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ABSTRACT

Personnel Simulation (PERSIM), a computerized model developed to trace the flow of faculty through the processes of entry into, engagement within, and withdrawal from an education agency, is described. Major topics discussed include: 1) PERSIM's capabilities; 2) the development of a data base for the model; 3) the integration of PERSIM's components; 4) factors affecting the selection of data base elements; 5) PERSIM's extension of the Markov Chain Concept; and 6) the model's generator feature. Following this, some test cases are defined and the results thereof presented. Lastly, applications of PERSIM for activities such as the evaluation of teacher contracts and proposed legislation, the projection of manpower estimates, the prediction of hiring requirements, and the analysis of terminations are described. (PB)

A MODEL GENERATOR FOR THE FACULTY FLOW PROCESS IN A LARGE-CITY DISTRICT

K. Ronald Higgins

Dallas Independent School District

THE CONCEPT OF FACULTY FLOW

In considering the movement of teachers during their tenure within a school district, it is useful to borrow two concepts from the chemical engineering discipline; process flow and the material balance. Thus, in analyzing the performance of a catalytic cracker in a petroleum refinery, engineers isolate and identify all streams that feed into the reactor, the processes which occurred within the reactor, and the effluent streams from the reactor. Having identified the process flow relative to the catalytic cracker (reactor), it is then possible to perform a material balance around the reactor. Such a material balance simply states that the input to the reactor is equal to the output from the reactor plus any accumulation within the reactor during the reaction process. Similarly, we may view a local education agency as a reactor vessel with a defined process. Into this vessel flow newly hired teachers, who remain in this system as long as they are involved in the process of teaching, and later leave the system through death, disability, retirement, etc. Moreover, from a cost point of view, while they are in the system, they are engaged in a process which can be considered as defined by the salary schedule applicable to the local education agency (LEA). The salary schedule is nothing more than a means of specifying remuneration to the teachers according to the values of entities which are usually defined as experience versus education level. Thus, the teacher can be said to flow through the system (LEA) in salary levels or steps that are defined by the salary schedule; hence, the term "faculty flow" to describe the process by which teachers enter, are engaged within and leave a local education agency.

Continuing our chemical engineering analogy, it is true that the engineer in analyzing the performance of the reactor (LEA) must know characteristics of the feed and effluent streams of the reactor, such as viscosity, temperature, pressure, entrophy, enthalpy, and density. Similarly, there are many characteristics by which we may describe the teachers entering and leaving a LEA which will be useful in the analysis of the faculty flow process. For example, one may wish to specify such items as cost (to the LEA), quality, ethnic background, and subject assignment areas.

The engineer performs his analysis through a series of mathematical calculations which relate input values to results. These results are usually expressed in terms of a group of variables which describe

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the process at a particular stage or state. Thus, in the catalytic cracker example, the composition of the feed stock and the temperatures and pressures within the reactor would be related by mathematical equations to the results, these results being specified as the distribution of products (i.e., gasoline, kerosene, jet fuel, asphalt, etc.) and the amounts of these products per unit of input. However, the engineer's ability to analyze and understand the process flow became severely limited as the number of variables and therefore, the number of possible combinations of these variables grew. Only since the advent of the digital computer and mathematical modeling has a rigorous analysis been possible for the engineer. This analysis is obtained by creating a mathematical model using the mathematical relationships previously described and programming these relationships within a digital computer so that they can be rapidly performed in a repetitive fashion.

Similarly, the educational analyst seeking to perform the decisions and evaluations concerning faculty flow has need of a mathematical model to relate the input variables to the results, measured in costs and numbers of faculty. Accordingly, a mathematical model involving a Markov Chain approach has been conceptualized and expressed in the form of a digital computer program. This program has been constructed with a sufficient degree of generality that the decisions/evaluations of the type to be enumerated can be accomplished. PERSIM provides a means of rationalizing at one time many of the factors affecting faculty flow within a school district, examples of such factors being court orders, changes in enrollment and student loading, anticipated terminations of teachers in the appropriate breakdowns (such as certification area or course subject area taught), staffing implications of promoting a new curriculum, the effect of changes in the teacher base salary or other changes in the salary table (usually related to tenure and the amount of education), changes in the pupil/teacher ratio in certain teaching subjects or school levels, altering the number of class sections per day that teachers will teach, etc. Thus, the educational manager now has a tool by which he can evaluate the effects of changes in either policy or the environment.

