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Ideas in Practice

Merit Pay—Equitable Selection of Recipients and Increments

W. F. Koehler, *Dean and Distinguished Professor Emeritus, Naval Postgraduate School*

Deans, department heads and faculty group leaders typically strive to distribute merit-pay increments equitably. Professional organizations attempt to aid this endeavor by collecting data and publishing past-year salary distributions by academic rank. During my 15 years of associated experience, I learned that such published distributions were of little current-year use when selecting merit-pay recipients and the magnitude of their increments. Discovering a way to eliminate or reduce some of the inequities would be significantly more useful.

To discover what would be more useful, consider the three distinct, consecutive steps of any merit-pay plan. Step one includes the collection of data for performance evaluation. Step two is the evaluation of the performance data. Step three is the conversion of the evaluations into merit-pay increments. Associated with each step are distinct fears of inequity in those being evaluated and in those performing the evaluations and conversions. The identification and elimination of the inequities associated with any of the three steps would provide for a more equitable merit-pay plan.

Step-three inequities are the easiest to identify and eliminate. The conversion fears of those being evaluated may be inferred from some of their common questions: How are the recipients of merit-pay increments determined? Does the squeaky wheel get the grease? Irrespective of the superficiality, subjectivity or objectivity of the evaluations, the fears of the individual converting the evaluations to merit-pay increments may be inferred from the following question: How can I avoid adding to unidentified inequities in the evaluations when selecting recipients for merit-pay increments and the magnitude of their increments? Such fears and inequities can be eliminated by an objective conversion procedure which in turn provides for a more equitable merit-pay plan.

The scope of this article is confined to the development of a mathematical salary-growth model as the basis of an objective conversion procedure, a demonstration of this procedure as used in an actual school ("School Z") and a summary of ad-

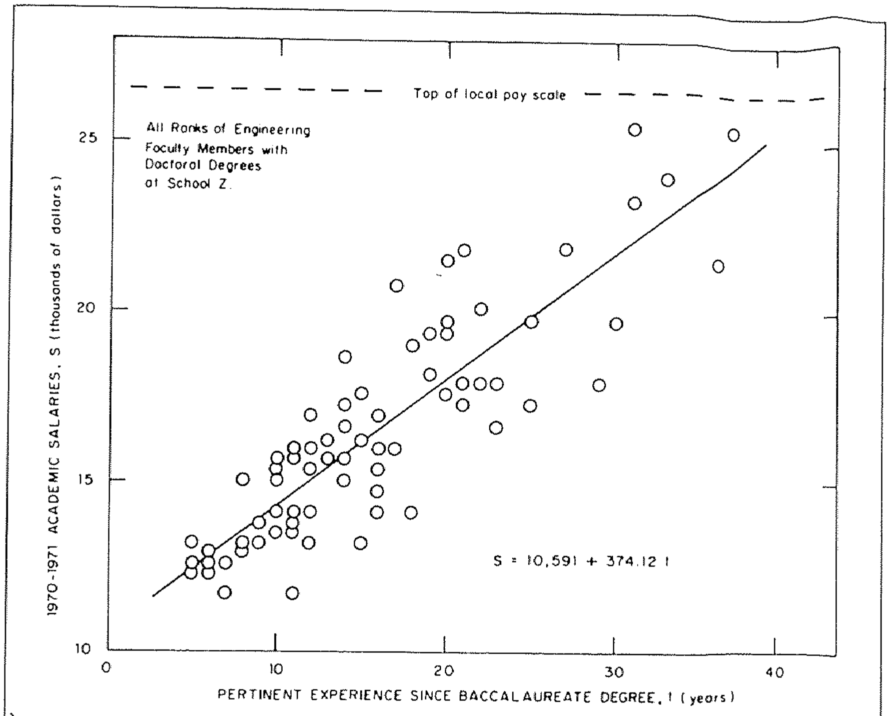

Figure 1. The initial distribution from which progress toward more equitable selection of recipients and increments is demonstrated.

