable consulting available.

The faculty commutes to the College from all parts of North Jersey. A sizeable number live in New York City. A few live in Newark.

D. Educational Programs

The College offers undergraduate degrees in six fields: chemical, civil, electrical, industrial, and mechanical engineering, and in engineering science. The last includes options in several fields, including chemistry, computer science, mathematics, physics, and pre-medicine. A new evening program leading to the degree of Bachelor of Technology began in the Fall of 1971.

The undergraduate engineering programs are typical of the highly structured curriculums offered in American engineering colleges. They are all accredited by the Engineers Council for Professional Development. The newer engineering science curriculum offers more elective flexibility and will first be offered for ECPD accreditation in 1972.

About 50 percent of full-time students complete the B.S. in 4 years; another 10 percent take 5 years or longer; the remainder drop out or transfer to other colleges. The part-time evening program can be completed in 8 years, although many students take longer.

At the graduate level, M.S. degrees are offered in the six fields listed above, and in management engineering. Doctoral degrees are available in chemical, civil, electrical, and mechanical engineering. Most graduate courses are offered in the evening, although a few day courses have been established in the last few years.

The Division of Technology offers part-time evening certificate programs of 3 years duration in a variety of technical fields. These programs are taught by part-time adjunct staff.

The Division of Continuing Engineering Studies offers a variety of technical and management short courses, ranging from "Numerical Control of Machine Tools" to "Executive Development."

E. A Technological University

There is no generally accepted model for a technological university. Although a number of technically-oriented institutions use the term in describing themselves, each adjusts the model to fit its own patterns and aspirations. Typically, the technological university offers a broad range of undergraduate and graduate degrees centered around a strong engineering program, but extending into fields beyond engineering. NCE's model, which is still being defined, will focus on technical programs, including engineering, science and technology, and hopefully extending into related professional areas, such as architecture and industrial administration.

The College has already begun to evolve into a technological university. The initial development and continued diversification of its graduate and research programs may be regarded as a first step. The broadening of undergraduate offerings into non-engineering fields is a second step, still in progress.

As a prelude to further evolution, the College must define its role among the complex of public colleges in Newark -- and within a developing Master Plan for Higher Education in New Jersey.

Development as a technological university will require a re-examination of the College's services to the city, the region, and the state -- to the citizens, business and industry, and government.

The College's planning and governance will face the challenges of change in the years immediately ahead.

II. DIVERSIFICATION OF ACADEMIC PROGRAMS

NCE has developed over a period of fifty years from a college with a limited number of undergraduate engineering programs into an institution involved in an expanding array of technologically-oriented curriculums, from certificate programs through the doctorate. In the course of this transition the scope of academic work has broadened and become more sophisticated. New fields of academic concern in engineering and non-engineering fields have opened up and have led to changes in old departments and to the creation of new ones.

In its diversification of programs, the College must be careful to avoid duplication of effort with other public institutions. It would, for example, be inappropriate to develop undergraduate degrees in the liberal arts, since these are available at most other public institutions. On the other hand, it would seem quite appropriate to develop new degrees in architecture and industrial administration, since there is no conflict in these areas at present.

The growing system of 2-year county colleges in New Jersey is relieving some of the pressures for college enrollment. Although Rutgers and the State liberal arts colleges have not been able to accept all qualified county college graduates, NCE has made a special effort to accept all students qualified for its programs. However, the number has not been large. Through an increased diversification of programs, NCE hopes to provide a variety of opportunities for transfer students from county colleges. The new Bachelor of Technology degree is an example of a program specifically designed to articulate with the county colleges.

The very significant Master Plan for Higher Education in New Jersey (whose genesis and ramifications are discussed in detail on Pages 27-44) recognizes the special role that NCE will play in the State system. The College must continue to emphasize to State planners that its role will be broader than it has been in the past, as it diversifies its programs in its development as a technological university.

The recent decline in freshman engineering enrollments emphasizes the sense of urgency NCE has to diversify its academic offerings in order to attract a larger fraction of the college-bound population of New Jersey.

A. Undergraduate Programs

Between World Wars I and II, the College became an undergraduate engineering institution offering degrees in the four traditional disciplines of chemical, civil, electrical and mechanical engineering. Shortly thereafter, management engineering was added, first as an option within mechanical engineering and later as a department of industrial engineering in its own right.

As the quantity and sophistication of scientific and mathematical content have developed over the years, some engineering schools have moved toward a five-year integrated B.S.--M.S. program, with heavy concentration on the scientific--mathematical basics at the undergraduate level, and with coverage of the practical engineering disciplines at the graduate level.

At NCE, all evidence has indicated that the majority of the College's students look forward to entering the job market with the completion of the bachelor's degree, a fact which has prevented the College from implementing the five-year program concept. Only recently has a substantial minority of undergraduates shown an interest in continuing their education as full-time graduate students. This group has grown from an insignificant fraction fifteen years ago to about 25 percent today.

In the last decade, it became increasingly evident that some students who were scientifically and mathematically oriented were not interested in any of the traditional undergraduate programs. In 1967, in response to their interests and as part of a pattern of diversification, a curriculum leading to the B.S. in engineering science was approved. This is a highly flexible curriculum permitting concentration in the areas of physics, mathematics, chemistry and computer

science with at least a minimum prescribed content of engineering courses. It has proved to be a popular program, as was foreseen by the engineering departments, and has constituted a source of some internal friction.

One of the most popular options in engineering science has been the computer science program. The pattern of emergence of the new department to meet a growth of interest at both the undergraduate and graduate levels in a new field is described in the section titled "The Computer Science Department," beginning on Page 18.

In a quite different direction, there has been discussion over the years within the American Society for Engineering Education and elsewhere concerning the need for new approaches to the humanities and social sciences. NCE has had an interesting record in this area dating back to the early 1920's, essentially due to the educational philosophy of Dr. Allan R. Cullimore, the institution's second head and first president, who stressed what he called "the engineer's duty as a citizen." This long-standing concern relative to the College's curriculum has led to the successive transformations that have by now resulted in NCE's Department of Organizational and Social Sciences. This development is also described more fully in a later section, beginning on Page 16.

The general problem of assessing the technological future and its effect on education is a perplexing one and one not likely to be solved by a single formulation. As a step in matching what seems to be one set of manpower needs to the aspirations and capabilities of one group of students, a Bachelor of Technology program has been introduced -- the College's first degree program specifically for the education of technologists. This, too, is described in a later section. (See Pages 22-26).

The College is now investigating further patterns of diversification and flexibility, within the context of the B.S., in engineering-related fields (possibly a B.S. in general engineering or an interdisciplinary B.S.). The objective of these

studies is to establish as many pathways as possible to match today's growth in different career objectives.

B. Graduate Programs

Interest in graduate work evolved with increasing intensity in the late 40's and into the 50's and 60's. Because graduate work before World War II was not a part of the expectation pattern of the typical engineer, there was little in the way of a tradition of graduate engineering instruction. With the first jump in demand for such education, largely stimulated by the G.I. Bill, NCE began to prepare such programs.

1. The Master's Degree

The first graduate courses were offered in conjunction with an existing master's program at Stevens Institute of Technology, which awarded the degrees. In spite of some early attempts to organize a program of full-time graduate study, graduate students were essentially all part-time evening students until well into the 60's. By 1954, the range of offerings at the College was sufficient to sustain its own degree programs, and the College was authorized to award the master's degree in chemical, civil, electrical and mechanical engineering.

The role of the master's degree in engineering has been cast somewhere in the gray area between an academic disciplinary orientation on the one hand and a professionally-directed program emphasizing practice on the other. While there are ways in which these two directions may be handled simultaneously, there is sufficient divergence to cause some academic concern. There are questions of departmental direction (particularly in smaller departments), of different kinds of students (the student, for example, with the doctorate as a goal versus the practicing engineer who wants a terminal master's degree directly related to his work), and of the need for very different kinds of faculty skills for the two

directions. These have been background questions during the development of the graduate program and will continue to be important in the new fields that will mark NCE's emergence as a technological university.

In the first years, graduate work was largely an extension into new areas that were not covered in the undergraduate curriculum in the same field or in the supporting academic fields, particularly mathematics. As undergraduate curriculum patterns changed, many of the engineering science subject areas "moved down" from the graduate to the undergraduate level.

A persistent problem, which still continues, is that of handling students from a variety of undergraduate schools where the patterns and the rates of such curriculum change vary.

It also gradually became apparent that the model of a student proceeding from a B.S. in an engineering field to an M.S. in the same field was not one that included all potential students. There has been a persistent interest among some in moving to other technically related fields after the B.S. This has come to include students with undergraduate work in the sciences, and more recently in the social sciences, whose interests fall under the technological umbrella. Movement toward these cross-disciplinary patterns seems to be accelerating and probably will continue to do so in the period ahead.

NCE's initial response to this need was the institution of the so-called undesignated M.S., as distinguished from the designated degree (e.g. M.S. in E.E.). The M.S. at first was intended for a student changing from his undergraduate field to another engineering field at the graduate level, or for a science student moving into graduate engineering work.

Later, the undesignated M.S. came to cover students wishing to major in the engineering sciences (applied mathematics, physics, chemistry, and later computer science), which marked the first steps at the graduate level toward that broadening of interests beyond engineering that characterizes the technological university.

Multi-interest fields in which broadening of function into the social and life sciences is involved have seen some program development or the beginnings of planning which can be expected to result in new programs. These include urban systems, environmental science, public administration, and bio-medical engineering.

2. The Doctorate

In 1960, authorization was granted for the awarding of the degree of Doctor of Engineering Science. Although the authorization permitted either a design or research orientation, in practice it has become a research degree. With respect to the master's degree, the doctorate has provided an important pressure toward maintaining an analytically-oriented disciplinary core within the various graduate programs. It has also served as the springboard for the development of a full-time graduate student group who currently number about 15 percent of all graduate degree students.

Even within the constraints of this traditional type of doctoral program, patterns which cross departmental lines are visible. For example, centers of strength and interest on the part of faculty and students in the area of applied mechanics exist in both civil and mechanical engineering. As interest and competence develop in such new areas as urban, environmental and transportation problems, long-standing departmental lines will probably be further strained.

The doctoral program carried with it a commitment to the support of research and to the growth of a research-oriented faculty. To support research, the College, with the assistance of industrial leaders, has formed a Foundation for the Advancement of Graduate Study in Engineering. The size of the doctoral program (which now includes the chemical, civil, electrical and mechanical departments) is relatively small, with fewer than ten degrees a year and about one-half million dollars a year in research support. However, its effect on faculty, particularly younger faculty, in the science and engineering departments has been profound.

With perhaps one or two exceptions, no new faculty without the doctorate have been hired in these departments in recent years.

3. The Professional Degree

Some engineering educators argue that the research-oriented doctorate fails in some ways to meet the needs of the design-oriented engineer. In addition the doctoral residency requirement makes it almost impossible for mature individuals with outside responsibilities to continue formal education beyond the master's degree. A post M.S. program leading to the professional degree (e.g. Chemical Engineer) designed for the experienced practicing engineer was instituted some years ago. It has been authorized in the four departments which offer the doctorate. The program has achieved very limited acceptance and enrollments have been quite small. It is difficult to predict the future of this program at the present time.

