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III

HUMAN RESOURCES: FACULTY DEVELOPMENT, RETENTION AND DEVELOPMENT

INTRODUCTION

New Jersey Institute of Technology has teaching and research openings for which qualified faculty have not been found. Faculty recruitment in areas of rapidly developing fields is a problem of national dimensions. For NJIT, the state's primary source of technological professionals, the situation is equally critical.

A principal objective of the Institute is to provide high quality professional education in response to an increasing demand for graduates in an increasing variety of programs. The Institute also has a responsibility to conduct research and to provide technical services to agencies of the state, to local government and to the industrial community. These far-reaching objectives must be attained at a time when all the current trends for the availability of qualified faculty are declining and when the average age of NJIT's faculty forecasts an accelerating need for replacements in the years immediately ahead.

NJIT has in place many of the mechanisms for addressing this situation. The Task Force's study was directed therefore, to the question of how to best utilize and, where necessary, augment existing mechanisms to meet effectively the challenge of human resource development now confronting the Institute.

THE CURRENT SITUATION

Difficulty in recruitment, retention and development of engineering, science and business faculty has become a national crisis. The American Association of Engineering Societies (AAES), as recently as June 1981, issued a letter to some two hundred and fifty university presidents appealing for action in what AAES candidly termed "The crisis in engineering education." Encouraged by President Carter's July 1980 memorandum to the Secretary of Education and Director of the National Science Foundation which raised".....increasing

concern whether our science and engineering education is adequate both in quality and number of graduates for our long-term needs," AAES requested presidents of institutions with engineering programs to take action to strengthen engineering education and restore the attractiveness of positions and careers on its engineering faculties.

The shortage of qualified faculty for institutions providing education in engineering, business and computer science is serious. The demand for engineering graduates at all levels has been increasing. If the national economy resumes its growth, the demand for engineers is likely to further escalate with fewer engineering graduates seeking advanced degrees to prepare for careers in teaching, as higher-paying jobs that do not require the doctorate are available in industry.

Already, the electronics industry which has experienced an average annual growth rate of 17% for the past ten years, has a shortage of technical personnel that "threatens to balance the international trade scales against us."[1] A survey by the Industrial Research Institute projects that due to corporate growth and future personnel losses, the need for scientists and engineers from now to 1985 will be 25% of the current levels of employment. The most important technical disciplines cited are mechanical, chemical and electrical engineering.[2] However, industrial engineering is now identified as an area of especially critical need as is also the case in computer science. A spokesman for the semiconductor industry has termed the shortage of trained personnel as the greatest threat to American leadership in semiconductors. He notes that Japan, with half the U.S. population, graduated 20,000 electrical engineers in 1978, an upward trend, whereas our 14,000 graduates in 1978 were down slightly from previous years.

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[1]American Electronics Association 1981. Technical Manpower Shortages the Electronics Industries. Statement prepared for the Senate Select Committee on Small Business, February 18, 1981. AEA 2600 El Camino Real, Palo Alto, CA 94306

[2]Industrial Research Institute 1980. Survey Results on Technical Manpower Requirements. IRI News, December 1980. 100 Park Avenue, New York, NY.

Furthermore, both the faculties and the facilities in most U.S. universities lag several years behind the state of the art in private industry.[3]

Adequate supplies of petroleum have, for the moment, decreased interest in synfuels; yet an increased demand is expected for engineers in this field at both the baccalaureate and advanced levels.

The net result is a projection of potentially unsatisfied PhD requirements from 1982-1987 of 3,000 to 3,500 per year, depending upon the rate of economic growth, R&D expansion, and emigration.[4] This is supported by the High Trend I project of the Bureau of Labor Statistics which estimates that employment of engineers will grow 60% faster than total employment.[5] There are those who believe that engineering employment will increase even more rapidly than the BLS predicts.

IMPACT ON ENGINEERING EDUCATION

Institutions with programs in engineering, business or computer science have observed with growing concern, the following trends:

1. Engineering colleges have granted almost 54% more bachelors degrees in the past five years whereas the output of doctorates has decreased by 13%. In engineering, the output of doctorates peaked in 1972 and has been dropping ever since.
2. In the field of engineering, the number of degrees conferred annually is declining relative to other industrialized nations.
3. High salaries offered to bachelor and master degree graduates are a

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[3]Floyd Dyamme, January 26, 1981. Testimony to the U.S. Senate Budget Committee, Subcommittee on Industrial Growth and Productivity. On behalf of the Semiconductor Industry Association.

[4]Landis, Fred 1981. The Demand for Doctorate and Master's Degree Holders in Engineering Through 1987. Paper prepared for ASEE Annual Meeting, June 1981.

[5]Max L. Carey, "Occupational Employment Growth Through 1990," Monthly Labor Review, August 1981, pp. 42-55.

strong contributing factor in decreased enrollment in doctoral programs.

4. Teaching and research equipment in engineering schools is becoming outdated at a growing rate. The Accreditation Board for Engineering and Technology (ABET) indicates that only 56% of all engineering programs visited in 1979-80 were accredited for a full period of time and that written statements to almost all programs visited cited the need to modernize laboratory equipment.
5. There exist significant salary disparities between younger faculty and their counterparts in industry. Faculty salaries have not been responsive to the supply and demand situation; for example, industrial salaries for bachelor graduates are sometimes higher than those currently paid to experienced faculty.

IMPACT ON THE STATE ECONOMY

New Jersey is particularly dependent on scientific and technical resources. It is a national leader in high technology industries such as chemicals, pharmaceuticals, electronics, computers, defense, communications, petroleum refining and distribution. New Jersey is one of the nation's leaders in research and development with hundreds of laboratories, and it is one of the nation's leading corporate headquarter states.