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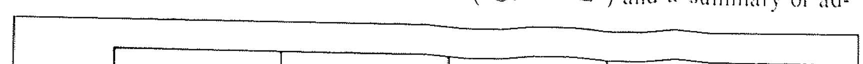

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ditional benefits. The benefits are particularly pertinent to those institutions that use arbitrary criteria to determine pay increments and have lock-step salary-growth patterns.

Development of the Salary-Growth Model

It seems reasonable to assume that faculty salaries depend in general on four major parameters:

1) Level of education and training;
2) Years of pertinent experience;
3) Level of performance and potential; and,
4) Marketability of discipline and specialty.

It is tempting to observe a plot such as figure 1 and conclude that salary is a linear function of experience. If this is true then the influences of level of education, level of performance and marketability of discipline are either nil or vary linearly with experience. This contradiction demonstrates the need to determine the salary dependencies on the four major parameters as a prerequisite to the design of an objective procedure for converting performance evaluations to merit-pay increments.

A reasonable strategy would hold parameters (1) and (4) constant and would search for the salary dependencies on parameters (2) and (3). Accordingly, consider the two theoretical extremes in engineering schools that have faculty members with the same level of education and marketability of their disciplines (figure 2).

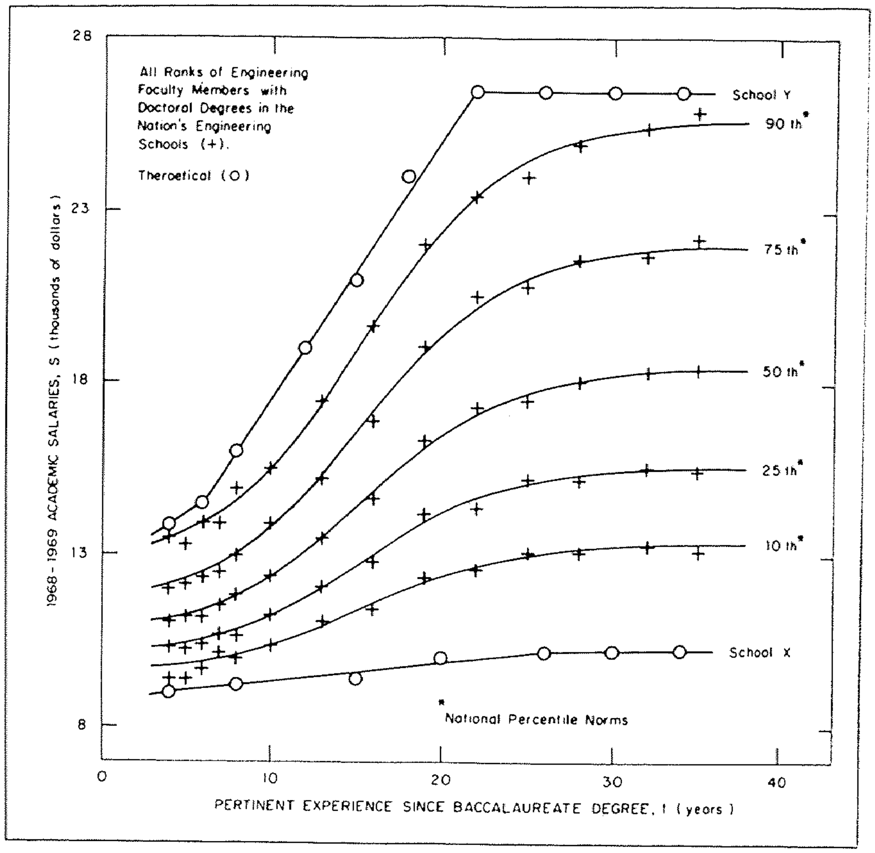

Figure 2. The two theoretically extreme distributions and the national percentile norms published by the Engineers Joint Council in their final report of the 1956-68 series on "Salaries and Income of Engineering Teachers." No comparable reports have since been published by EJC/AAES.