CAPABILITIES PROVIDED BY PERSIM

In order to serve the faculty flow administrator in the manner just described, PERSIM provides a method by which the following decisions/evaluations can be made:

1. Forecast the status of the faculty flow system X number of years in the future. This system is capable of being described (within PERSIM) in terms of the several variables used to describe faculties such as race, sex, teaching assignment, college preparation, etc.

2. Anticipate the hiring requirements for X number of years into the future by using the same variables as in "1" above.

3. Forecast salary costs for the school district for X number of years into the future using the same number of variables to describe teachers as in "1" above. Also, the effect of varying pay structures within the LEA is accommodated.

4. Predict the effect of a set of policy and/or environmental changes upon the faculty flow for X number of years into the future. These effects are measured in terms of cost levels and number of teachers within the desired selected category specified in "1" above.

DATA BASE DEVELOPMENT

It should be noted that the ability of the computer model (denoted hereafter as PERSIM for Personnel Simulation) to make these predictions is conditioned by the availability of data sufficient to develop a data base capable of supporting such predictions. This is to say that the model makes extensive use of historical trends in predicting the future. These trends are expressed in terms of certain variables which describe teachers, such as race, sex, degree level and teaching area. Thus, one trend might be the percentage of female black English teachers with a Master's degree over the last 10 years. Identification and quantification of such trends is an absolute necessity in developing a computer model. The Markov algorithm demands that several years of data for any variable used to describe teachers (e.g., course assignment, race) must be available in order to predict the value of that variable in the future.

The requisite data have been provided to PERSIM by the following procedures:

1. Identification and selection of 15 variables which describe teachers.
2. Procurement of seven years (1966-67 through 1972-73 school years, inclusive) of raw data from the Dallas Independent School (DISD) for each of the 15 variables which were identified in 1 above.
3. Development and implementation of computer programs which would:
   a. extract
   b. perform required code conversions
   c. edit
   d. verify the 15 data elements previously identified.
4. Development and implementation of programs which would load the refined data into a data base capable of being queried by the remainder of the PERSIM programs.

INTEGRATION OF PERSIM COMPONENTS

Following the development of the computer models which constitute PERSIM and the development of the PERSIM data base, there occurred a shake-down period during which the operation of the models with the live data was observed and appropriate analyses and changes affected. This effort was centered about the development of the appropriate parameters for the PERSIM model which would enable it to realistically represent conditions in DISD and therefore provide acceptable predictions. When this operation was finished, a series of test cases were presented to PERSIM, the model was operated to produce predictions about the future status of DISD, and these predictions were evaluated to ascertain their reasonableness. These test cases will be described subsequently.

FACTORS AFFECTING SELECTION OF DATA BASE ELEMENTS

In addition to the mathematical model indigenous to PERSIM, two factors condition the selection of data elements in the historical personnel data base -- transferability and cost. PERSIM is intended to be and is structured as a generalized model, capable of being implemented by school districts throughout the United States. Accordingly, the concepts of transferability and cost largely depend upon the availability in machine readable form of personnel data to any school district interested in PERSIM; manual data collection must be minimized. The upshot of these considerations was the identification of 15 data elements categorized as indicated in Fig. 1. These data elements were contained in supports submitted to the State Education Agency and this agency converted this information to machine readable form. It may be anticipated as a similar situation relative to the availability of machine-readable personnel information may obtain in many other states. Only these 15 data elements are necessary to provide the results described in the remainder of this article; however, in Dallas the data base has been expanded to approximately 40 items of information for each teacher, the additions including such elements as Principal's Evaluation, NTE scores, In-Service Education Achievements, Specialized Assignment Information, Pre- and Post-Course Achievement Levels for all students in each course taught by a particular teacher, etc. These additional data elements were added to take advantage of the Model Generator Feature of the PERSIM model which will be described later.