4. Future Developments

Many questions pose themselves in attempting to assess the future of the graduate program. A central question relates to the viability of a small doctoral program in a national situation of apparent oversupply of doctorates. Another concerns the development of appropriate patterns of faculty and degree organization with increasing emphasis on interdisciplinary work and in areas with concentration in the social sciences. In order to deal with these and related matters, an in-depth study of the College's graduate programs has been organized. The committee engaged in the study has a mandate to recommend broad changes in the content and organization of the graduate curriculums in-so-far as they are needed to determine a meaningful future role for the graduate program.

Another important question that must be examined is the developing national trend toward the M.S. as the first professional degree in engineering. Although the B.S. may continue as an acceptable entry point into the profession, it is

becoming clear that the M.S. will be a necessary prerequisite for work in the more sophisticated engineering fields.

C. Specific Illustrations

The processes of change and the problems associated with the College's transition are complex and a detailed account of all new developments is beyond the scope of a presentation such as this. In order to illustrate the processes, there follow three examples of the trends and changes which have been described:

"The Evolution of the Social Sciences": The development of an existing department in a field outside of technology;

"The Computer Science Department": The emergence of a new department in a new scientific discipline;

"The Bachelor of Technology Program": The introduction of a degree program that is a distinct departure from the existing engineering curriculums.

1. Evolution of the Social Sciences

In common with all accredited engineering colleges, NCE allocates a substantial percentage of its engineering curriculums to the humanities and social sciences. Approximately one quarter of the undergraduate program is devoted to these areas. Although originally regarded as part of the general education of the engineer, the social sciences are now becoming recognized as fundamental to the profession of engineering itself. The Chairman of the College's Department of Civil and Environmental Engineering recently suggested that the social sciences are as fundamental to the education of his students as are mathematics and the physical sciences. This more central, professional role for the social sciences is the latest development in a long tradition of "Education for Engineering and Citizenship"* at Newark College of Engineering.

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*The College's motto.

a. Early Patterns

Much of the early emphasis on human behavior in NCE's curriculums focused on the engineer's role in industry. A half century ago, shortly after the College began offering bachelor's degrees, the new President, Allan R. Cullimore, established a cooperative work-study program that emphasized an understanding of human relations as well as technical matters. Later, industrially-oriented courses in human relations became a part of the curriculum, and in 1941 a Department of Personnel Relations was organized. Its direction was set by an early chairman, Lillian M. Gilbreth,* working closely with Dr. Cullimore.

By the mid-40's the department's mission stated that "in addition to a thorough training in the foundations of the natural sciences and their applications to engineering problems, the engineer must have a knowledge of those phases of the social sciences which directly and indirectly affect his professional work." Industrially-oriented courses in psychology, sociology and history were introduced.

The emphasis on the professional development of the student for his role as an engineer in industry continued until the early 1960's, when the department (then called Professional Development and Industrial Relations) began moving toward a more general discipline-oriented approach to the social sciences. By 1968, a new curriculum introduced a core of basic social science courses, while consolidating the earlier traditional approaches into a single required course in management practices, treated from a behavioral point of view. This modification recognized the changing role of the social sciences and also responded to comments of an ECPD accreditation report.

General education requirements for all undergraduates, established in 1968, include sophomore courses in economics and a social science elective, and senior courses in management practices and contemporary issues.

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*A renowned pioneer in industrial engineering, probably best known as the mother in Cheaper by the Dozen.

b. Changes in Response to a Changing Environment

The "PDIR" department subsequently moved toward a more discipline-oriented approach to the social sciences, as evidenced by its changes of name, in 1964, to Industrial Relations, and, in 1970, to Organizational and Social Sciences. It has broadened its course offerings and for the first time is offering graduate courses and is cooperating in the development of graduate programs.

Having de-emphasized its role in the professional development of engineering students, the department is evolving a new professional relationship with the engineering programs as a discipline fundamental to the practice of the profession. At the same time, the department is on the threshold of developing programs of its own, related to the application of social science in a technological society.

Because of their close relationship to the growing interface between engineering and human problems, the departments of Civil and Environmental Engineering and of Industrial and Management Engineering have recognized the need for close interaction with the Department of Organizational and Social Sciences.

It was for IME that OSS first taught graduate courses in a variety of fields, ranging from "Psychology in Engineering" to "Contemporary Collective Bargaining." More recently, the two departments have cooperated in extending an existing M.S. program in management engineering to include options in Management of Research, Development, and Design; Management of Manpower Policies; and Management of Public and Regulated Agencies.

With CEE, OSS has developed an M.S. program in urban systems, for which it has initiated courses in "Urban Social Structure," "Econometrics," and "Economic Analysis of Urban Areas." This fall, the two departments added a joint staff member in planning.

In cooperation with the Dean of the Graduate Division, the department has initiated discussions with the Rutgers-Newark Graduate School of Business regarding

the establishment of an M.S. program in public administration.

At the undergraduate level, the department is offering several courses for the new Bachelor of Technology program. In addition, it has added a number of electives, including courses in "Municipal Government" and in "Behavioral Science," the first OSS offerings to be designated technical electives by an engineering department.

Working with IME, the department is investigating the possibility of offering a program leading to a Bachelor of Industrial Administration to serve a student population distinctly different from that currently attracted to the College.

As its course offerings have expanded, OSS has added staff with academic background and experience in such new fields as urban economics, public administration, and behavioral science.

c. Progress, Promise, and Problems

Although the Department of Organizational and Social Sciences has made great progress since its inception, and although it shows considerable promise for the future, it is not without its problems. The department is of relatively long tradition at NCE, but has in its successive manifestations until recently provided a limited service function to the engineering departments. Some engineering faculty -- and some students -- doubted the effectiveness of the department in its earlier mission of sensitizing students to the engineer's role in industry. Some of this negative attitude among faculty has carried over to the present, even though the department's courses and faculty have changed radically. Not all the engineering faculty yet understand the new role the department can play. Few engineering departments have acknowledged the central importance of the social sciences in engineering. Although OSS has cooperated successfully with two

science students) instant turn-around is provided for solution of classroom computer problems.

c. The Department at Present

Thus far, even in the present restricted job market, the computer science department has not felt a decrease in the demand for its course offerings at either the B.S. or M.S. level. In fact, a surprisingly large percentage of incoming freshmen (The Class of 1975) have indicated an interest in majoring in computer science.

At the undergraduate level, the department offers courses in programming, logic, numerical analysis, operating systems, computer organization and simulation. Students in computer science earn a B.S. in Engineering Science, which means that they have a strong minor in an engineering field. For most of the students the minor is either in industrial or electrical engineering. This arrangement is fairly satisfactory, but there are the usual curriculum difficulties about what is taught where, and whether the industrial minors should not know at least something about (electrical) computer structure. The broad diversity of academic disciplines which falls within the field of computer science, in other words, leads to problems of field definition.

The graduate curriculum, on the other hand, is complicated in at least two further ways. One is the split which is experienced in most engineering school graduate divisions between the academically-oriented and the professionally-oriented student, both of whom must often be taught in the same class. The second and even more divisive dimension of student grouping arises from the fact that a large number of the graduate students have obtained their bachelor's degrees in engineering fields and wish to broaden themselves with a degree in computer science. Teaching such students in the same course with graduates of a full B.S. computer science program is very difficult.

engineering departments in the development of new courses and programs, it is still a junior partner; the degrees are awarded by the engineering departments.

To develop new programs less related to engineering and to attract a different student population, OSS must overcome the College's long-standing image of offering only engineering degrees. Externally, this image affects the attitude of the other Newark colleges and the State Department of Higher Education. In order to function effectively in the Newark college complex and in the State system of higher education, NCE must communicate its competence in the areas of social science.

2. The Computer Science Department

This description of the development of a new academic department is meant to sketch the kinds of pressures and demands, both within the college and from outside, which cause a whole new field of study based on a fresh technological development to emerge. The digital computer, in this case, was the prime mover.

A brief history of the department is included, along with an overview of the development of the departmental undergraduate and graduate programs. Some of the current problems being faced by the department are noted, and a final comment outlines its plans and expectations.

a. Initial Interest in Computers

In 1961 NCE, with the help of a National Science Foundation grant, acquired an IBM 1620 (Model 1) computer. In preparation for the computer and during the first few years it was on campus, non-credit courses in programming were given to faculty members and students on a volunteer basis.

Some of the students, sophomores at the time, wrote a "load-and-go" Fortran compiler which was enthusiastically received by IBM 1620 users across the country. Several of these early students have since gone on to graduate work in computer science.

For some time after the 1620 appeared at NCE it was considered essentially a tool for use in the various engineering courses. No formal courses were offered in the field of computer science per se, but several engineering departments began to offer applications-oriented programming courses. Within the traditional engineering courses not a great deal of computer work was included. Many other colleges and universities at that time experienced a similar lag in the introduction of computer applications, as witness the numerous conferences sponsored by NSF, IEEE, The Ford Foundation and others to encourage the use of computers in engineering education.

In response to a growing recognition of the importance of the computer in the engineering fields, a required computer programming course for all sophomores was approved in 1965. Before its introduction a year later, faculty from the various engineering departments prepared themselves to teach the course. The course was taught for the first years by teachers assigned from the engineering departments with resulting problems of supervision and coordination.

At about the same time that the sophomore programming course was evolving, several graduate courses were introduced in the areas of computer languages and numerical analysis. These were offered within the mathematics department. It was clear quite early that the work in the computer languages area was far from the mainstream of the interest of the mathematics faculty. Student interest, however, continued to develop and by 1967 graduate work in logic and automata was introduced.

As the research interests of faculty and students developed during the mid-1960's, computer use expanded. Before the College had moved beyond the IBM 1620, provision was made for buying time on larger computers and a time-sharing tie-in was installed to a large commercial computer. The added use of computers and the increase in the sophistication of the problems being dealt with led to growth of a staff of people who were capable of rendering technical assistance to those

working on the problems. Among them were people with the ability to teach some of the graduate work described above.

b. Establishment of a Computer Science Department

The combination of undergraduate and graduate teaching needs and the growing academic research interests led to a decision in 1968 to establish a Computer Science Department. The staff available at the time was numerically far short of what would have been needed to meet the departmental responsibilities as they then existed, not to speak of projected growth. Establishment of a department, however, was felt to be indispensible to attracting the needed staff. By the fall of 1968 a departmental chairman had been appointed and the staff consisted of two full professors and two instructors.

Under the leadership of the newly appointed chairman, faculty development has continued, student interest has grown dramatically and course offerings have increased. At the time of this writing (Fall 1971) the introductory programming course (now a freshman course) is totally supervised by computer science departmental staff. In addition there is a computer science option within the engineering science undergraduate program and a computer science major within the engineering science M.S. program. The current catalogs list nine undergraduate and eleven graduate courses offered by the department. All the courses are heavily subscribed. The staff has grown to two full professors, two associate professors and three assistant professors. In addition, graduate assistants are used for instruction in the freshman course.