One extreme would occur in School Y, which has the maximum recruiting potential, including maximum resources, rigorous screening of candidates, maximum starting salaries, comprehensive performance evaluations and large merit-pay increments for the top performers retained beyond the probationary period. These top performers would move rapidly toward the top of the local pay scale as sketched in figure 2 and would probably be some of the most effective faculty members in our engineering community. The plotted salary-experience points for School Y represent a snapshot picture of the salary-experience distribution of its most effective faculty members. The continuous line drawn through these points may be considered the expected salary growth of a steady, most effective performer in uninflated dollars in the school of maximum recruiting potential.

The other extreme would occur in School X, which has the minimum recruiting potential, including minimum resources, superficial screening of candidates, minimum starting salaries, superficial performance evaluations and rare merit-pay increments for the least effective faculty members retained beyond the probationary period. These least effective faculty members would move slowly up the local pay scale as sketched in figure 2 and would probably be some of the least effective faculty members in our engineering community. The plotted salary-experience points for School X represent a snapshot picture of the salary-experience distribution of its least effective faculty members. The continuous line drawn through these points may be considered the expected salary growth of a steady, least effective performer in uninflated dollars in the school of minimum recruiting potential.

Administrative experience reveals that the more effective faculty members tend to migrate to schools of greater recruiting potential. The less effective faculty members who are released during or at the end of their probationary periods tend to migrate in the opposite sense. These migrations are motivated by the individual faculty member's search for the unique conditions conducive to self-fulfillment, and the individual school's search for the unique talent to excel in its mission. Partial matching of individual needs and institutional needs is the most frequent outcome of these searches and usually is mutually acceptable because of the inadequate supply of required talent, inadequate recruiting potential or a combination thereof. Consequently, the individual school accumulates

