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INTERDISCIPLINARY RELATIONSHIPS IN ENGINEERING COLLEGES

ENGINEERING RESEARCH

by

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SUMMARY

Interdisciplinary programs in engineering colleges would be helped by:

1) placing the few available individuals who have outstanding ability as educators, researchers and administrators in the most responsible jobs and using the least technically qualified tenured faculty for routine paperwork; 2) development of a faculty and student recruitment program which recognizes the number of women students is increasing rapidly and engineering assignments of the future can be filled as well by women as men; 3) putting much more emphasis on interdisciplinary engineering education for extended overseas professional service and 4) developing interdisciplinary programs to prepare and motivate engineers for the policy making role of public elective or appointive offices in addition to the staff role currently played by engineers. Interdisciplinary programs seem to be hampered in their development by: 1) departmental provincialism; 2) inadequate technical and administrative ability of tenured senior faculty, department heads and deans; 3) inadequate institutional financial ability to add substantial numbers of quality faculty in a period of declining or steady enrollments and 4) confusion associated with overworking of the term interdisciplinary.

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"Interdisciplinary" -- An Overworked Word

In the last five years the references to interdisciplinary program, interdisciplinary research project, interdisciplinary curriculum and similar designations have become overworked. A day never goes by in an educational institution but the term is heard innumerable times. To add to the confusion, the words "interdepartmental" and "multi-disciplinary" are frequently used as a synonym to interdisciplinary; but in other instances with an intended but undefined different meaning.

To illustrate the misleading results, study a few examples. The first example is associated with agriculture. A few months ago a publication stated that in a U. S. labor force of about 70,000,000 some 64,000,000 were in agriculture and its interdisciplinary fields -- with large numbers in agri-business. Another example involves the communications field. A specialist in communications recently expressed great concern because the departments of physics, electrical engineering, speech, English, music, art and psychology were encroaching on his area. An additional example involves the difficulty currently associated with developing a direction for hydrology. The word has not only a dictionary meaning, but a different meaning for each of a large number of people working in water resources.

The discipline of engineering can be defined to include for each student and professional engineer the basic technical content of the programs normally associated with chemical, civil, electrical and mechanical engineering. Further, for an engineering college to be considered as having a quality program



it must be offering bachelor through doctoral work in these four areas under conditions where the students and staff are qualified and supported by physical facilities and library resources adequate to provide a top educational opportunity suited to each student and faculty member seeking professional stature. This implies to the writer a substantial decrease in the undergraduate program in the number of "required" courses and a substantial increase in the "elective" courses.

For purposes of this paper an interdisciplinary program involves combination of the engineering discipline as defined above with offerings outside of engineering.

Administrative Structure of Interdisciplinary Relationships

The structure of interdisciplinary relationships can take any of the following forms, frequently but not always honored by the creation of a new department or a new interdisciplinary degree.

1. Inter-College: For example, agricultural engineering is an interdisciplinary program even though usually accorded departmental status in a college of engineering or a college of agriculture. The program involves the discipline of agriculture and the discipline of engineering; both of which are accorded college status in most universities.

2. Inter-Departmental: Nuclear engineering illustrates this type of relationship. While accorded separate departmental status in many cases, it can be considered as an offering of chemical or mechanical engineering in cooperation with a physics or chemistry department.

3. Inter-College-Department: Industrial engineering is a possible example, particularly in situations where the program is a joint offering of an engineering college and a department of business.

Many will probably disagree with the above examples -- and for good reason. The examples illustrate that the term interdisciplinary, like hydrology, has a different meaning for each person based on his own subjective experiences. All too frequently administrative organization of the institution is the basis of an individual's particular concept of the meaning of interdisciplinary.

The basis of much difficulty is the confusion between departmental and college labels (administrative structure) and discipline (function). Interdisciplinary can relate only to function.

Engineering College Departmental Structure and Interdisciplinary Programs

The development of quality interdisciplinary programs which might be administered by engineering colleges seems to be occasionally hampered by combinations of at least the following.

1. Mediocre part-time mature tenured associate or full professors who are adherents of provincial department channels and who are out-of-date in terms of technical knowledge.
2. Department heads, who are inept administrators, who think that undergraduate teaching is the only important function of a college of engineering and who fear quality staff and the creation of new departments or programs.
3. Administrators who fail to recognize the need for the sums of money necessary to provide the research facilities, adequate number of faculty and adequate library holdings for a quality bachelor to doctoral program; in comparison to the more modest sums needed per FTE student for a strictly undergraduate program.
4. An inordinate concern at the department head and dean levels about the influence of federal funds upon the direction of research and graduate programs.

More progress in the development of interdisciplinary programs could be made if the faculty, department heads and administrative staff would accept the concept that the administrative structure of a university exists solely for the purpose of carrying out required paperwork. Further, that this structure is to assist the faculty member in performing the best teaching, research and service of which the individual is capable without regard to whether or not the individual is devoting all his efforts in technical areas under the jurisdiction of his department head. In such an administrative climate the faculty could work as functional groups (interdisciplinary groups) without the frustrations imposed by the mistaken concept that interdisciplinary means inter-departmental or inter-administrative unit.