Computer capability has grown consistently, although always somewhat behind demand. The major equipment is now an RCA System 3 computer with time-sharing capability via teletypes at various campus locations. The computer center operates on a two shift basis and on Saturdays. Access for qualified users is arranged at other times. With the use of load-and-go Fortran (again written by our computer

d. Future Developments

Across the country the evolution of computer science departments, almost none of which bear that name any longer, is in the various directions of "information science" or "systems science" or "management information systems."

These developments are in the air at NCE as well and the programs of many of our students, both graduate and undergraduate, are following these trends. There is a strong interest in systems analysis, operations research, mathematical programming, automatic control, administrative uses of computers and so on. NCE's students for the most part lean toward the practical use of computer science in applications. They are not primarily interested in continuing on to the doctorate.

It seems clear that a change of direction, perhaps a broadening of the curriculum into the area of systems science (although that term is never easy to define) should be NCE's next step. Such a step would require a close and willing cooperation among the various engineering departments. Already, however, problems of jurisdiction between departments have begun to develop and are currently being aggravated by declining enrollments in some of the departments.

Certainly, the "computer science problem" will not go away and will have to be solved in a positive manner in the very near future.

3. The Bachelor of Technology Degree

Having moved toward the science end of the technological spectrum in the 1960's, the College is now moving toward the technical side of the spectrum with the development of the Bachelor of Technology degree. The degree is a significant departure from recent patterns, and yet it adheres to the earlier tradition of the College, which originated as a school for technicians.

In the last decade, baccalaureate programs in technology have been initiated at many institutions across the United States. In June 1970, 4,105 persons

received a bachelor's degree in industrial or engineering technology. In New Jersey on that date, no students were enrolled in programs leading to such a degree, although several institutions had programs in the planning stage. NCE's program, which began this past September (1971), was the first in a public institution to be approved in the state. (Fairleigh Dickinson, a private university, initiated a similar program in September of 1970.)

a. The Role of the Technologist

The engineering technician, who has traditionally worked in a supporting role to the engineer, has not until recently had a formal education beyond the Associate degree. During the last decade, however, a strong national trend toward further education became evident. The increasing complexity of technological problems required a substantially higher level of education for engineers in industry, and engineering curriculums thus have become more thoroughly based in mathematics and science. Since the more routine work of the engineer has always been delegated to the technician, the latter now finds himself in need of further education to cope with his new assignments. This trend toward a more advanced education at both levels has led to the establishment of bachelor's programs in technology and to a new occupational identity, the technologist.

The technologist represents a distinctly new level of specialization, interposed between the earlier technician, who still serves a useful function, and the more sophisticated kind of engineer being graduated today. The technologist works closely with the engineer and the technician in the solution of technological problems. It has been said that the 4-year technologist resembles the engineer of two generations ago in his practical approach to the solution of everyday problems. This is an oversimplification of today's situation, because the technologist has many newer techniques at his disposal, but it does help to clarify the role that the technologist fills in industry.

b. Development of the Proposal

For many years the College's Division of Technology has offered part-time evening programs of three years' duration leading to certificates in various fields of engineering technology. This program stops short of an Associate degree, but students do occasionally transfer to a county college or a technical institute to complete the formal degree.

In 1969 the President of the College appointed a committee of the faculty and administration to review the role of the division. The possibility of offering an Associate degree was explored but was discarded because the state's developing county college system could more appropriately fill this need. The committee then studied the feasibility of instituting a bachelor of technology program to provide persons holding an Associate degree in engineering technology with an opportunity for further education.

A Technology Committee, including faculty members from each of the five engineering departments, with the director of the Division of Technology as Chairman, began to investigate such programs at other schools and to consider the possibility of developing a baccalaureate program at NCE. Concluding that a Bachelor of Technology was both feasible and desirable, the committee recommended its adoption to the Committee on Curriculum in the spring of 1970. The Committee on Curriculum endorsed the proposal, and the necessary teaching positions were incorporated into the College's 1971-72 asking budget.

Three options appeared to be initially appropriate -- in the electrical, industrial, and mechanical areas. The faculties of the three engineering departments concerned were thus asked to review the proposed program.

A majority of the faculties of the three departments supported the new program, with some misgivings, because of a certain unfamiliarity with the technologist concept and because it appeared to some at least to imply a lowering of

the College's standards. Over the summer of 1970 a detailed proposal was prepared by the Dean of Engineering and the staff of the Division of Technology. Based on the original faculty committee proposal, it also included sections on need for the program, and administration of it. To resolve problems of articulation, the administrative staff also visited several county colleges where the program was met with enthusiasm.

Discussions in the fall of 1970 brought out several faculty concerns. Some felt that the program would merely produce "second class" engineers who might be confused with the College's regular graduates. Others were concerned about being asked to teach these "second class" courses to the possible detriment of their professional standing. Some suggested that the new program might compete for students who would otherwise elect to take the regular program.

In terms of administration, there was concern about the relationship of the new program to the existing academic departments. It had been proposed that a faculty committee chaired by a new assistant dean be placed in charge of the curriculum. The faculty wanted assurance that existing departments would have responsibility for preparing courses and selecting teaching staffs, working with the assistant dean and the faculty committee. They also wanted assurance that no one would be forced to teach in the new program.

Eventually, after considerable discussion, the proposed new program received the formal approval of the Faculty as a whole. Faculty approval made it possible to proceed with submission of the proposal to the College's Board of Trustees and finally to the State Board of Higher Education for action. The State Board approved the proposal and authorized the degree without question.

c. The Approved Program

As finally approved, the Bachelor of Technology program consists of the last two years of a four year course of study. The first two years are provided by

county colleges and technical institutes in their existing and developing associate degree programs in engineering technology. The program is initially being offered in the evening on a part-time basis; a full-time day program is presently being considered. An administrator with the rank of Assistant Dean supervises the program.

With the exception of a few humanities and social science electives, all courses in the technology program differ from those offered to engineering undergraduates. The technology courses often cover material similar to that found in engineering courses, but the approach is less mathematical and more applications-oriented. The purpose of the courses is to demonstrate application of engineering principles to the solution of practical industrial problems.

The program also includes several courses in industrial management, since it is expected that many graduates will hold supervisory positions.

III. THE NEWARK COLLEGE COMPLEX

A. Introductory Remarks

This section describes and evaluates the relationship of Newark College of Engineering with the three other institutions of higher education in Newark. NCE is under intense pressure to cooperate with its sister institutions for a number of reasons. Their close proximity to each other makes cooperation, in a physical sense, easily possible. An interdependence born of new interdisciplinary approaches to higher learning provides another reason. The economics of shared costs and facilities presents another. For these and other reasons, all of the colleges are being urged by the office of the Chancellor of Higher Education in New Jersey to develop meaningful understandings and programs as quickly as possible.

The essential problem has been that until this past August no one in the State knew what the ground rules or frame of reference for such cooperation would be. Now, however, guideposts for cooperation are being established and some definite progress can be expected during the present academic year and in the years to follow. It is impossible to predict with any accuracy the ultimate form that this cooperation will take, because of New Jersey's involvement in the developing master plan, already referred to, for all higher education, public and private, whose ramifications are many and whose eventual specifications will affect Newark's institutions in presently unforeseen ways.

Essentially, however, the four institutions to be described are in two relationships at once: each is changing internally in pursuit of its own individual destiny as an institution and each is seeking valid means of cooperating with the others. Internal and external change within this context is responsible for much of the difficulty so far encountered in establishing the kind and degree of cooperation required.

At present the situation, in terms of State governance, is as follows, as

reported in the NEWARK STAR-LEDGER For August 7, 1971:

> "The State Board of Higher Education yesterday adopted a plan to create a university center in Newark, the state's largest city.
>
> "The action establishes what is expected to become New Jersey's largest and most diversified center for higher education, with an enrollment potential of more than 30,000 students.
>
> "The center will be created from the four existing institutions within the city -- Rutgers University in Newark, Newark College of Engineering, the New Jersey College of Medicine and Dentistry and Essex County College -- plus any additional institutions these four schools may jointly create.
>
> "Each institution will retain its separate identity within the university center, although future planning and development, as well as actual merger of programs, will be supervised and coordinated by a central planning agency -- the Council for Higher Education in Newark (CHEN).
>
> "In adopting the action, recommended by a special two-member committee of the higher education panel, the state board also urged 'immediate implementation' of the office of Coordinator of Higher Education in Newark.
>
> "This new post would be directly responsible to the boards of the four institutions and, indirectly, to the state board.
>
> "The action culminates years of planning, behind-the-scenes persuasion and discarding of alternatives, one of which included the direct administrative merger of the four schools.
>
> "However, this plan calls for the academic and facility integration of the institutions, while actual administrative policy will be dictated by the governing boards of the individual institutions."

In actual fact, the four institutions have been cooperating on a rather informal basis since 1968, as will be indicated in some detail later in this presentation.

B. Identification of the Institutions Involved

Of the four institutions in Newark, NCE is the oldest, having grown out of a city-state venture in 1881. The College itself was instituted in 1919 as a devel-

opment of the original Newark Technical School. Major support now comes from the State, since Newark can make only a token appropriation each year.

The Newark Colleges of Rutgers-The State University (R-N) were originally a conglomerate of institutions, mostly proprietary, which became the University of Newark. In 1946 the University of Newark merged with Rutgers University. Rutgers-Newark maintains five day colleges: Arts and Sciences, Graduate Business, Law, Nursing, and Pharmacy, as well as divisions of three other late afternoon and evening units: Education, University College, and University Extension Division. It also houses sections of the Graduate School (Arts and Sciences) and the Graduate Schools of Social Work and of Library Service.

The College of Medicine & Dentistry (CMD) was incorporated in 1954 as the Seton Hall College of Medicine and Dentistry. It became a State school in 1965. In 1966 a major portion of its clinical and research programs in medicine was moved from Jersey City Medical Center to Martland Hospital in Newark. It recently merged with the medical school at Rutgers, New Brunswick and is now known formally as the College of Medicine and Dentistry of New Jersey in Newark. Interim facilities for instruction and administration were completed in the summer of 1969. Degrees offered include M.D., D.D.M., and Ph.D.; M.S. degrees are offered in anatomy, biochemistry and a number of other fields.

Essex County College (ECC) was created under a relatively new county college law. It has been supported by Essex County and the State since students were first admitted in 1968. The College offers transfer programs conferring A.A. or A.S. degrees and 2-year A.A.S. degree programs in occupational fields. The College is located temporarily in a 12-story building in the downtown area, but plans are under way for the erection of a megastructure closer to the other three institutions, on land that has already been acquired.

C. The Climate for Cooperation

At present, the four institutions are academically evolving and physically underdeveloped. With regard to evolution, NCE has stated its mission of developing toward a technological university; R-N seeks to continue development of its graduate and professional offerings, particularly, with emphasis on the applied fields; ECC and CMD are relatively new institutions. In regard to physical development, again it must be pointed out that ECC and CMD are in their earliest stages and carry on in temporary facilities; NCE has reached the capacity of its present campus; and, the R-N facilities are presently not only imcomplete but also reflective of an imbalance. With regard to facilities and a drawing together of the institutions there is at present a lack of adequate parking and living facilities.