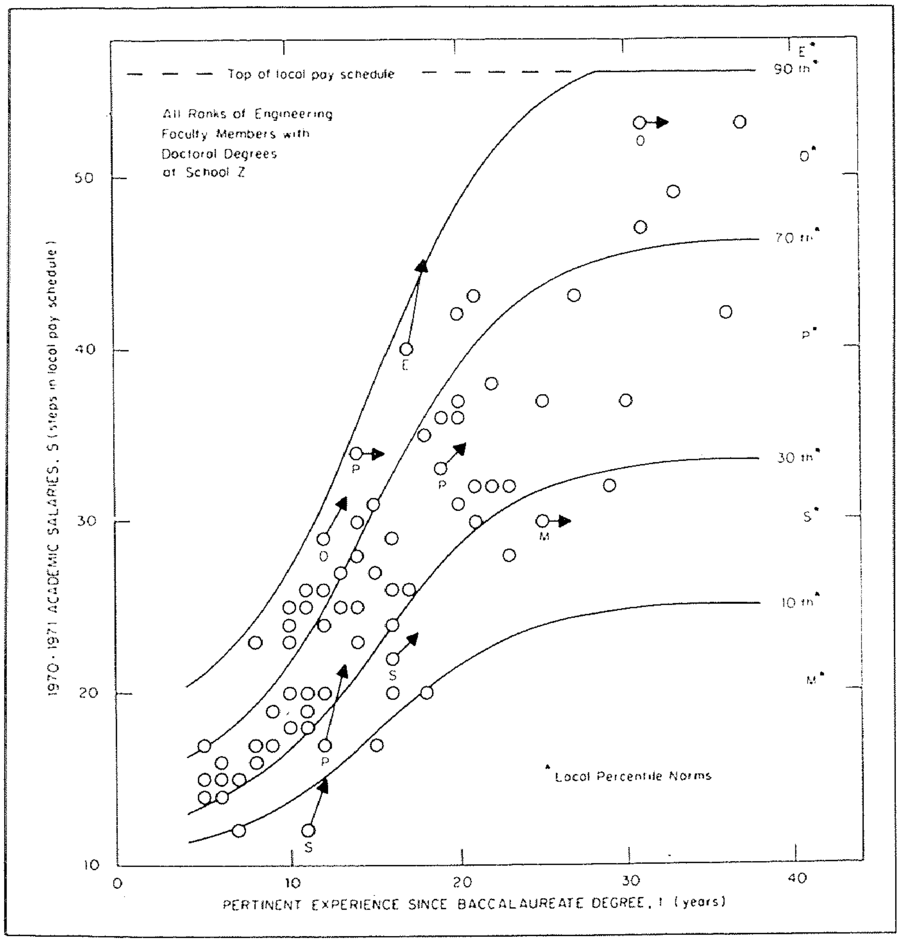

Figure 3. A composite of the plotted points in figure 1 and the national percentile norms of figure 2 transformed to the coordinates of steps in the local pay schedule and years of experience to avoid inflation adjustments. The vertical components of the arrows represent examples of objective determinations of equitable merit-pay increments corresponding to local performance evaluations E, O, P, S and M, irrespective of their subjectivity.

less than its ideal distribution of talent with a diversity of proficiency for the required tasks.

A good example of salaries to represent this national diversity of proficiencies in figure 2 is the set of percentiles reported[1] by the Engineering Manpower Commission (EMC) of the Engineers Joint Council* (EJC) for the academic year 1968-69.** As in the cases of the two theoretical extremes, the plotted points for the various percentiles may be considered a snapshot picture of the salary-experience distribution of doctorate engineering faculty members in U.S. schools with recruiting potentials ranging from minimum to maximum; whereas the S-shaped curve drawn through the points for the nth percentile may be considered as the expected salary growth in 1968-69 dollars of a steady, nth-percentile performer in a school of average recruiting potential. Accordingly, these S-shaped percentiles may be considered as a set of national norms for the salary dependence on experience for various levels of performance of doctorate faculty members in an engineering school with average recruiting potential. As described in the box, this set of norms is adequately represented by equation (1).

$$S_n = K_n + \frac{L_n}{1 + e^{-m(t - t_o)}} \qquad \text{Eq. (1)}$$

S_n represents the nth percentile salaries as a function of t years of experience since the baccalaureate degree. K_n, L_n, m and t_o are empirical constants. This set of norms and its mathematical representation complete the search for the salary dependence on parameters (2) and (3), experience and level of performance, respectively, when parameters (1) and (4) are constant.

Additionally, equation (1) may be used in the case of a set of engineering faculty members with a different level of education; that is, in the case of a variation of parameter (1). For example, the corresponding 1968-69 data reported by the EMC for master's-degree engineering faculty members may be represented by equation (1) but with less precision because of the paucity of data. The corresponding constants K_n and L_n are smaller than those for doctorate engineering faculty members. Furthermore, one would expect that equation (1) could be used in the case of a different marketability of specialty or discipline; that is, in the case of a variation of parameter (4). Of course, it would be necessary to determine appropriately the constants K_n, L_n, m and t_o for this case. Accordingly, the salary dependencies on the four major parameters have been determined and the set of norms represented by equation (1) is the basis of an objective procedure for the conversion of performance evaluations to merit-pay increments.

Demonstration of the Objective Conversion Procedure

A comparison of the linear median

*Changed in 1980 to the American Association of Engineering Societies

**The EMC stated in its 1970 report, "This report should not be confused with the series of *Salaries and Income of Engineering Teachers* reports published by the EJC from 1956 to 1968 under a grant from the National Science Foundation. These reports were based on postcard returns from individual faculty members and went into considerable detail. NSF has suspended its support of these surveys, so there will be no comparable report for 1970." Beginning with its 1970 survey, the EMC changed the method of collecting data and introduced a smoothing procedure in the calculation of the percentiles that obscures significant aspects. As of the date of this publication, EMC's 1968-69 results are considered most representative of the true shape of the percentiles.