A significant report issued April 1981 by the State's Office of Economic Policy entitled "The High Technology Economy and Higher Education" makes the case that "New Jersey's future economic prosperity will depend to a large extent on the State's success in nuturing and augmenting its high technology industries." A memorandum from the Chancellor of Higher Education to the Members of the State Board of Higher Education in September 1981, points to the 1981 Statewide Plan for Higher Education as a broad affirmation of the

responsibilities of higher education and cites the specific current problems of technological education. In this memorandum, the Chancellor specifically cites the problem in New Jersey of faculty and graduates of undergraduate programs in engineering and computer science being lured away from teaching and academic research into private industry by well-paying jobs and of obsolete research equipment and inadequate laboratory facilities. As a consequence the Chancellor has proposed the idea of creating a Special Commission on Science and Technology and made this an item for the agenda of the Board's meeting of October 23, 1981. He has requested that state supported institutions of higher learning submit a "high technology" budget addendum to begin to address some of these questions.

THE OUTLOOK FOR NJIT

It is unlikely that significant numbers of additional faculty lines will be authorized for NJIT in the next decade. Most new faculty will replace either young untenured faculty who leave for other positions or older tenured faculty who retire. The Institute must therefore meet the changing technological and societal demands made of its educational programs largely with current faculty numbers.

This faculty must continue to demonstrate professional excellence and yet be capable or responding to changes in student needs and in the content of programs of study. The need for faculty development will increase.

Projections of supply of engineers to fulfill growing national demand are based on the assumption that engineering schools will be able to educate all who want and are qualified to attend. An insufficient number of appropriately qualified faculty may limit some institutions in this regard. Faculty shortages, present and future, may be even greater in the computer science area and in certain specialties in management and the basic sciences. The entry

level requirement of new assistant professors has been the doctorate and the number of people pursuing this degree in engineering is declining. Competition in faculty recruitment will decrease.

In addition to providing high quality professional education, NJIT has a special responsibility to provide technical services and assistance to state and local government agencies and to the industrial community by providing training programs and by undertaking research that addresses the needs of New Jersey and the nation. NJIT recognizes a special relationship to state agencies and has moved aggressively to fulfill this role. Examples of agency cooperation include a statewide energy audit program established with the New Jersey Department of Energy, a variety of programs created in concert with the Department of Environmental Protection and recent activities undertaken with the Department of Transportation. The Division of Continuing Education at NJIT also offers dozens of courses and seminars including those which deal with such timely subjects as fire prevention and the management of hazardous wastes.

With specific references to public service and research, the 1981 New Jersey Statewide Master Plan for Higher Education states that NJIT should provide public service and engage in programs of research which are primarily for, but not limited to, applications orientation. These clearly highlight a special emphasis on the interaction between technology and society. Research and public service together with instruction comprise the mission of NJIT. They are essential functions for any institution which is described as a "university."

Another element of the Statewide Master Plan recommends that NJIT offer upper division segments of baccalureate programs in engineering technology. These are to be offered at community colleges in the central and southern parts of the State which have articulating lower division programs. Working with

representatives of interested community colleges throughout the State, NJIT has committed itself to strengthening programs of articulation. The following excerpt from the NJIT Master Plan Phase II expands upon this policy: " . . . toward the same end, the Institute will offer appropriate courses and programs at community colleges and in articulation with community colleges, and at other off-campus locations where needed. Extended outreach will apply also in expanded pre-college and admissions activities."

The challenge to NJIT, therefore, is to meet these increasing needs without significantly increased numbers of faculty.

RESPONSIBILITY FOR FACULTY RECRUITMENT AND DEVELOPMENT

While the responsibility for faculty recruitment, retention and development rests organizationally with the Vice President for Academic Affairs and the deans, the implementation of appropriate activities in this regard are the responsibility of the department faculty and its chairperson. Academic departments are assisted by the Employee Relations Department in preparing position opening announcements and placing advertising copy and processing responses. However, follow-up action remains the responsibility of the individual departments within the approval authority of area deans and Vice President for Academic Affairs.

Appointment of non-tenured full-time tenure-track faculty is generally for one academic year. Under limited circumstances an appointment contract may have a duration of three years. NJIT follows the usual "up or out" policy. While it is generally expected that any professional in education will continue academic development after first employment at NJIT, promotion and tenure policy requires it.

The extent of training and orientation programs for Institute employees

varies with department, job requirements and employee abilities. In large measure, training and orientation activities have been the responsibility of the department head.

AFFIRMATIVE ACTION

An integral part of the Institute's personnel policies and practices relates to affirmative action in employment. The basic policy statement is promulgated in the "Affirmative Action Plan of New Jersey Institute of Technology" dated April 22, 1977. This document has been filed with appropriate agencies and is maintained in the Office of Affirmative Action. The Institute publishes an annual report updating statistics and guidelines which are derived from the baseline data concerning staffing, recruiting pools and appropriate goals. Initial data indicate that the Institute is doing an effective job of achieving employment goals for administrators and support staff. Further activities are being strongly directed toward increasing faculty and graduate student representation from among underrepresented minorities and women, particularly in engineering.

ASSURING A PROPERLY STAFFED AND COMPETENT FACULTY

Although the procedures related to recruitment, promotion and tenure of faculty have been and continue to be operating in a generally satisfactory manner, areas of concern exist. These are receiving the attention of both the administration and the faculty. However, the important question pertaining to faculty recruitment, development and retention is this: How can NJIT continue to be sufficiently attractive to qualified faculty in order to compete successfully with available alternative employment opportunities?

Of particular importance is the question as it pertains to young faculty. Russel C. Jones, Vice President for Academic Affairs, Boston

University, cites the need to " . . . draw more young engineers into vital teaching careers and retain older ones" and states the following:[6]

> "If we are going to attract the brightest bachelors level graduates in engineering into the PhD pipeline, they must be able to see that current engineering doctorates are well rewarded in society.
>
> Universities must find the will and mechanism to provide market-place differentials for faculty members in high-demand areas such as engineering.
>
> One of the major factors which makes engineering faculty positions less desirable than industry positions is the significant in-equality of laboratory equipment and support personnel."