Curiously enough, each of the four institutions has a somewhat different relationship to the State, some of which will be obvious from the very brief discussion of their separate histories outlined above. The creation of the State Board and Department of Higher Education has seemed to offer both opportunities and problems. The opportunities would be the encouragement and support of cooperation and coordination among the institutions, and support, both of expertise and funds, for programs at all levels. There is hope that the master plan for higher education in New Jersey, which is perhaps at present the chief mission of the State Board and Department, will be a workable one.

From the point of view of the institutions, certain disadvantages which might arise from the existence of the Board and Department must be pointed out. There are dangers -- perhaps already apparent -- of bureaucratization and excessive control. There is also the problem of lack of encouragement, or more concretely, lack of financial support for new endeavors. The gravest danger at this writing is that the all-important master plan might be ill-conceived. There is already some evidence of a questionable base for State planning and a lack of consultation

with practitioners and, therefore, master plan proposals which do not reflect available education-academic expertise. Representatives of the institutions of higher education in the State, including the four colleges in Newark, feel that a basic fault of the current master plan draft is that it was created and presented for public discussion by department staff without seeking prior advice from those upon whom the responsibility for its implementation will fall.

D. The Situation in Newark

The factors that involve successful cooperation among Newark's four public institutions of higher education are many and complex. One of the paradoxes of their various relationships is that often a factor can be both an asset and a liability.

By far the most influential factor in Newark's situation is the difficult mix of white, suburban, relatively affluent members of the educational and business communities who invade the City each morning and leave each evening and the real population of Newark, poor for the most part, predominantly black and Puerto Rican, whose situation is in sharp contrast to that of the first group.

The daily tensions of life in Newark under these circumstances affect the educational institutions in various ways: vast numbers of students in northern New Jersey need the educational advantages Newark offers, yet there are serious problems of security, City services such as parking and housing, and transport congestion. The four institutions face these problems both separately and together with respect, for example, to security, adequate parking and dormitory facilities.

As a paradoxical element, the northern New Jersey industrial complex, with Newark as its hub, can also be thought of as a vast economic, social and political laboratory, whose very problems are an exciting stimulus to education in the

social and political sciences; in engineering applications such as housing, transit and urban renewal; in public health and a number of other fields.

Once this major element in the educational life of Newark is recognized, the assets, real and potential, begin to outweigh the liabilities. NCE and Newark-Rutgers, each with a quite new campus of about twenty acres face-to-face across High Street, have a growing number of excellent facilities with which to work.

Essex County College and the College of Medicine & Dentistry, already described, will within the next few years expand into their own new campuses. Thus the future, at least in terms of physical plant, is assured, although even here it must be admitted that the situation would appear far brighter if there were any real solution over the horizon for the lack of parking and dormitory facilities.

The future of public higher education in Newark is inextricably caught up in the future of the total State higher educational system. It is well known that New Jersey has lagged far behind the rest of the nation in its commitment to higher education. In recent years, the State has been working hard to catch up with reality. It has done this by expanding present facilities, by stimulating the growth of the 2-year county college system, by building a number of whole new four-year institutions -- by finding seats, in other words, for the hordes of college-bound students who until now have had to go outside New Jersey for an education.

New Jersey is thus achieving quantity, but in the process is coming dangerously close to sacrificing quality. Whether the State can really invest in Newark as the great center of learning it envisions is, today, one of the most troublesome questions of all.

If the Legislature should decide to authorize State support of New Jersey's private colleges according to proposals recently advanced, a further thinning down of fiscal support for the public colleges would be one of the inevitable results.

E. The Development of CHEN to Date

Given all the above factors, it seemed almost inevitable that these four separate institutions with their four different missions, academically evolving, physically underdeveloped, with certain assets and certain liabilities, thrown together "by a set of curious chances" into geographic proximity and at the same time becoming parts of a new State system for higher education, should seek a way, jointly, to make the best of their situations.

In May of 1968 the State Board of Higher Education passed a resolution authorizing establishment of coordinating committees of presidents of public higher education units where they are in proximity. In the preceding February, the four colleges in Newark had already formed such an association on their own initiative but with the blessing of the Chancellor of Higher Education.

To date CHEN has dealt with problems largely on an upper-administrative level. The group is organized through an Operating Committee of Presidents and a few other selected administrators which meets at least monthly. The State Department is invited to be represented at all meetings. Policy matters are presented to the Boards of the individual institutions. A number of task forces have been established, which may be conveniently subdivided into basic categories indicating special areas in which CHEN feels it can operate effectively at its present stage of development. The following are the established task forces which have operated with varying degrees of success since their creation. They are listed by major category and are largely self explanatory:

1. Operating, Planning, Information -

    a. Planning, including the Model Cities Project
    b. Parking
    c. Legislator Information Sessions
    d. Response to "Wolfe-Baker" Committee. (This was the ad hoc sub-committee of the State Board set up to study higher education in the City of Newark.)
    e. Joint Facility Planning
    f. Joint Faculty Appointments
    g. Housing
    h. Common Calendar and Schedule Survey

2. Academic and Career Programs -

   a. Allied Health
   b. Nursing
   c. Physiotherapy Career
   d. 3-year undergraduate - 3-year medical degree
   e. Clinical Pharmacy Internship
   f. Extension and Continuing Education

3. Instruction and Institutional Resources -

   a. Library and Audio-Visual
   b. Computer Study
   c. Animal Farm
   d. NSF Chemistry Project
   e. Social Work Cooperation

4. Students -

   a. Disadvantaged Students
   b. Relations with Central High School
   c. 2-year transfers to 4-year units

5. Services -

   a. Student Health
   b. Day Care
   c. Faculty Club

Several far-reaching projects have occupied CHEN during the 1970-71 period. The most taxing, perhaps, was that associated with the investigations and final recommendations of the Wolfe-Baker committee. As indicated earlier, that study has been completed and the committee's recommendations approved.

Another major activity has been the organization of information sessions at Newark for members of the New Jersey legislature. These have taken the form of presentations on behalf of each of the four colleges and of CHEN itself, by the presidents or their representatives.

During the year, application was made jointly by CHEN and the Newark Housing Authority for a HEW-HUD grant under the Model Cities Program to finance planning for the general four-college area -- that is those areas on the periphery of the four colleges. Earlier, using funds contributed by the Sloan Foundation, the group had contracted with the architectural firm of Haines, Lundberg, and Waehler

for a proposal in this area. The division of regional and community planning of that firm recently produced its report on this study entitled: "Proposed Program for the Joint Community-Higher Education Planning and Development Processes in Newark, New Jersey."

Two other major studies have been completed during the 1970-71 period including a parking study for R-N and NCE by E. A. Barton and Associates. Another is a study of the best method for handling computer services for the four colleges. The latter was supported by funds from the State Department of Higher Education. At the time of this writing both the parking and computer reports are still under study for possible implementation.

F. Real Accomplishments Thus Far

CHEN is limited in its ability to do concrete things because of the uncertainty of its permanence and support. A request was put in the budget for funds to support a full-time administrator and the appointment has recently been made. The group has until now been limited to those considerations which could be accomplished within the time available to top administrators who normally operate on a policy level. Examples are:

1. Intercollegiate Registration. The programs presently include registrations between NCE and R-N. Among the courses taken by NCE students at Rutgers are biology, physiology and anatomy -- important to those planning to do graduate work in biomedical engineering or who are pre-med majors. Other students are taking courses of personal interest, such as foreign languages, philosophy, urban sociology, and literature. R-N students, on the other hand, are studying computer programming and special mathematics and engineering courses at NCE.
2. Transfer Procedures. NCE and R-N have worked closely with ECC to facilitate the transfer of qualified students from the 2-year to the senior institutions.

3. Library Cooperation. A committee of the four units' libraries holds periodic meetings. At present actual cooperation is limited to inter-library loans and use.
4. Joint Faculty Appointments. To date a R-N sociology professor has been given a joint appointment at CMD and an NCE faculty member has lectured at CMD. Other possibilities are under study.

G. The Future

Present thinking among representatives to CHEN favors the development of a consortium. This assumes -- as seems reasonable at this time -- that the State will not insist upon an actual merger of two or more of the presently existing institutions. With this idea in mind and without regard, for now, to the precise administrative setup for such a consortium, the following areas would certainly be among those receiving top priority (the order is not necessarily significant):

1. Expansion of Intercollegiate Registration. In addition to the encouragement of greater use of this idea along lines already established, the whole concept should be expanded to cover a number of interdisciplinary programs presently under consideration. Fundamental to current CHEN thinking is the concept that the major function as educational institutions is to provide the maximum number of "paths for students". There are currently limited paths inter-institutionally. The main thrust for the future must be aimed at providing greater opportunities for movement to assist students, properly guided, in following programs of interest and value to them. In this sense, then, all other cooperative efforts are merely peripheral to the goal of maximum opportunities for our chief constituency, the students.
2. Increased Laddering Opportunities. Closely related to "1" above is the whole question of programs fitted to one another. The primary example

is the articulation necessary for transfer programs from 2-year to 4-year institutions, but there are other laddering paths that must be articulated as well.

3. Interdisciplinary Programs. Related to "1" and "2" above is the proliferation of programs designed to utilize the specialized staff and facilities of the four institutions. These could be called "program paths" as opposed to "student paths". Two programs which the four colleges hope very much are in their immediate futures are a College of Allied Health and an Architectural School. If recommended by a State Committee, the latter could be based at NCE.

4. Faculty Interchange and Joint Appointment. The student and program paths all suggest additional areas in which such cooperative arrangements might be considered.

5. Materials Interchange. At present the four libraries have arrangements only for inter-use and inter-loan. If funding is received, it would be possible to institute a union catalog and an information retrieval system. At a later time these efforts could be extended to joint acquisition. When the facilities of Essex County College are built, joint audio-visual processing should also be a possibility.

6. Joint Facilities. There are some facilities which could be built as a joint effort and these possibilities are under study by committees of CHEN. Two obvious examples are in the areas of parking and living facilities. Closely related are the possibilities for sharing of services such as in student health and computer facilities. The Chancellor has recently indicated to R-N and ECC, both of which are interested in physical educational facilities, that no new construction will be permitted until a thorough examination has been made of all needs within that sphere in Newark.

7. Planning. It has already been demonstrated that joint planning can be effectively carried out either by the four-college staff or through outside consultants. Much more needs to be done in this important area.
8. Coordination of Graduate Programs. The draft of Phase II of the Master Plan, published in January, 1971, was devoted in large part to a plan for graduate programs in New Jersey. Recommendations relating to graduate programs in Newark called for a graduate university of New Jersey to be headed by a Vice Chancellor. Prior to the dissemination of Phase II, CHEN had already proposed its own suggested organization of graduate study in Newark in terms of a Graduate Advisory Council. While this proposal allows for participation by others, it applies primarily to the four colleges -- and particularly, of course, the three which offer graduate programs. All four institutions in Newark -- indeed, virtually all institutions of higher education in New Jersey -- were in agreement that the so-called "graduate university" plan was unworkable and undesirable. The plan was therefore dropped in favor of the advisory council approach.