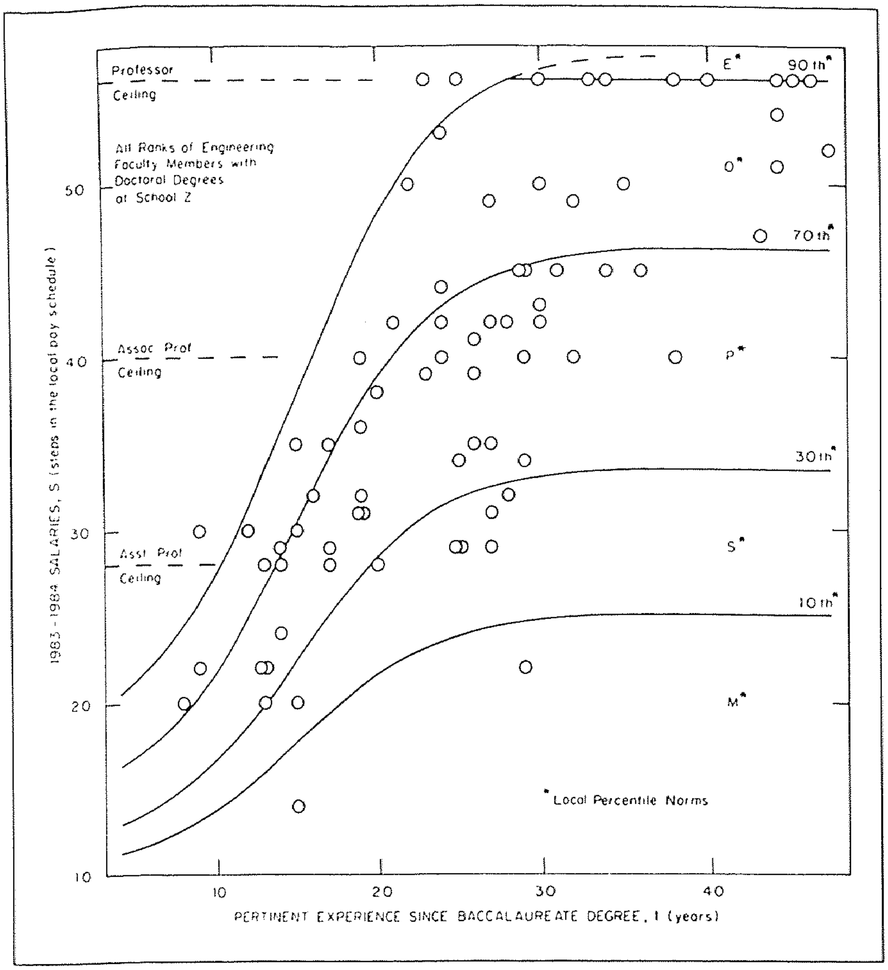

Figure 4. The increased spread of the salary-experience points relative to figure 3 implies 13 years of progress toward more equitable selection of recipients and increments of merit pay, irrespective of inflation.

of figure 1 with the S-shaped, 50th-percentile norm represented by equation (1) reveals the faulty nature of the local distribution of figure 1. The transfer of the percentile norms for various levels of performance from figure 2 to a local plot provides for the rectification of the local distribution by objectively revealing the recipients and magnitude of merit-pay increments. The mechanics of transferring the national norms of figure 2 to figure 3 (pages 226 and 227) to provide local norms are described on page 229. Transfer to figure 3 instead of figure 1 was chosen because the ordinates of figure 3 are steps in the local pay schedule instead of dollars, which separates merit-pay increments from cost-of-living increases and precludes year-by-year inflation adjustments.