A joint National Science Foundation-U.S. Department of Education study includes the following suggestions for coping with the faculty recruitment and retention problems.[7]

1. Improve research and teaching environments; e.g., reduced teaching loads for those active in research, better research facilities and support.
2. Allow faculty to earn more money outside.
3. Encourage industry support of university research groups.
4. Make available industrial research facilities to faculty members.
5. Generate cooperative arrangements whereby faculty members engage in industrial research and engineers from industry serve in university departments.
6. Foster industry-university cooperation to establish work/study programs at the graduate as well as undergraduate level.

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[6]Russel C. Jones, "Speaking Out - Some Solutions to the Faculty Crisis," Graduating Engineering, November 1981, pp. 86-88.

[7]Science and Engineering Education for the 1980's and Beyond. Prepared by the National Science Foundation and the Department of Education, October 1980, pp. 9-10.

The Engineering Action Forum of National Leaders, sponsored by the National Association of State Universities and Land-Grant Colleges, has proposed a number of steps (in addition to those cited above) that universities may wish to explore.[8] Among these are:

1. Encouraging the most promising undergraduate students to continue on for graduate work (e.g., by providing an adequate package of financial support such as a three to four year commitment to the student and by public recognition of student abilities).
2. Seeking to appoint qualified retired industrial and governmental employees with appropriate teaching skills.
3. Increasing the number or frequency of sabbatical leaves.
4. Encouraging and supporting faculty efforts to develop contacts with industry to obtain support for faculty development.
5. Instituting programs of major prizes and grants for unique faculty accomplishments.
6. Promoting and supporting the development of effective management skills at the department level.

CONCLUSIONS AND DIRECTIONS FOR PROGRESS

NJIT has in place many of the mechanisms proposed for addressing the situation and may well be ahead of other institutions in its policies and practices for promoting the recruitment, retention and development of faculty. NJIT has long had a traditional sabbatical leave policy in existence, funding for faculty travel and professional development is provided, and release time for research and public service activities is available. Graduate student

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[8]American Society of Engineering Education (ASEE) March 1981. "Universities Limiting Engineering Enrollments," Engineering Education News.

assistance is provided faculty for teaching and research. Recently, sabbatical leave policy was improved to add the possibility of eighty percent salary support for a full academic year.

Corporate support is actively solicited by the Institute to support research, to provide laboratory equipment and to finance other developmental interests of the faculty. Relations with industry are fostered and are manifest in various ways including advisory committee memberships, cooperative education programs and student projects.

Given the metropolitan location of the Institute, opportunities for consulting are available to faculty as are opportunities to participate in NJIT's Continuing Education offerings. Teaching schedules generally are arranged to provide one day per week for such activities. It is now possible for the Institute to provide some salary support for faculty research initiated during the summer months in addition to release time during the regular academic year. With this support, the Institute may now offer a new Assistant Professor a base salary of approximately $22,000 for the academic year supplemented, for the first year or two of employment, with up to $4,800 additional for summer research. This results in an annualized salary of $26,000 to $27,000. Compared with the average starting salary for new graduates in engineering in 1981 of $24,000 the disparity in salary is somewhat ameliorated as a result of summer payments, although, admittedly, faculty appointment requires the doctorate and comparison is being made with baccalaureates.

In the following six graphs, the salaries of NJIT's faculty are compared to average national levels.

In the first group of three, NJIT salaries are compared with average national academic salaries (for all disciplines). In the second group of three they are compared to annual salaries for all engineers. In order to make NJIT

salaries comparable with annual salaries 15% is added to the academic year salary. The choice of 15% is arbitrary but agrees with the usual practice at NJIT to annualize a salary when converting academic to annual.