In speculating on any future plan of action, one of the major obstacles is that the present state of affairs within the Newark Complex tells very little about the attitudes of the real cooperators. This makes it very difficult to identify what actual problems must be approached if the efforts at cooperation are to be successful. The main task seems to be to determine some facts about the possibilities for development in certain categories or "pathways" for cooperation and/or movement among our various constituencies. With this background in mind, a brief consideration of each of three broad categories follows, with some tentative thoughts about means of future cooperation.

H. Student Pathways

There are many avenues through which NCE students could become more involved

with students at the other institutions in Newark. These "paths" range from joint social activities to increased cross registrations and combined academic programs. Each of these would greatly increase the contact of NCE students with students at the other institutions. There are three other colleges to be considered, but because of the nature of Essex County College and the College of Medicine and Dentistry, it is not likely that greatly increased student contacts can be expected there. The focus for the future, then, will probably be on interrelationships between students at NCE and those at Rutgers-Newark.

It is probable that cooperation among students will be easily achieved. Students generally seem to view suggestions of cooperation as related to their area of primary concern -- that is to say, social interrelationships. The administrative point of view, on the other hand, will probably reflect a concern for academic programs and the means for facilitating them. Both attitudes are most important for the future of cooperative efforts.

This coming together of student populations will probably be enhanced by the fact that the studies at Rutgers-Newark are tending more toward the applied science areas and the technological studies at NCE are becoming more socially and humanistically oriented. At what point these two worlds become sufficiently alike to make a student in one feel not only comfortable but accepted in the classes of the other remains a matter of pure speculation. It is at this point, however, that joint academic programs and cross registrations will become most feasible from a "student pathways" point of view.

I. Faculty and Program Pathways

It has been sagely said that a faculty person may be defined as one who thinks otherwise. If this is true within disciplines and within institutions, how much more must it be evident with regard to inter-institutional issues! If one adds to disciplinary ridigity and the exclusivity of specialization the factors of

institutional snobbery and various forms of personal and professional insecurity, among other things, it becomes readily apparent that faculty are not going to accept cooperation as a way of life without some very intriguing academic rewards, realistic assurances of good motives and/or convincing threats.

Preliminary investigations have revealed little contact among faculty at the various institutions except in certain research areas. Indeed, it appears that the greatest possibilities for the development of cooperative efforts lie in the areas of research and graduate study.

Whatever the area of study under consideration, there are the questions in each case of: who offers what?; who should offer what?; who is interested in what?; can he be accommodated?; and, what administrative procedures are to be followed?. None of these is a simple question, but one can easily speculate that they must be faced and answered in the future not just in the interest of cooperation but also as a sine qua non for the continued development of these two institutions in Newark as autonomous units. Returning to the original point, then, with regard to the issue at hand faculty must be convinced of the wisdom of thinking cooperatively rather than otherwise.

With the developing new curriculums at the College, some former service departments are becoming in a sense degree-granting as well; but the primary concern here is with the traditional engineering departments and how they might relate realistically to programs -- particularly professional programs -- at other institutions in Newark. Present judgment in this area with regard to cooperative efforts between NCE and the other institutions on this level may be summarized as follows:

1. College of Medicine and Dentistry: A committee has been studying the feasibility of developing a biomedical engineering program, and its findings suggest that NCE should not become involved in such a program at this time. Nevertheless, there are a number of researchers at NCE who are interested in and involved with research related to medical problems. It would appear then that joint research

interests should be the basis for initial explorations of expanded cooperation with CMD.

2. The professional schools of Rutgers-Newark: With an increasing interest on the part of many engineering students in the relationships between engineering solutions and societal problems, there are very natural interests in the legal aspects of such concerns. At the same time, law school curriculums seem more and more oriented toward the same problems, again at the demand of the students. Here is a natural area for exploration of coursework jointly developed by the faculties of NCE and Rutgers School of Law. An excellent example would be in the area of environmental law, where there might well be serious discussion of joint course development or actual interchange of faculty. Similar program ideas should and will be explored at Rutgers Graduate School of Business in Newark. As a matter of fact, preliminary discussions have already been initiated by NCE personnel with their counterparts at the professional schools of Rutgers-Newark. Several specific programs suggest themselves as areas for real cooperative efforts in the near future, i.e., Architecture and Public Administration.

3. R-N College of Arts and Sciences: Two avenues must be explored here as representing an expansion of the present somewhat limited cross-registrations. The first is special courses developed by NCE for Rutgers students and vice versa. The second is the possibilities for greater enrollment of NCE and R-N students in the same classes.

J. Pathways to Facilities

These last two items are linked in the same general category because they are both matters primarily within the purview of administration. Questions involving the joint use of facilities and equipment such as, for example, physical education buildings or audio-visual equipment except as they involve the services of faculty personnel, are generally thought of as administrative problems. A recent

action by the Chancellor of Higher Education dictating that R-N and ECC may not proceed with plans for physical education facilities before a study of the needs of the entire higher education community in Newark are examined, tends to indicate that many of these kinds of decisions are being shifted to a higher administrative level.

Most questions related to facilitation of pathways are purely administrative. For example, questions of cross-registration must involve on their several levels the deans and the registrars. So also the question of a possible common card catalog while requiring decisions on a number of levels could not be accomplished without the cooperation of the librarians.

An interesting recent case of evolving administrative cooperation on the staff level arose from an action by CHEN, working through the public relations directors of the four institutions, to set up meetings of administrative staff members with similar job descriptions to discuss mutual problems and possibilities for joint efforts. It seems quite clear that no effective cooperative programs can be carried out without this type of contact linked with a clear understanding of the mission of CHEN and the urgency of attainment of its goals in the interests of the development of the Newark Complex.

K. A Few Last Words

In the final analysis only those in a position to have an overview of the entire institution can be expected to have a sure sense of those areas where cooperation might best aid development. It is hoped that everyone participating directly in the case study may be brought to this point of overview at NCE -- often limited to trustees, administrators, and a few faculty. NCE believes that as the senior institution in Newark it must assume leadership both in the initiation and guidance of programs of cooperation. Evidence of this ability to accept and carry out a leadership role will be an essential part of the proof that NCE is in a

position to continue to develop as a high quality technological institution.

While it is perhaps poor psychology to end on a negative note, this paper is meant to raise issues; and, it seems appropriate to bring this section to a close by placing emphasis on what is considered one of the most perplexing problems facing those who would like to see cooperative efforts serve our development. In the simplest terms, the problem is "people". It has already been pointed out that cooperative efforts can succeed only if those who must do the cooperating are aware of its importance and willing to indulge in it. Administrators are practical people and will cooperate whether they really like it or not, either because they are told to do so by some higher authority or because it is politically expedient. The same constraints do not generally apply to faculty and students!

An interesting generalization concerning attitudes may serve to state (perhaps overstate) the issue. It has already been pointed out that NCE's primary cooperative efforts in the faculty and student pathways will probably be with Rutgers-Newark. The generalization says that faculty at R-N tend to look down on faculty at NCE while students at NCE tend to look down on students at R-N. At first glance this seems to be a sort of paradox. Yet there is a certain logic. The University would be expected to draw a research- and publication-oriented faculty; and yet the University has few graduate programs in Arts and Sciences in Newark at this time. NCE's faculty, in general, would seem to be more practice and teaching oriented; and yet there is a cadre of research-oriented faculty and there is a highly developed graduate program at NCE. With regard to students, it is probably true that admissions requirements (particularly in Math-Science) are higher at NCE than at R-N and that work schedules are more demanding. But, perhaps more important, there are also certain social differences which are reflected in various student orientations toward both study and study environment.

The question of whether the development of NCE into a technological university can take place in serious cooperation with its neighboring branch of the

State University or independently may well depend upon the resolution of these counter-productive attitudes.

(Generalizations are only generalizations! At the initiative of several Rutgers faculty members, a voluntary collaborative seminar on "Technology and Society" was begun in November, 1971. About two dozen faculty from Rutgers and NCE are participating, although all four institutions were invited to join. The seminar, which meets weekly to discuss brief papers, represents for most of its members the first interaction between the faculties themselves, on a scholarly level, without the mediation of presence of administrators from the colleges.)

IV. SERVICE TO THE CITY, THE REGION, AND THE STATE

A. Introduction

Newark College of Engineering is situated at the heart of one of the greatest industrial and societal complexes in the world. Today, therefore, the College finds itself faced with two major service responsibilities: one to government, commerce and industry; the other to the individual citizens of the region, particularly in regard to the amelioration of poverty and urban decay. New Jersey, the nation's most urbanized state, has a social and economic system which depends heavily upon the proper functioning of technologically based sub-systems of transportation, communications, electric power, and so forth. In health, safety, welfare, and education, vital services are delivered by men and women with various technical skills. Many industries and agencies of government seek advice from NCE's faculty and hire its graduates. The College's campus is located in Newark's congested downtown area, near one of the most blighted sections in the U.S. As a publicly supported institution built on tax-free land, much of it created by urban renewal, and surrounded by the schools and dwellings of Newark's poor, NCE cannot but see "service" written large at every turn.

Persons active in government and the community are well aware that NCE has an important service role to perform. Their opinions were voiced in a survey prepared in connection with this case study. Most expressed a strong hope that the College would make a major contribution in meeting the challenges of today's society. They cited housing, pollution, public safety, mass transit, traffic control, and related subjects as being legitimate areas for NCE's concern. Their comments focused on the city of Newark, but the region and whole state were included in the catalog of ills that needed treatment. A sense of crisis pervaded most answers, but also a faith that a reputable engineering college, evolving into a technological university, could help to provide a broad range of services and

find solutions to these and other problems.

The expectations of those surveyed need to be weighed against the College's resources and limitations. Specific programs of service must flow naturally from the traditions and procedures of the College. Such programs must neither transcend nor dominate its fundamental educational mission. The number and kinds of programs will be limited, clearly enough, by available funds and the attitudes and skills current among faculty and administration. College personnel who perceive disparities between the College's performance and society's needs will raise with their colleagues the possibility of launching new service programs when they are feasible. The institution cannot afford to pass up opportunities to forge stronger links with the public, locally and throughout New Jersey.

What kinds of services does NCE perform? How did they originate? What needs do they meet? An examination of some current programs may provide an idea of the opportunities that exist, the achievements that have been registered, and the limitations that affect the College's service role.

B. Service to the Region and the State

1. A Resource for Industry

An important aspect of the College's service function is its position as a "resource" for industry in the region, the state, and even nationally. The campus is the scene of several dozen conferences annually in such diverse programs as sales engineering, executive development, mathematics for engineers, fire protection technology, coatings technology, and others, most of which are offered by NCE's Division of Continuing Engineering Studies. Faculty members frequently testify as expert witnesses in contested cases and consult as advisors to business and industry. Through its Placement Office the College provides industry with data on engineering and scientific manpower needs and wage and salary trends.

Such data are especially useful to small firms that normally are out of touch with the national professional societies. The Placement Office has also helped conduct training programs for corporate recruiters, manpower planners, and line supervisors. Business and industry also have access to the College's library of 79,000 volumes.