The set of four discrete percentile norms in figure 3 was chosen to provide five broad-band levels of performance as local norms: Exceptional (E*), Outstanding (O*), Proficient (P*), Satisfactory (S*), and Marginal (M*). A norm for unsatisfactory performers is not required because such performers are terminated during or at the end of their probationary periods. The actual percentage population in the five levels of performance deviated significantly from the expected 10, 20, 40, 20, 10 percent population per performance level defined by the 90th, 70th, 30th, and 10th percentile norms. These deviations implied the need for more comprehensive performance evaluations to identify the E's and the O's early in their careers and reward them with merit-pay raises.

A few results of the initial, more comprehensive evaluations of the preceding four quarters of performance are inserted in figure 3 near plotted points to demonstrate the objective revelation of a few recipients of merit-pay increments and the magnitudes thereof. For example, the salary-experience point of the labeled E performer with 17 years of experience in figure 3 would move one year to the right along the experience scale in the following year's plot. The vertical component of the vector attached to that E performer's point indicates his movement along the pay-step scale corresponding to an equitable merit-pay increment of five steps. Without the generation of the percentile norms in figure 3, this particular E performer would probably have received a zero increment because of his enviable location in the salary-experience plot of figure 1, and others with lower performance evaluations would have received non-zero increments. The vectors attached to the salary-experience points of the other labeled performers demonstrate the objective selection of the recipients for merit-pay increments from zero to five steps. In this sense, the use of the local percentile norms in figure 3 provides, in an objective manner, for the equitable selection of recipients and increments of merit pay.

Further Benefits of the Objective Conversion Procedure

The conversion procedure was actually implemented in School Z by distributing figure 3 at the beginning of an annual performance-evaluation period. A few ficticious salary-experience points with attached vectors were inserted to demonstrate the objective conversion procedure. Those to be evaluated appreciated knowing their location in the salary-experience plot without sacrificing salary confidentiality. They considered the diagram evidence of some objectivity in the merit-pay procedures and enhanced their respect for the entire merit-pay plan. Those making the evaluations and conversions found the diagram a useful guide.

The initial distribution of figure 3 provided the most compelling evidence of the need to implement more comprehensive performance evaluation, which was soon mutually acceptable. (The description of this comprehensive evaluation is beyond

How to Transfer National Salary Norms (Figure 2) to Local Norms (Figure 3)

Fitting equation (1) to the EMC percentile data of figure 2 required the determination of the four constants K, L, m and t_o for each of the five reported percentiles. This was accomplished by the use of an unconstrained minimization algorithm.[2] The input data included the coordinates of all the plotted points in figure 2 along with weighting factors ranging from 0 to 1. Each weighting factor was proportional to the number of salaries used by EMC to determine the percentile values for each year-group. Preliminary computer runs implied the same value of m and t_o for all five percentiles. The output of the final computer run, which required m and t_o to be the same for all five percentiles, is recorded in the upper portion of table 1. To estimate the validity of the fit, the weighted difference (Δ) between the 70 input and calculated salaries was substituted in $(\Sigma\Delta^2/70)^{1/2}$ which yielded 166. Since 166 is but 1 percent of the 50th-percentile salary at the flex point, the fit is considered excellent.

One would expect that one assumption or criterion would be required to produce a normalizing factor F for the transfer of each national percentile norm to a local plot. However, in the case of transferring the calculated or smoothed values of the 90th, 50th and 10th percentile norms from figure 2 to figure 1, only two assumptions were required. The third was precluded by the discovery of the inherent relation among the percentile norms. That is, the principle of the geometric mean relates, within 0.7 percent, the 75th, 50th and 25th percentile norms for $t \geq 4$ years; and, the 90th, 50th and 10th percentile norms for $t \geq 22$ years.

The smoothed 90th-percentile norm of figure 2 was transferred to the local plot of figure 1 by assuming that the steady, 90th-percentile performer would be accelerated to the top of the local pay scale about 15 years before the 65-year retirement age. This would correspond to $t = 28$ years in figure 1. Accordingly, the top of the local pay scale divided by the salary calculated by equation (1) for the steady, 90th-percentile performer with 28 years of experience produced the normalizing factor of 1.0603. Subsequent multiplication of the other calculated values of the 90th-percentile norm in figure 2 by 1.0603 produced the 90th-percentile norm for figure 1, which, in turn, was transformed to the 90th-percentile norm on the local pay-step scale and plotted in figure 3.