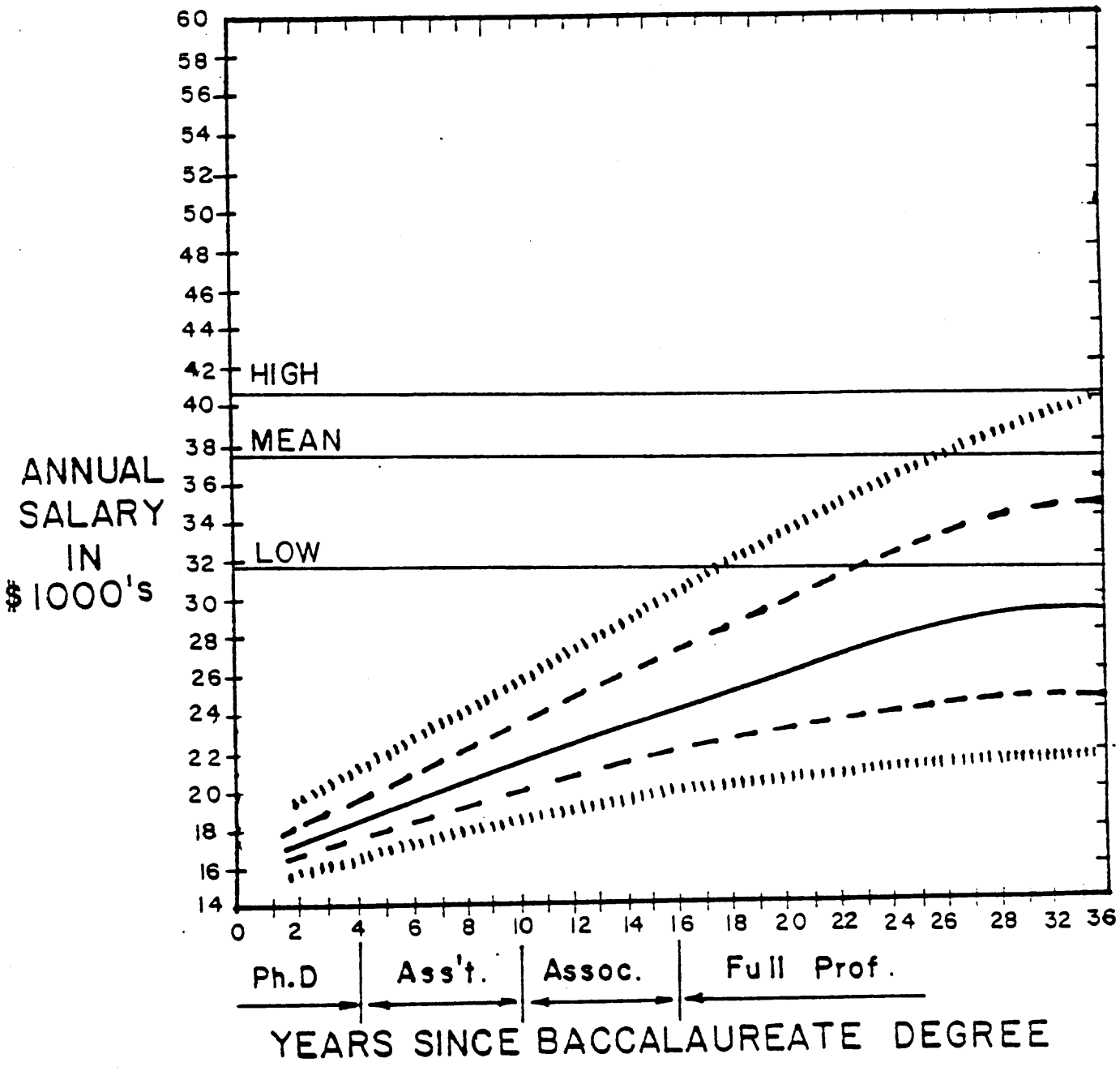
In each graph the horizontal lines labeled high, mean, and low represent NJIT salaries. The curves represent national figures. The horizontal axis, labeled "Year Since Baccalaureate Degree," has been (arbitrarily) subdivided into typical periods spent in obtaining a doctorate (4 years), as an assistant professor (6 years), as an associate professor (6 years) and full professor.

See Tables Beginning Next Page.