The Division of Continuing Engineering Studies currently enrolls about 700 persons in evening workshops and classes. It brings specialists from business and industry to NCE to transmit to persons working at various levels of engineering the knowledge and skills they have acquired through experience.

There is also the prospect of granting undergraduate credit, under other auspices within the College, for corporate-related research in senior project courses. Two problems that will have to be solved are those of responsibility and liability for work done by students and of setting grade standards for student work of a marginal nature. Both problems are similar in nature to those of the public service internships program described on Pages 50 to 51.

Off-campus courses are the subject of increasing discussion at the College as a means of broadening its service role and clientele. They would be unique to NCE's position in New Jersey, but would be similar in nature and purpose to the well-established programs existing at other institutions, particularly in the West. Few off-campus programs presently exist in New Jersey. New audio-visual technologies make possible certain off-campus courses that could be offered by NCE on a provisional or experimental basis.

2. Serving the Profession

The College is the headquarters for the New Jersey Engineers' Committee for Student Guidance, one of the many such state and regional organizations sponsored by the Engineers Joint Council. This volunteer group of practicing engineers was founded in 1950 to give reliable information about the profession to high school

students and student-guidance groups. The office of its Meetings Coordinator receives inquiries and arranges the desired seminars, movie presentations, and visitations. A growing number of such events is being manned by undergraduate student teams. At present three of the Committee's six officers are NCE people. The College provides mailing and duplicating facilities and some secretarial help.

Another service that NCE has performed for almost forty years consists of preparing, proctoring, and grading the Professional Engineering Examinations for the State of New Jersey. A similar service is provided for the Land Surveyor's Examination.

3. The Research Foundation

The Foundation for the Advancement of Graduate Study in Engineering is a major instrumentality through which NCE interacts with business, industry and government. It was originally called the NCE Research Foundation.

At the time the Research Foundation was established, in 1959, there was little money and virtually no grant activity for research at the College. The Foundation was supposed to deal with these matters and such others as patent rights and in-service teacher-training institutes. After a period of initial organization and development, the Foundation was reorganized in the mid-sixties to attract more support from New Jersey's major corporations and to relate its activities more directly to the interests of industry and to the research needs of the College. Industry helped to fund the new approach. A Board of Overseers was recruited from eminent businessmen and scientists to raise funds and to set broad policies.

Pertinent here are the relationships between the Foundation and business, industry, and government in the area of service. For example, a program of College-Industry Seminars is now in its third year. It brings to the campus experts from industry and government to conduct advanced scientific and technical

seminars. From 18 to 24 seminars are held annually. Each is attended by up to 40 persons from industry in addition to faculty and guests. One result has been that many have visited the campus for the first time and have thus become aware of the opportunities it offers.

Another example is the research project worked out jointly between the Foundation and a specific company. In one such approach, the project is funded by the U. S. Department of Commerce under the State Technical Services Act. By this means the Foundation provides technical assistance to small and medium-sized New Jersey industries in such fields as chemicals, metallurgy, electronics, plastics, and machine tools. In the future, the Foundation intends to coordinate its research project approach with the goals of the New Jersey Department of Economic Development so as to maximize the benefits to business in the State.

4. The Center for Urban and Environmental Engineering

On the regional level, an important potential for service exists in the College's Center for Urban and Environmental Engineering. It was founded in 1965 as an offshoot of the Foundation, but languished because of insufficient funds and inadequate means of relating to government and industry. In 1969 the Center was reorganized, and a technical director was appointed. A research staff of thirteen faculty members with diverse experience and skills serves without compensation. With the publication of a brochure, "Crises of Environment: Toward the Solution of Urban Problems," the Center began a campaign to secure industrial and municipal sponsors. Several research projects aimed at various pollution and urban problems were undertaken, but overall results are limited. A conference on "Environment for Inner City Residents" is being organized for next year. It will emphasize that pollution affects all people and will seek to gather information on the problems and experiences of those who attend from Newark and adjacent towns.

The potential for service by the Center has not yet been tested. Some

industries are reluctant to promote plans for pollution controls, and many municipalities, especially the smaller ones, are wary of dispassionate outsiders coming in to study local problems. Means to overcome these roadblocks will have to be devised before the Center can play a valid service role. A step in that direction was the setting up last year of an Advisory Board to offer independent suggestions and criticisms on the Center's work, but, again, little has been accomplished. Some means of coordination may have to be established between the Center's activities and official State enforcement policies.

5. Public Service Internships

NCE offers several programs designed to relate students and faculty to the needs of municipal and county government. The public service internship is one. In 1969-70 the N.J. Department of Community Affairs issued guidelines under which it would sponsor young people in responsible part-time positions in public affairs. At the initiative of the College's Department of Civil and Environmental Engineering, NCE agreed to coordinate its project course in civil engineering with the State's guidelines. It set up student jobs with salaries paid by the State and with planned work experiences that would be meaningful and instructive. Subsequently ten students worked up to fifteen hours per week each in municipal government in Newark. Work-study assignments that were successfully completed included an analysis and design of a vest pocket park system within the "Model Neighborhood" area of Newark, a study of Newark's solid waste disposal system, and an evaluation of the economic feasibility of a proposed extension of the Newark City Subway to outlying areas of the city and county.

Under revised State guidelines, only students from economically disadvantaged families can now apply for the internship program. State allotments have been reduced, but the program at NCE will continue. It will be modified and expanded by the Department of Civil and Environmental Engineering so that all seniors

(about 120 per year) will register for project courses in supervised (although not necessarily paid) situations. Teams of faculty and students will participate in projects in Newark and in other localities. The acceptance, or at the least serious consideration, of the recommendations made by such teams will depend upon the economic and political feasibility of implementing them and the open-mindedness of local officials.

The concept of the public service internship holds exciting possibilities for students and faculty in a number of programs that might evolve as the College develops into a technological university. A graduate program in public administration, for example, could utilize to advantage the unity of practice and theory which internships and project courses promote. The College could also thereby render specific services to agencies of government that might be deficient in engineering and administrative talent.

What is needed is a commitment by the College to maintain these programs even if outside funding should become less easily available. The unresolved questions are: How will the decline in enrollments affect the observance of such a commitment? What mechanisms can be created to implement such programs on a long-term basis?

C. Service to the City

1. 1967, a Turning Point

Prior to the civil disorders in Newark in 1967, the College was not significantly involved in reaching out to the growing numbers of low-income families in Newark, who were gradually forming a majority of the city's population.

By that year about three-quarters of the city's public school enrollment came from the black and Spanish-speaking communities, yet a decreasing number of graduates from the senior high schools was going on to college. The 1967 disorders

prompted concerned members of the faculty and administration to form a committee that included persons from all areas of College life. The committee realized, as did the College faculty generally, that the relationship of the institution to the people of Newark could not continue in the direction it had been moving: declining numbers of Newark residents attending NCE; a very limited number of blacks as students or College employees, and virtually none of Hispanic background; and very few direct or visible returns to the city from the College's presence on High Street. Some College personnel feared verbal and physical attacks, while others felt a heightened sense of commitment and understanding. All agreed that some positive action had to be taken.

2. A Commitment to Service

The President affirmed the College's commitment to community service at the opening meeting of the faculty in the fall of 1967. The Deans of Engineering and of the Graduate Division then issued a statement setting the tone for the above-mentioned committee. It said in part: "NCE has traditionally provided a low-cost education to those who were moving up the socio-economic ladder, but relatively few members of the disadvantaged community surrounding the College had sought an engineering education. Obviously something more than an open door and low tuition is needed." Before the year's end, plans were drafted for a special program to serve disadvantaged students, to begin the following summer. The initial stages of planning and recruitment involved the two deans, several interested students, the staff of the Counseling Center, members of the faculty, a black engineer, high school personnel, and a black minister.

3. The Engineering Opportunity Program

The College's Engineering Opportunity Program (EOP) began in July, 1968, with twenty students, primarily from Newark, most of them black, who had done relatively

well in their inner-city high schools but who had achieved low scores on the standard admissions tests. Their median SAT's in math were 425 and in verbal, 350, compared with NCE's medians for entering freshmen of 620 and 485. The students received summer instruction, orientation and counseling, and were involved in personal and social contacts with the College staff attached to the program. In September they were enrolled as regular freshmen, but carried only about 13 credit hours compared to the normal 18. They continued to receive financial aid for tuition and personal expenses, and special tutoring, counseling, and cultural opportunities. In spite of the experimental nature of the program and the students' weak backgrounds, most of those in the program showed definite signs of accomplishment. Of those who dropped out, most either transferred to liberal arts colleges or entered useful employment.

Those responsible for EOP have learned lessons from it. Improved procedures and recruiting methods have been developed. Each annual EOP group has achieved more scholastically than the preceding one, in part no doubt because of these improvements.

EOP motivated many of the faculty to examine their attitudes toward the potential of black students for entering the engineering profession. At first, many in the College community held skeptical views. Among the faculty there was a fear that NCE's standards might be lowered because EOP students were not as well prepared as the general run of the students being admitted. These attitudes were ameliorated somewhat through contact between the EOP students and the faculty, private discussions with the misinformed, and discussions with faculty members who had EOP students in their classes. Sensing these doubts and animosities, the students created defensive mechanisms to protect themselves. Today there are still pockets of tension and misunderstanding, but they are being managed and worked on; and each succeeding group in the program (which now contains a mixture of whites, orientals, Hispanic, and a black majority) finds that the ground has

been somewhat better prepared for it than for the group that came before. They discover a firmer hand and clearer direction in the program than existed at first. They acknowledge that the faculty is usually fair in work assignments and grading. But they continue to probe the system and to demand full recognition and acceptance. To the extent that the expectations of the students are not completely met, there will continue to be tensions and crises from time to time.

NCE's Engineering Opportunity Program proved to be prophetic in anticipating the thrust of public policy in New Jersey. In July, 1968, the Legislature created the Education Opportunity Fund to provide scholarship assistance to educationally and economically disadvantaged youth who might not otherwise be able to attend college.

As the major public technological institution in New Jersey, NCE will have to expand its enrollment among disadvantaged youth, even as it broadens the range of programs and services it provides to the city and the state. The recently established Bachelor of Technology program is a step in that direction.

The College's image among minority groups in Newark is negative or non-existent, and the fact that the present Mayor of Newark is a graduate of the College has not substantially changed this image. Some feel that if community people will not come in greater numbers to the College, then the College will have to go to the community. One suggestion has been a storefront technology-information center as a means of bringing information about environmental and technical problems in everyday life and of stimulating interest in the College. Another is that an intensive recruiting program be initiated for black and Hispanic staff members. Whatever the specific method employed, it may have to embody an innovative approach if the College is to embark on new paths of service in this area.

4. Further Service to Minorities

The generally favorable results of the EOP program have encouraged the College

to launch new programs of service to minority groups.

One is the Technology Opportunity Program (TOP), begun in 1970 as a bridge-year leading into the evening Division of Technology certificate programs. At present about twenty men are enrolled in remedial courses in science and mathematics. They also receive tutoring, counseling, and presentations of career alternatives. Half of the group does not have high school diplomas and is working toward the equivalency certificate.