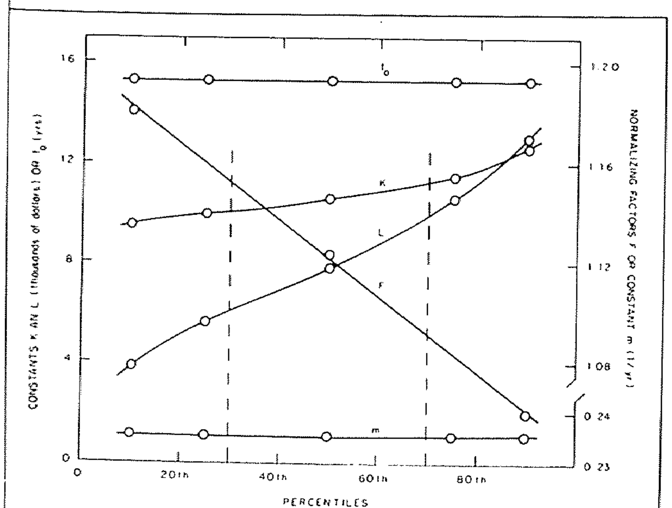

Figure 5. From these graphs of the constants of equation (1) for the reported percentile norms, one may estimate the corresponding constants of the unreported 30th and 70th percentile norms to provide for their plots in figures 3 and 4.

Table 1. Constants of Equation (1) and Normalizing Factors.

Percentile	K (\$)	L (\$)	m (1/yr)	t_o (yr)	F
90th	12,630	13,050	0.23565	15.311	1.0603
75th	11,445	10,600	0.23565	15.311	
50th	10,615	7,861	0.23565	15.311	1.1227
25th	9,972	5,643	0.23565	15.311	
10th	9,527	3,829	0.23565	15.311	1.1800
70th	11,250	9,920	0.23565	15.311	1.0930
30th	10,050	6,050	0.23565	15.311	1.1520

Note: K, L, M and t_o are empirical constants. F is the normalizing factor.

The smoothed 50th-percentile norms of figure 2 was transferred to the local plot of salary-experience points of figure 1 by assuming the local institution had an average recruiting potential. Since the least squares solution for a straight line to represent the plotted points in figure 1 is a good approximation for the median, and since the 50th-percentile norm is nearly linear for $10 < t < 20$, normalization at the flex point was chosen. That is, at $t = 15.311$ the value of S from the equation in figure 1, divided by the value of S from equation (1) for the 50th-percentile norm in figure 2, produced the normalization factor of 1.1227. Subsequent multiplication of the other calculated values of the 50th-percentile norm in figure 2 produced the 50th-percentile norm for figure 1, which in turn was transformed to the 50th-percentile norm on the local pay-step scale and plotted in figure 3.

Having calculated the value of S for the 90th and 50th-percentile norms in figure 1, one can calculate the value of the 10th-percentile norm at $t = 28$ years by using the principle of the geometric mean. Dividing this value by the calculated value of the 10th-percentile norm at $t = 28$ years in figure 2 produced the normalizing factor of 1.1800. Subsequent multiplication of the other calculated values of the 10th-percentile norm in figure 2 by 1.1800 produced the 10th-percentile norm for figure 1, which in turn was transformed to the local pay-step scale and plotted in figure 3.

The set of national norms composed of the 90th, 70th, 30th and 10th percentiles is more realistic for use at the local level. The constants associated with the reported percentiles, which are recorded in the upper portion of table 1, are graphed in figure 5. From these graphs one may estimate the constants and normalizing factors for the unreported 70th and 30th percentiles. These estimates are recorded in the lower portion of table 1 and they provide for the plotting of the 70th and 30th percentiles in figures 3 and 4.

the scope of this article.)