SALARIES OF

NJIT PROFESSORS

AS COMPARED WITH WEIGHTED NATIONAL AVERAGE ALL FACULTY SALARIES 1980



LEGEND

UPPER DECILE

UPPER QUARTILE

MEDIAN

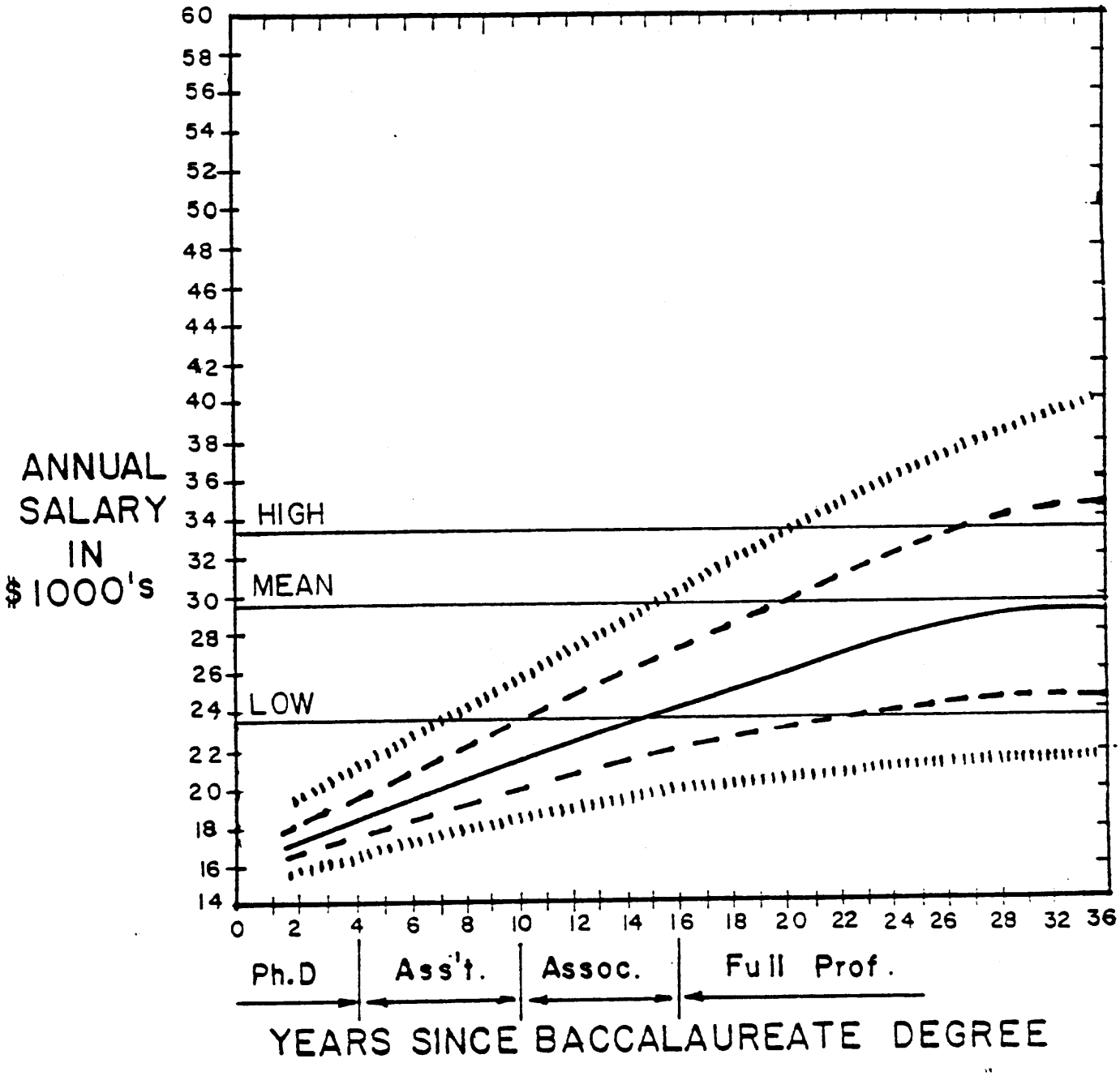
LOWER QUARTILE

LOWER DECILE

SOURCE AAES 1980

SALARIES OF
NJIT ASSOCIATE PROFESSORS

AS COMPARED WITH WEIGHTED NATIONAL
AVERAGE ALL FACULTY SALARIES 1980



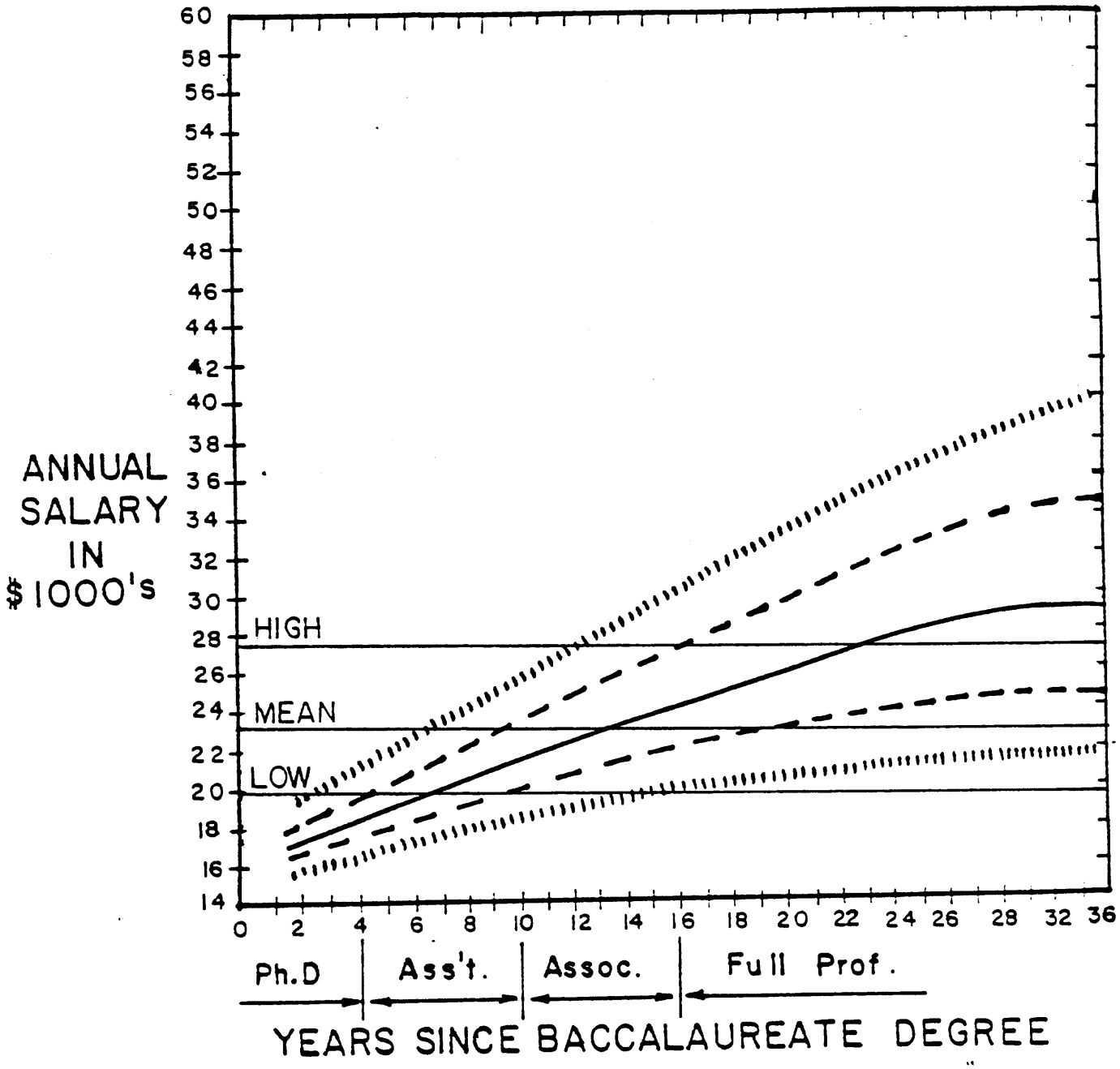