Another program is the Construction Management Series. It offers to minority group subcontractors short courses in business administration, essentials of forming a construction business, accounting, labor relations, contracts, and budgets. Essential supportive services are provided through informal counseling and career discussions. Sessions are led by people from business and industry, among whom are black architects, construction contractors, and counseling personnel.

Inspired by the need to relate to the crisis in Newark, several NCE fraternities, among whom a tradition of service has flourished, decided to assist Newark high school students with their studies. Eta Kappa Nu, for example, voluntarily tutored college-motivated youth at adjacent Central High School. The number of high school students served totals about four dozen, and reports indicate useful results from the viewpoints of academic progress and social interaction. This need is also recognized by the NCE student chapter of the Association for Computing Machines. Jointly with the Student Senate it has sponsored field trips for seventh graders at the Warren Street Elementary School. The children visited an IBM plant and saw films, demonstrations, and the plant's facilities.

5. Service to the Local Community

The College conducts several programs of direct impact on the local community. Its officials understand that expanded efforts are needed to attract Hispanic and black students to the College and the profession. These young people are normally

uninterested in careers in engineering and science. Inadequate scholastic preparation often precludes their success at NCE. In light of these factors, the President, the Dean of Engineering, and the Dean of the Graduate Division proposed that a pilot High School Program be started as a prelude to an application for a National Science Foundation Grant. Under this program twelve students from Central and nearby Arts High Schools met one afternoon a week per semester with NCE faculty members to work on air and water pollution and other studies. The outcome of one such study - a tot lot - will actually be built on Newark's West Side with federal funds assisting.

After the pilot project had shown that the program was feasible, the College applied for and was awarded an NSF grant to provide a summer program in urban engineering. As a consequence, thirty high school juniors from schools in Newark and the surrounding area participated during the summer of 1971 in a six-week program that combined a rationale for approaching urban problems with review work in mathematics, physics, and chemistry. Its purposes were to furnish students with an understanding of how scientists and engineers tackle problems and to show that professional careers may lie within the range of student interest and capability. The College is now seeking funds to continue the program in following summers.

Another effort, sponsored by NCE's Research Foundation, is the Central High School Program. This has enabled students at the neighboring high school to work with NCE faculty on selected research projects. Between 15 and 30 students a year have participated. Getting them together with their college faculty advisors is sometimes a problem. High school authorities fail to release students at scheduled times or else send them when faculty members are unavailable -- and the match between individual students and faculty is not always felicitous.

It may also be necessary for NCE to stimulate or support efforts to create in the very young, in kindergarten and preschool, an awareness of the importance

of science and technology in their lives. Perhaps a greater interest in these fields will thereby develop among children and youths from the so-called disadvantaged groups. This mission cannot be the College's alone, however; it will require a coordinated educational effort by public, professional, and private agencies, particularly by elementary and high school principals and teachers.

D. An Ongoing Commitment

The sum of the services discussed above is still short of the total which some faculty and administrators at the College feel is needed to take full advantage of the resources of the College in coping with the immense educational and social needs of the 1970's. But considering the rather short span of years in which these services have been developed, they represent a meaningful involvement of time, ideas, money, and energy, and, even more significantly, in commitment, that is having a profound impact upon the College and its constituency. No aspect of College activity is immune from a consideration of the service role and its effectiveness. A consciousness of the need for service pervades many levels within the College and enters into all discussions of the College's future.

Newark College of Engineering, like numerous institutions of American life, is being tested as never before. Its location in the City of Newark adds a special urgency to this testing process. Its manifold interfaces with the vast industrial-population complex in the North Jersey-New York-Connecticut region links its future to the economic and social development of this vitally important area. To the extent that NCE continues to provide an expanding and increasingly fruitful range of services to the people of the city, the region, and the state, it will survive and grow as an institution worthy of public respect and support.

V. PLANNING AND DECISION-MAKING

A. Planning for the Future

As the College moves toward its goal of becoming a technological university, its planning and decision-making processes are evolving to meet the challenge of growth and diversification. The College has had a tradition of strong central administration, particularly focused in the President. In the last decade, in common with many other institutions, a concerted effort has been made to involve faculty and students more effectively in the decision-making process. Many structural and procedural changes have been made on the initiative of faculty, administrators, and students. The following pages outline the present decision-making process, with particular attention to the innovations of recent years. An attempt is made to project future patterns.

The College's development as a technological university must take place within the context of public higher education in New Jersey, in a period where centralized state planning is becoming increasingly important. This section will conclude with an examination of the College's relationship with the other public institutions and with the New Jersey Department of Higher Education.

B. The Decision-Making Structure

The College's decision-making structure is not untypical of the pattern in many colleges. It involves an extensive collection of faculty, administration, and student committees, with various avenues of communication, formal and informal. Several groups central to the decision-making structure are described briefly in the following paragraphs.

1. The Executive Committee

Chaired by the President, this committee meets monthly to consider matters

of general academic administration. These concerns may range from academic personnel policies to the annual equipment budget. Membership consists of the department chairmen and the academic deans. This committee has played a central role in the administration of the College for many years.

2. The Committee on Curriculum

Charged with overseeing the undergraduate and graduate curriculums, this committee meets at least monthly. The department chairmen, two students, and the academic deans are members. The Dean of Engineering is chairman. Although this committee is authorized to reach decisions on a variety of curriculum matters, it must report to the Executive Committee on major policy questions.

3. The Faculty Council

Established in 1966, the Council is elected by the Faculty on a representative basis. It was established with the full support of administration and faculty to "communicate, investigate, deliberate, and initiate." Intended as an advisory group, it may recommend actions to "the Faculty, the Staff, the President, the Board of Trustees, or any person or duly constituted committee or academic body of the College." The group, which meets at least bi-weekly and has several sub-committees, has undertaken a broad range of activities, particularly concerning faculty personnel matters. It plays a central role as a representative voice of the faculty.

4. The Professional Staff Association

A further development in faculty organization took place as a result of the enactment of Chapter 303, New Jersey Public Laws, 1968, called the New Jersey Public Employee Negotiations Law. This law provides for negotiation procedures for all public employees in the State of New Jersey on all issues affecting

conditions of employment.

The employee group may elect a representative through whom all discussions with the employer on all negotiable subjects take place. The NCE staff decided to organize its own association to represent it. In April, 1970, the Professional Staff Association was officially recognized by NCE's Board of Trustees as the bargaining agent on terms and conditions of employment.

5. The Student Senate and Other Bodies

Representing the students, the Senate has broad responsibilities for student affairs. It frequently interacts with the above groups, with the Dean of Students, and with the President on matters of student interest.

Other significant groups are the Administrative Council, which deals with non-academic administrative matters, the Committee on Academic Standing, and the Committee on Student-Faculty Relations.

C. Planning of Academic Programs

The Committee on Curriculum coordinates the development of new undergraduate and graduate courses and programs. Proposals for new courses typically come to the Committee after thorough review by the faculty of the proposing department. After a consideration of questions relating to need, costs, and priorities, the Committee may give final approval for offering the course. Where questions of possible use by other departments or duplication with existing courses arise, the proposal may be referred to various departments for comment before final action. Major revisions of an existing curriculum are referred to the Executive Committee and to the Faculty for approval, where appropriate.

New degree programs receive extensive consideration. Initial proposals for new degree programs often develop within the Committee, although they may come from departments or individual faculty and students. Typically, after an initial

discussion the Committee appoints a faculty sub-committee to review the need for a new program and to develop a formal proposal. Chairmen are asked to review such proposals with their department faculties and modifications may be made on the basis of these discussions. If the proposal still looks promising, the Committee will recommend its approval to the Executive Committee. An open hearing may be held for general faculty comment. The proposal then is submitted for Faculty action, Board of Trustees approval, and final authorization by the State Board of Higher Education. At any point it may be rejected or referred back for modification.

Involvement of the faculty in academic planning has increased in recent years. Departmental chairmen have been encouraged to make special efforts to discuss all pending curriculum matters with their respective faculties. The Committee on Curriculum, in further encouragement of this trend, is placing greater reliance on sub-committees, made up of representative faculty members, to examine questions of curriculum development.

In spite of continuing efforts to inform and involve interested faculty, the academic decision-making process is not without problems. To be effectively involved, all faculty must keep current with the complex national trends in engineering education. Some faculty feel that they are not sufficiently informed or involved -- that someone else is making decisions for them. This is also a problem with effective student participation in academic planning.

D. Academic Personnel Decisions

The College's policies and procedures regarding academic personnel have been substantially altered in recent years. Many of the changes were initially proposed by the Faculty Council; others were initiated by the Executive Committee; some simply evolved on the basis of experience. In several cases, the two groups worked together to develop a proposal for Faculty consideration. Most of the

changes ultimately required Board of Trustee approval.

For several years, faculty appointments, promotions, and tenure have been reviewed by department and College-wide committees. The departmental committees, which consist of tenured full professors, make initial recommendations for appointments, promotions, or tenure. Promotion and tenure recommendations are reviewed by a College-wide committee (consisting of three faculty and three administrators), for final recommendation to the President. The system has greatly increased faculty involvement, compared to the earlier system, where a department chairman alone made recommendations directly to the President. It has also increased the complexity of the process, thereby creating some confusion and uneasiness among younger faculty.

The Executive Committee and the Faculty Council worked closely together for two years on an extensive revision of the criteria for promotion and for tenure. After a study extending over two years, the revised criteria were submitted for Faculty approval with the endorsement of both groups, thereby facilitating prompt favorable Faculty action.

The procedure for appointing department chairmen has undergone a gradual evolution in the last several years. It is the prerogative of the President to appoint chairmen; and, with the assistance of the Dean of Engineering, he has moved toward formalizing faculty involvement in the selection. At present, when a vacancy occurs in a chairmanship, an advisory committee on selection is elected by the department faculty. The committee meets with the Dean of Engineering to identify and screen candidates and make a recommendation to the President. During the screening process, all department staff have an opportunity to comment on the candidates.

More recently, the Faculty Council has proposed formalizing the selection procedure and also developing a periodic evaluation procedure for chairmen, with a specific term of office.

There are also formal procedures for faculty involvement in selection of a President and Deans.

E. Student Involvement in Decision-Making

In keeping with national patterns in the last few years, students have become more involved in the decision-making process at the College. As a commuter institution, with most students and faculty living far from campus, NCE has a special challenge in maintaining effective student-faculty-administrative communication. Student involvement greatly increased in the mid-60's when new facilities permitted a substantial increase in extracurricular activities.