Engineering College Faculty and Interdisciplinary Relationships

Engineering colleges seem to have a problem similar to other academic disciplines which do not have expanding enrollments at a time when total university enrollment is increasing. When enrollment is nearly constant or declining it is difficult to have sufficient staff turnover to permit rapidly building up and maintaining top quality faculty while meeting the need of providing a reasonably honorable assignment for outdated staff. Technically qualified faculty are frequently the younger staff. These younger staff also seem to be the ones most interested in interdisciplinary educational and research programs. The senior full-professor staff sector seems to contain the provincial tenured group that cannot see beyond the confines of an isolationist departmental structure.

The suggestion which is frequently heard is that if a dean or department head could do away with the old tenured staff he could build a top quality department. This is an irresponsible shallow approach. An institution or organization in our present day society has an obligation to provide a respectable

assignment and reasonable income to any faculty member who has devoted many years of satisfactory service to the institution, whether or not he is tenured. In this day of increased emphasis on interdisciplinary team methods and rapidly increasing knowledge it has become increasingly important to recognize the value of technically competent staff without administrative duties. It is also important to increase the use for minor administrative duties of staff who have become obsolete.

Senior staff who have fallen behind and who are beyond the age to reasonably be expected to update themselves or young assistant professors who have an aptitude for administration, should be used for minor administrative duties such as department head over a small program. These people could perform routine assignments which must be done, but which do not require using top staff or associating top salary or position with a minor administrative staff-type assignment.

On the other hand, in order that program leadership and management, planning and faculty selection be under capable guidance, large departments and all colleges of engineering should have a really outstanding educator, researcher and administrator in the most responsible positions; supported by an adequate number of second-tier administrative staff positions. These leaders should have the following qualifications.

1. A demonstrated lecturing or teaching ability.
2. An earned doctorate in one of the disciplines for which he is responsible.
3. Active involvement in research or scholarly study through teaching at least one graduate course each year or through continuous service as major professor for at least one doctoral candidate.

4. Recognized leadership ability by the faculty, his professional colleagues about the nation and in the faculty recruitment process.
5. Participation in the technical activities of national professional societies.
6. A demonstrated fiscal planning and fiscal management ability.
7. A demonstrated ability to separate important activities from ones which should be delegated or which do not need to be performed.
8. A record of at least one quality paper being presented to professional meetings or journals each year.
9. An established entry to the officers responsible for administering fiscal resources at the national level and to his congressional delegation.
10. A demonstrated guidance and counseling ability.
11. An ability to conduct long- and short-term planning of educational, research and service programs; and an ability to implement plans on a reasonable time schedule.

Students and Interdisciplinary Programs

Considerable experience in the last three years has led to the conclusion that students are attracted to interdisciplinary programs. This is particularly true of engineering oriented programs under the administration of arts and sciences. There are several reasons why interdisciplinary programs seem so attractive to students, in addition to the interesting names associated with some of these programs.

Some of the interdisciplinary programs are available to women students. With the relatively rapid increase in women students, frequently of higher

academic ability than the male students, programs which appeal to them will be expanding in enrollment and in the numbers of new faculty to be added to the staff. It seems reasonable to conclude that engineering enrollments could be increased if:

1. Engineers would admit that the changing job duties of engineers are such that increasingly, females could as well do the job as males.
2. Engineering faculties would appoint a few female engineers to their respective faculty, who in turn could help keep female students enrolled in engineering.
3. Engineers would get out of their self-imposed cell and actively communicate in the high schools and parents' organizations the idea that future engineering jobs can use at least equal numbers of men and women.

It appears that the students recognize better than the engineers that the engineering colleges, like the agriculture colleges, are facing a changing social need. The changing needs in the country can probably be better met by the product of programs in the biological, physical and social sciences than by the present product of engineering programs. Agriculture has seen this largely in the form of a declining enrollment in agriculture but an increase in agri-business and the use of the product of colleges of arts and sciences in the processing and distribution industries. Engineering is seeing the same decrease in enrollment -- and what might have been engineering jobs being handled better by mathematicians, physicists, chemists, biologists and business administrators.

More Interdisciplinary Needs

Several sectors of our engineering colleges need to develop top quality programs for which the anticipated job opportunities will be overseas. This development should probably emphasize in the first years the civil and agricultural engineering departments. The programs should be developed so that the

student is prepared and educated to devote perhaps over half of his professional career overseas. Such programs not only provide outstanding professional opportunities; but our nation needs qualified engineers in overseas service for our national survival and the underdeveloped countries need such people to be available if the widening gap between the rich and the poor nations is to be narrowed.

While it is not clear just what steps are needed, it is clear that the engineering profession needs to develop some interdisciplinary programs which will both motivate and prepare engineers for public service as legislators, congressmen, city mayors and other policy making elective or appointive public offices. Engineers complain about political decisions but do not seem to recognize that the activities of our society are controlled by policy development which is based on the social-political process of allocation of fiscal and other resources. Either due to lack of motivation, interest, education or ability, engineers do not act by getting out of the staff positions of action agencies and into the policy positions of elective or appointive public office.