The increased spread of the salary-experience points in figure 4 (page 228) compared with figure 3 demonstrates the effectiveness of the objective conversion procedure as an administrative tool for rectifying a lock-step salary-growth pattern.

The percentage population per performance level in figure 4 is skewed upward relative to the 10, 20, 40, 20 and 10 percent distribution associated with the 90th, 70th, 30th, and 10th percentile norms for an institution with average recruiting potential. This may be interpreted as: 1) lenient performance evaluations and dubious conversions to merit-pay increments in an institution of average or below average recruiting potential; or 2) comprehensive performance evaluations followed by equitable conversions to merit-pay increments in an institution of better-than-average recruiting potential. The record of the institutions from which School Z recruited new faculty and the record of the institutions to which the non-retained probationers migrated support the second interpretation. Accordingly, such comparisons provide an estimate of unreasonableness in the performance evaluations.

Some local management flexibility is associated with the arbitrary choices of criteria for deriving local norms from the national percentile norms. These choices determine the spread between the 90th and 10th percentile norms on the local plot. Additional flexibility is associated with the choice of how rapidly the local institution can afford to rectify its salary-experience distribution. When funds available for merit pay would support only a fraction, f, of the increments determined by the objective conversion procedure, the individual increments would be reduced equitably by multiplying by f and rounding off to the nearest step in the local pay schedule.

Conclusions

The national salary-experience norms for the various levels of performance in figure 2, when transferred to a local plot such as figure 4, continue to provide School Z with a viable and objective procedure for converting performance evaluations into equitable merit-pay increments without adding to the unidentified inequities in the performance evaluations. In this sense, the type of data provided by EMC for the 1968-69 academic year and plotted in figure 2 is significantly more helpful than the past-year salary distributions by academic rank which are published by various professional organizations. It would be of significant value to repeat the 1968 national survey periodically to make the results more representative of the engineering community, and to provide the information for detecting significant changes in the shape of the derived local norms.

The objective conversion procedure has provided not only equitable selections of recipients and increments of merit pay, which in turn contributed to the rectification of the local lock-step salary-growth pattern, but also has been a key influence in the mutual acceptance of more comprehensive performance evaluations. The objective conversion procedure may be considered an effective first step toward more comprehensive performance evaluation.

Equation (1), representing the salary dependencies on the major parameters in the general case, has the potential to provide interdisciplinary as well as intradisciplinary equity. To exploit this potential, survey data similar to that plotted in figure 2 are needed for other disciplines and specialties.

The first derivative of equation (1) for the nth-percentile performer may be written in the form of equation (2) where K + L and K are the upper and lower asymptotes respectively.

$$\frac{dS}{dt} = \frac{M}{L}(S - K)[(K + L) - S] \quad \text{Eq. (2)}$$

This equation predicts that early in the nth-percentile performer's career his merit-pay increments should be proportional to $(S - K)$, should increase to a maximum of $mL/4$ at the flex point ($t_o \doteqdot 15$ yrs) and should thereafter decrease to zero as S approaches the upper asymptote. The compatibility of this prediction with the gross aspects of common practice reinforces the concept of equation (1) as a viable mathematical model for the salary growth of a steady-performing faculty member.

The role of academic rank is demonstrated in figure 4. The salary ceilings for the various ranks are associated with the upper asymptotes of equation (1) for certain steady nth-percentile performers, a finding compatible with common interpretation of these ceilings as career-end plateaux.

Equation (1) has been used[3] to represent growth of a parameter of some simple biological organisms, such as the root length of a bean and the size of a yeast colony in a test tube. It is accordingly tempting to refer to the norms of figure 2 as the natural salary-experience norms for various levels of performance of doctorate engineering faculty members at an engineering school of average recruiting potential.

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