LEGEND

UPPER DECILE
UPPER QUARTILE
MEDIAN
LOWER QUARTILE
LOWER DECILE

SOURCE AAES 1980

SALARIES OF
NJIT ASSISTANT PROFESSORS

AS COMPARED WITH WEIGHTED NATIONAL
AVERAGE ALL FACULTY SALARIES 1980



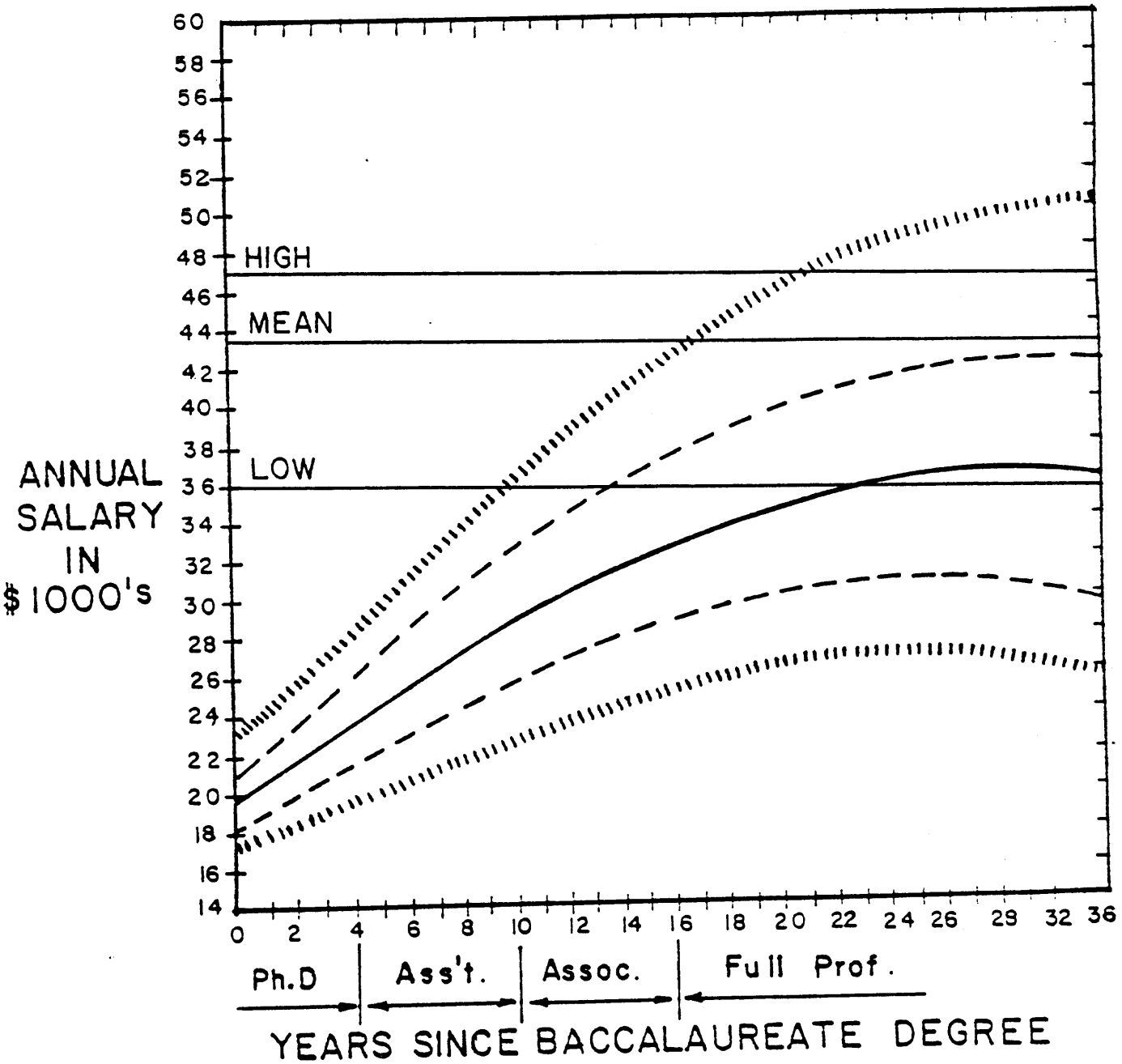
LEGEND

UPPER DECILE
UPPER QUARTILE
MEDIAN
LOWER QUARTILE
LOWER DECILE

SOURCE AAES 1980

SALARIES OF
NJIT PROFESSORS
(ACADEMIC YEAR + 15%)