In the early days, students were assigned a position in the College organization which was defined by the first President of the College, Dr. Allan R. Cullimore:

> "A student of an engineering college especially will readily perceive the professional aspects which should be common to undergraduate life and to the days when the classroom assignments are but a memory. The place of the employer is taken by the College. Its administration and faculty establish the policies under which the student is expected to work and prescribe the immediate objectives of his labors."*

In keeping with the relative quiesence of the 1950's and with this interpretation of the "professional aspects," the student government concerned itself primarily with those matters relegated to the area of student activities and rarely either represented student interests, rights, and privileges, or became involved with academic and administrative matters. There were no students assigned to faculty committees. However, it was a common practice for departmental administrators to seek student opinion regarding curriculum revision

* Engineering - A Discipline, Newark College of Engineering, Allan R. Cullimore

through the professional and honor societies. One committee, the Committee on Student Morale, met several times annually and invited students to meet and express views, complaints and suggestions. This was the extent of the formal, structured means of feedback and communication. The most effective kind of student exchange with faculty and administration depended upon the presence of a given person when there was a matter to be aired.

During the 1962-63 school year, a required student activity fee was established. The expenditure of the income from this source, dedicated to the student activity and athletic programs, was made the responsibility of the Student Council. Because the increased income generated decided increases in activities and athletics, the student government metamorphosed from a lethargic to an animated stage.

Student enrollment was rising during the period and this factor, combined with the Council's newly acquired responsibilities, resulted in a revitalized and eventually enlarged student government organized on the basis of functional representation. Following 1963, the Student Council began to concern itself with all matters affecting NCE students and gradually became involved in administrative and academic affairs on an informal basis. It was not until 1964-65 that students were appointed to faculty committees with full membership status. During that year, students joined the Athletic Policy Board, the Committee on Student Life and Open House Committee, the Committee on Professional Conduct, and the Student Life Fund Review Board. In 1965-66, the Student-Faculty Relations Committee was established; this represented an important step toward involving students with policy making.

By the 1967-68 school year, the Student Council had begun to take an active and obvious interest in all phases of college governance that affected students. Student representatives began to meet with officers of the Faculty Council, and by 1969-70 students were permitted to attend faculty meetings and meetings of the

College Board of Trustees. The President of the College meets at least once each month with student representatives for lunch, and the Deans have feedback meetings almost daily. Many recent policy changes have been made because of the efforts of NCE students working through their Class Councils and the Student Senate.

Student appointments to college committees provide a productive and valued input to decision-making. Currently, students serve on nearly all of the College committees, including those for Curriculum and Academic Standing. The initiation of departmental feedback committees by the Electrical Engineering Department in 1964 also represented an important contribution to the improvement of student-faculty communications. The procedure was so successful that the Student-Faculty Relations Committee encouraged the establishment of similar committees by all of the Departments, and they have been functioning with varying degrees of success since 1966.

In conclusion, it appears that the older concept of "professional relationships" has gradually been replaced by a newer view of the value of student opinion as it applies to the exercise of the responsibilities borne by the administrators and the members of the faculty.

F. College Governance in the Future

The direction college governance will take at Newark College of Engineering in the years immediately ahead is not entirely clear. The Faculty Council and some administrators have expressed concern that many of the policies and traditions of the College are not fully documented and indexed, and that there are undesirable gaps in the system. There are some members of the faculty who feel that the faculty should have the dominant role in the setting of all College policies. There are others who feel that the various constituencies of the College should share responsibility and authority according to their share of accountability. Somewhere between these extremes probably lies an optimum plan of governance.

G. Long-Range Planning

Shortly after assuming the Presidency in the late 40's, Dr. Robert W. Van Houten began the development of a long-range plan for the College. The procedure that followed was not a formal one, but it did involve the Trustees, the President, the Vice President, and certain key faculty and administrators. With the help of consultants, a long-range development for the physical facilities of the College was drafted in the mid-50's. This became the basic guide for the ensuing campus development.

Concurrently, the Executive Committee and the Curriculum Committee began a long-range revision of the curriculums, the educational philosophy, and the procedural regulations of the College. There were many sub-committees, ad hoc committees, and individual assignments, but no formal planning structure. The President and the administrative staff gave similar attention to the administrative organization and gradually made changes, always hopefully, in advance of each need.

With the change in Presidency in 1970, and the current apparent stabilization of physical and enrollment growth, all coupled with changing demands on the College for services, a more formalized structure for planning is being developed. A group has been established to handle the development, approval, and implementation of requested minor-to-major changes in physical facilities.

Within each department there has been organized a long-range planning committee, each of which submitted initial reports at the end of the 1970-'71 year. Under the chairmanship of a faculty member, representatives from each of these committees are meeting to develop a College-wide long-range planning committee and procedures for it to follow. The recommendations that come from this committee will be directed to the proper faculty committees, administrators, or to ad hoc committees set up to further develop or implement the recommendation.

A computerized accounting system that will distribute and accumulate costs and provide budget control and ongoing space studies through a computerized system

developed by the State Department of Higher Education will assist in the long-range planning process. Studies of faculty loading and productivity are also in process.

H. The State System

Planning for the future of Newark College of Engineering must be done within the context of a developing public system of higher education in New Jersey. The Department of Higher Education, established in 1967, has been charged with preparing a comprehensive master plan for higher education in the State. The master plan is presently under development, and has already been the subject of considerable controversy between the Department and the individual institutions.

Prior to the establishment of the new department, higher education was administered by the Department of Education, responsible for all levels of education in the State. Preoccupied with the manifold problems of public primary and secondary education, and lacking sufficient staff, the department provided a minimum of coordination of higher education and required only a limited accountability from the public colleges and universities.

Now, with the establishment of the new Department of Higher Education, some college administrators are concerned about its growing bureaucratic tendencies which, they feel, are infringing upon institutional autonomies and hindering, rather than helping, needed development. The Department of Higher Education, on the other hand, points to its responsibility for coordination and the development of a greater degree of accountability, especially in the fiscal area.

A rather remarkable exchange of these opposing viewpoints appeared recently in The Record, one of New Jersey's major newspapers. The quotations that follow are both revealing and quite accurate in describing the present "frame of mind" of higher education in the State.

Dr. Mason Gross, the then retiring President of Rutgers - The State University, made the following remarks in an address to legislators from other states at a meeting in Florida:

"I have yet to discover any state university president who is happy with the system under which he now exists. I am not happy with it as it exists now, and I am apprehensive as to what may come about in the future . . .

"(Rutgers' budget) requests are revised and reduced by the Chancellor's office, then resubmitted to the state budget office as if they were the school's original requests. In sending the Rutgers estimate of fiscal needs to the budget office, the State Board of Higher Education relies on the decisions of the Chancellor's office, and doesn't get to see itself the university's own requests.

"This we find a terribly frustrating situation . . . A department of higher education such as we have in New Jersey is able to attract a number of very able, even brilliant young people, most of whom stay only a short time. They are people whose connections with the actual working of universities on campus are probably confined to their own undergraduate experiences.

"They are, therefore, experts on how to make a budget, or how to build a building, or whatever problems may come up, but they have no feeling whatsoever for what makes a university tick.

"This is the real essence of a bureaucracy built up around the Chancellor."

Ralph A. Dungan, Chancellor of the Department of Higher Education, later offered this rebuttal in the pages of the same newspaper, whose main points are quoted here:

"Forty-six states have created mechanisms to plan and co-ordinate higher education. The trend in recent years has been toward greater centralization, not more campus autonomy. In any event, as Dr. Gross points out, few university presidents are happy with statewide co-ordination.

"And why should they be? For the first time public agencies have been created and staffed which are able to challenge accepted practices and the authority of

those who have traditionally dominated the scene in higher education. For the first time there are those who believe we must act as well as make speeches if we are to bring about that major educational reform which will be necessary if we are to survive this decisive and austerity-ridden decade.

"Statewide co-ordination with powers of program and budget approval grew out of the increasing frustration of governors and legislators as they attempted to cope with a vastly expanded higher education establishment without directly involving themselves in university affairs . . .

"The days are gone when the authority of university presidents is sufficient to command unquestioned support of their requests or even their view of social and educational goals. In higher education there are more players in the game, and decision-making on goals and resource allocation is not the exclusive preserve of either the faculty or the educational administrator. It is this fundamental fact which is difficult for some accustomed to other traditions to accept.

"Of equal concern to those legislatures which created statewide co-ordinating and monitoring agencies like the New Jersey Board of Higher Education was the need to moderate and co-ordinate the pellmell growth and proliferation of programs, degrees, schools, etc. which marked the decade of the Sixties. Efforts at voluntary co-ordination and planning failed because of institutional ambition and log-rolling.

"Dr. Gross is absolutely correct in raising questions about possible adverse academic consequences of excessive interference in the affairs of a college or university by a statewide co-ordinator or anyone else. Unfortunately, his case is more polemical than factual. He confuses asking a question about how space is utilized -- or how many dollars are expended to educate an engineer or sociologist or why a part-time student pays more for his education than a full-time student -- with dictation about what standards should or will be . . .

"(But) one way or another public institutions and independent colleges to an

increasing degree are going to have to maintain higher and more precise standards of public accountability than they ever have in the past."

I. NCE's Role in the State System

In some respects, NCE occupies a unique position among the public institutions of higher education in New Jersey. As a special purpose institution, focusing on professional education in engineering, it has not been subjected to the severe enrollment pressures experienced by Rutgers and the eight State colleges. In the last decade, NCE has emphasized development of quality graduate programs, while experiencing a modest growth in the undergraduate enrollment. Other State institutions have grown spectacularly, and it has been pointed out that recent State emphases have had to focus strongly on providing space for additional students. This emphasis on numbers has led to what some feel is a lack of perception of the College's needs by state officials.

NCE has been caught in the turbulence of the evolving State colleges and an evolving State Board and Department of Higher Education. Over the years, NCE has developed a stability and autonomy and a reasonable clarity of mission not possessed by some other elements of the State system.

No one among the Presidents, or on the Chancellor's staff, or even on the Board of Higher Education has a developed understanding of the role each is to play in the development of the system and its master planning. The fine line that distinguishes coordination from bureaucratic interference or control is constantly being breached. This fact creates anger and frustration, and muddies the waters of understanding. It also brings great confusion to the development of responsibility, authority and accountability, as well as to local short and long-range planning.

Undoubtedly, the parts each element must play in the total system will evolve eventually; but it is to be hoped that the ensuing scar tissue will not disfigure

the elements so that their public and private image will become unacceptable to the citizens of New Jersey or to the national educational community.

New Jersey's overriding recent problem has been the accommodation of its college students in private and public institutions within the State. The number of students to be enrolled has dominated the distribution of capital and operational resources, as was pointed out earlier in this case study. This fact has already affected the excellence and needed diversity of the total educational system. Resources are limited and are becoming more so, and as a result the controls are becoming ever more stringent in Trenton.

In all fairness, the looming shadows of the State Budget Office, the Legislature, and the Governor must be recognized as exerting their own pressures on the Chancellor's office. These pressures are difficult to translate into a common language that will provide understanding within the academic system as well as within the State system of governance.

The position of NCE in all this confusion has been that of losing some of its definition. Recognized as a conservative, carefully administered professional college, with a well-defined mission and plan -- an institution which marshalls its resources most carefully -- NCE now finds itself being measured by the common yardstick of numbers, with little attention paid to its present or future significance in the total scheme of things.

NCE is presently emerging from its initial shock over the attacks on its own autonomy. To continue to retain its hard-won vitality and quality the College knows that it must work more aggressively than ever to convince all elements within the State of its value as an institution.