AS COMPARED WITH WEIGHTED NATIONAL AVERAGE ALL ENGINEERS 1980



LEGEND

- UPPER DECILE
- UPPER QUARTILE
- MEDIAN
- LOWER QUARTILE
- LOWER DECILE

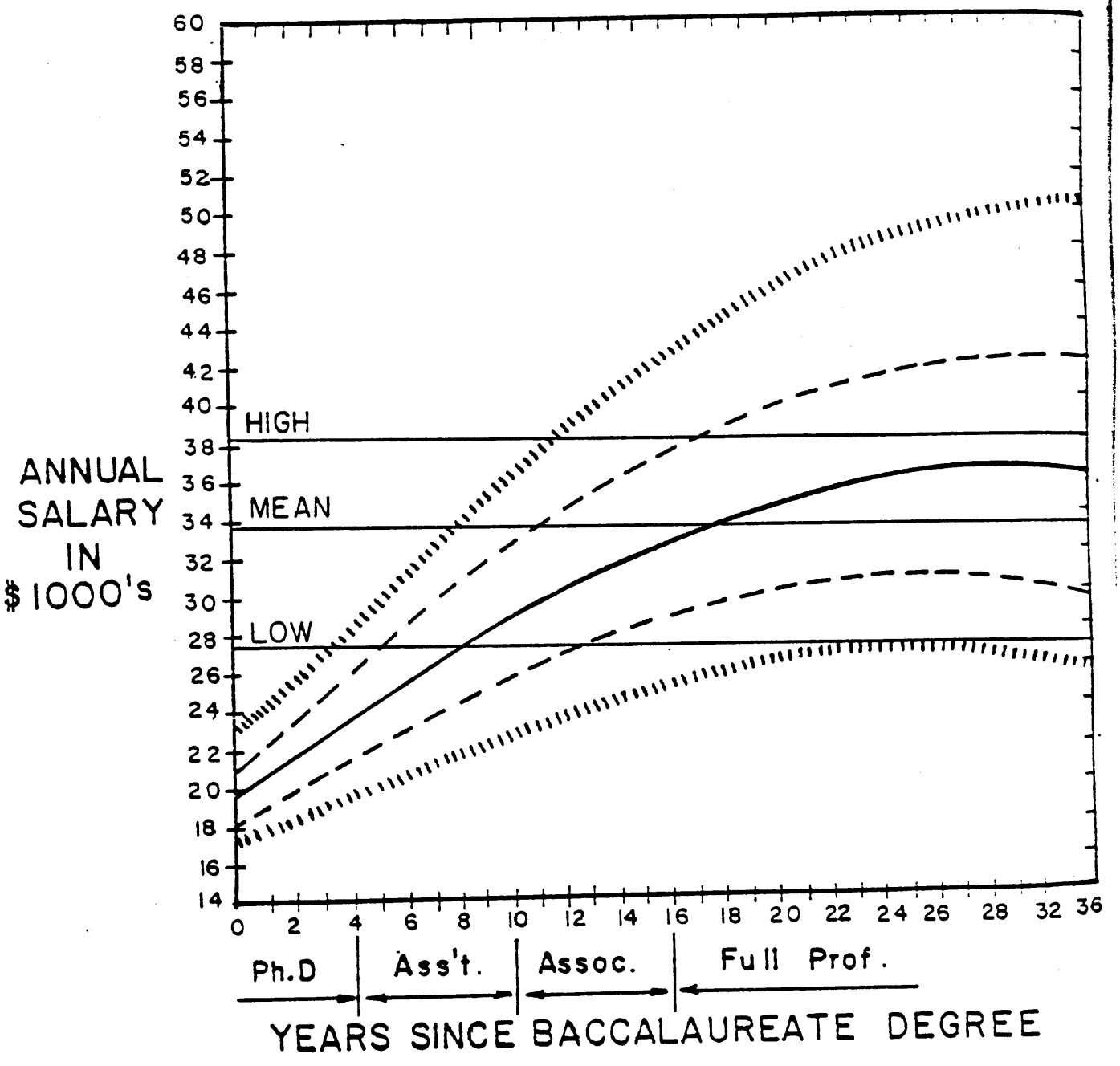
SOURCE AAES 1980

SALARIES OF

NJIT ASSOCIATE PROFESSORS

(ACADEMIC YEAR + 15%)

AS COMPARED WITH WEIGHTED NATIONAL AVERAGE ALL ENGINEERS 1980



LEGEND

UPPER DECILE

UPPER QUARTILE

MEDIAN

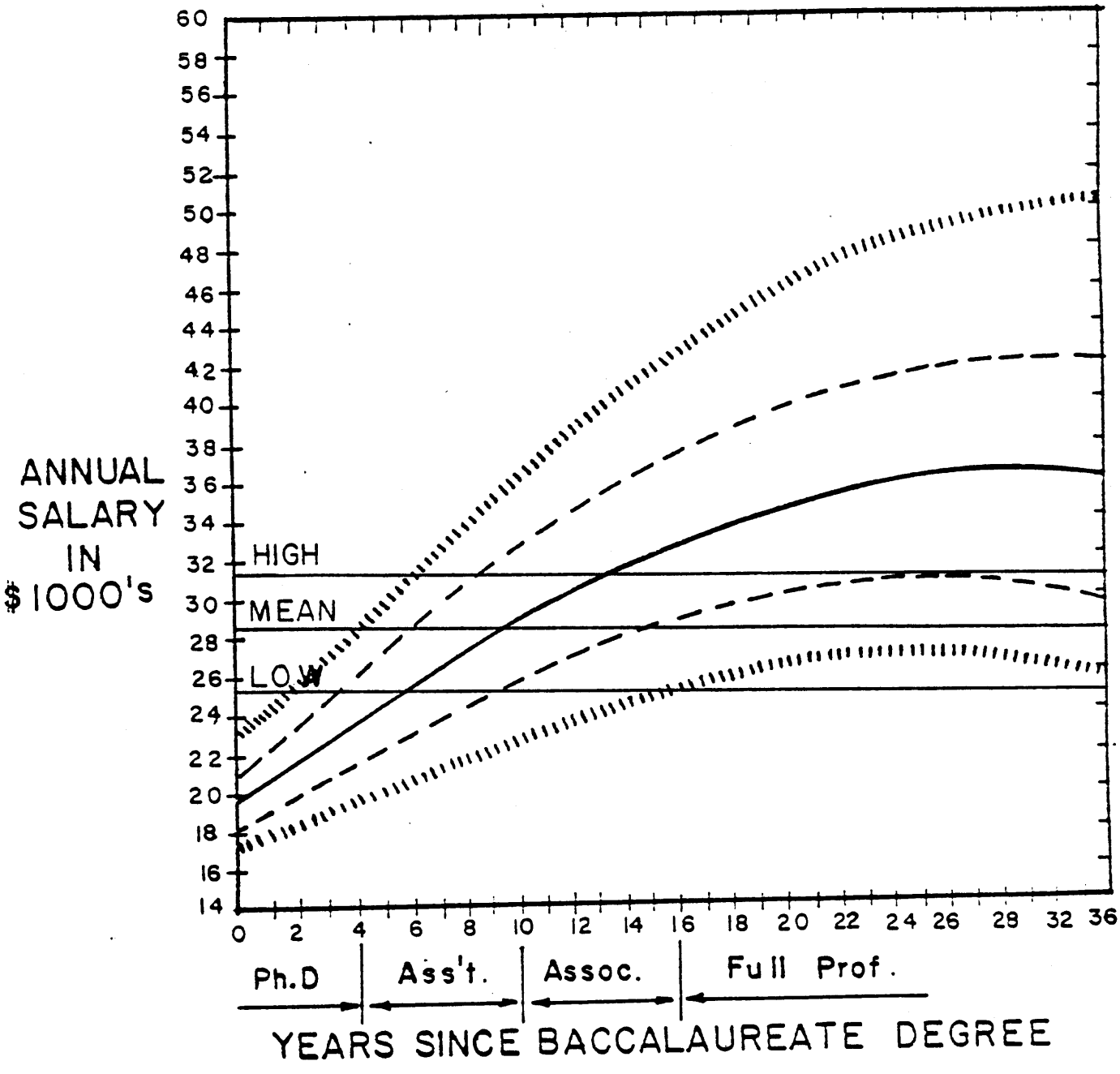
LOWER QUARTILE

LOWER DECILE

SOURCE AAES 1980

SALARIES OF
NJIT ASSISTANT PROFESSORS
(ACADEMIC YEAR + 15%)

AS COMPARED WITH WEIGHTED NATIONAL AVERAGE ALL ENGINEERS 1980



LEGEND

- UPPER DECILE
- UPPER QUARTILE
- MEDIAN
- LOWER QUARTILE
- LOWER DECILE

SOURCE AAES 1980

Mechanisms exist for the recognition of meritorious faculty. A merit [illegible] is in effect, annual awards for teaching, research and public [illegible] are given and Institute publications devote special attention to [illegible] accomplishments, new programs and Institute development.

Class size, although increased by past standards, remains relatively [illegible] as compared with other institutions.

Recently, a management development program for supervisors, administrators and department chairpersons was initiated.

Notwithstanding the fact that many faculty recruitment, retention [illegible] development measures currently receiving wide attention and endorsement in the educational media are already operational at NJIT, it is recognized that to compete successfuly in the marketplace for prospective faculty, even greater [illegible]s must be offered. This will require careful and imaginative planning.

[illegible] Recruitment

The Task Force submits the following proposals aimed at promoting the [illegible]veness of employment at NJIT to persons the Institute desires for [illegible] appointment. As is indicated, many of these are already in place, [illegible] require further definition, others are in the initial stages of [illegible]mentation and some would be new departures for the Institute.

1. [illegible]mine the expanded use of salary inducements for appointment purposes including summer payments and support by outside funding [illegible] as the recently acquired Exxon grant.
2. [illegible]ntify opportunities for additional appointments at advanced faculty rank for persons with the appropriate qualifications recognizing that in some instances this may be difficult because of impact on present staff.
3. Department chairpersons and deans should examine possible teaching

schedule and course configurations to permit additional amounts of release time for faculty to pursue research and service activities. (This is currently being implemented in some departments.)

4. Re-examine criteria for faculty appointment in specific fields of current and projected need such as engineering technology, in which traditional criteria may require modification.
5. Re-examine the question of the extent to which a candidate for faculty appointment must demonstrate a research potential.
6. Investigate ways to permit deans and chairpersons to spend more time in recruiting. Associated with this effort, a study should be made of ways to more effectively delegate administrative duties.
7. Maintain as high priority the Institute's current program of upgrading laboratories and academic facilities.
8. Review tenure policy to permit earlier tenure under specific circumstances; e.g., allowing some credit for previous service at a professional rank for assistant professors.
9. Promote the establishment of special faculty chairs in developing fields. (This has been incorporated in the most recent budget submission to the State.)
10. Explore the possibility of offering employment contracts of longer than the present one-year term to enhance attractiveness of employment at NJIT particularly when relocation is required.
11. Review the recently increased graduate assistant stipends in light of the general inability of universities to attract U.S. nationals to full-time graduate study.
12. Examine additional ways to encourage appointment of visiting professors on loan from industry or other institutions for either full-time or

part-time teaching assignment, seminars, faculty development or education development.

13. Consider ways to attract persons from industry to provide greater opportunity for appointment of additional minority and women faculty. Associated with this effort, a study should be made of possible financial stipends, teaching aides and benefits which may be offered to visiting professor appointees. These individuals will also serve as role models for the increasing minority and women student population.

14. Investigate additional possibilities of establishing joint programs with industry for industry sponsored in-plant experiences for faculty and full-time graduate students.

15. Review the Institute's advertising program and consider new approaches to the on-going institutional search program. Associated with this effort consideration should be given the preparation of specially designed promotional literature descriptive of the Institute, New York City metropolitan environment and suburban living, consulting opportunities and other factors which may enhance the attractiveness of NJIT to potential faculty members.

B. Faculty Retention

In addition to proposals listed above for faculty recruitment, other important factors for retention after first appointment should be considered. These are proposed with the recognition that their implementation will require the cooperative efforts of all parties in the faculty governance process and that some items fall within the area of collective bargaining.

1. Examine the possibilities for greater flexibility in advancing individual faculty within established salary schedules and for

providing opportunity for multiple salary increments and changes of salary range.

2. Explore the possibility of providing above-range salary compensation under specific circumstances and explore mechanisms for determining possible inequities in salary status.
3. Re-examine the present "up or out" policy and explore the possibility of providing long-term employment contracts under specified circumstances to serve as a substitute for tenure-track appointment.
4. Explore ways to promote faculty use of graduate aasistants in teaching and research.
5. Explore ways to foster greater scholarly inter-action. Departments should be more responsive to opportunities to conduct seminars and colloquia for persons with common interests to meet and discuss evolving developments.
6. Examine means to encourage more extensive use of sabbatical leave for research and educational development.
7. Examine existing mechanisms for faculty recognition and reward for contributions to their departments and to the Institute, including a review of promotion and tenure criteria.

C. Faculty Development

It is recognized that for faculty development efforts to be most productive, faculty response must be broad-based and continuing. It is believed that new areas, as they develop, may well be best staffed by existing faculty engaged in continuing up-dating activities as addition of new faculty may be somewhat limited. In addition to the preceeding recommendations related to faculty recruitment and retention, many of which apply to faculty development, the following are offered:

1. Develop a skills inventory of faculty to identify areas of strength, weakness and potential and from this, review existing programs for faculty development. (A faculty directory is near completion.)
2. Investigate ways to enhance the role of department chairpersons in encouraging faculty to continue development of professional competence as through assistance in pursuing research support, sabbatical leaves and other development opportunities.
3. Encourage faculty to join in cooperative programs directed toward developing junior faculty.