Fig. 1

PERSIM

INITIAL

DATA BASE DEFINITIONS

	ELEMENTS
Group I: Locators	
	1. Social Security Number
	2. Employee Name
Group II: Cost Factors	
	3. Highest Degree Held
	4. Total Experience
	5. Pay Grade
	6. Pay Step
	7. Annual Salary
	8. Foundation Salary
Group III: Personal and Professional Descriptors	
	9. Ethnic Type
	10. Sex
	11. Termination Reasons
	12. Termination Date
	13. School Number
	14. Course Assignment
	15. Professional Status Code

PERSIM'S EXTENSION OF THE MARKOV CONCEPT

One of the Markov conditions is that the states of the system be mutually exclusive and collectively exhaustive. PERSIM satisfies this requirement by forcing the user to choose one of the following two options:

1. A pay grade, pay step, termination code selection -- which simply says that the teacher is either being paid or has terminated the system.

2. A professional status code plus termination code selection. To either of the above choices may be logically AND-ed as many as three additional variables which describe teachers, such as race, sex, certification area, etc. Thus, PERSIM is able to predict the number (and cost) of teachers who will occupy a state described by a certain pay grade and pay step or termination code and a certain subject area or teacher certification area classification and a certain race, sex combination, etc.

The maximum number of possible states that a teacher may occupy is thus dependent upon the selection of variables which the user chooses to have AND-ed together. For example, if the user selected pay grade-pay step-termination code and certification area and race/sex as variables (a total of three PERSIM variables -- a fourth selection is possible) the maximum number of states which a teacher would occupy would be equal to the produce of the maximum number of possibilities for each of the three variables chosen. Thus, the forty-five possible pay grade-pay step-termination codes times the thirty-eight possible certification areas times the eight race/sex combinations would result in 13,680 states into which a teacher could move. However, if the PERSIM variables selected were professional status code, subject area, and sex, one possible state would be "High School Classroom Teacher; Homemaking, Female." The maximum number of possible states would be thirty-four (for professional status code) times twenty-two (for subject area) times two (for sex) = 1,496.

THE MODEL GENERATOR FEATURE

The advantage of incorporating the matrix algebra technique indigenous to the Markov Chain concept within PERSIM is now evident. If a conventional statistical analysis technique such as regression analysis had been used, it would have been necessary to generate 1,496 separate regression equations in order to predict the future distribution of teachers classified according to professional status code, subject area, and sex. This amount of work is a formidable effort in itself and could easily have required many man months to accomplish. If it then became necessary for the administrator of the faculty flow process to predict the future distribution of teachers according to pay grade-pay step-termination code and teacher certification area and by race/sex combinations, it would have been necessary (under conventional statistical modeling techniques) to begin all over again and to generate 13,680 separate regression equations to accomplish the desired projections. Additional selections of variables from the PERSIM data base would then necessitate additional development of regression equations. PERSIM avoids this repetitive procedure by:

1. Taking advantage of the computational compactness of matrix algebra techniques and,

2. Including a method for generating a transition matrix for any selection of up to and including four PERSIM variables.

It can be seen then, that PERSIM constitutes a research tool for the study of the simulation of the faculty flow process.

DEFINITION OF TEST CASES

The following six test cases seek to illustrate some of the flexibility and capability provided by PERSIM in modeling the effect of policy/environmental changes upon the faculty flow process. These cases all involve a time horizon of four years beginning with the current school year of 1971-72. Moreover, the data values used for the first year (referred to as the "current" year hereafter) for all test cases are representative values for the Dallas Independent School District (DISD). Case 1 serves as the Base Case against which the results of the succeeding five cases will be compared. All values of parameters in this case are held constant over the four-year time horizon of the simulation. In each of the cases numbered 2 through 6 one variable assumes values different from the values it possessed in the Base Case. Thus it is possible to determine (by comparison with the Base Case) the effects (measured in terms of counts and cost of teachers) of changing this one variable. It should be remembered, however, that PERSIM permits the varying simultaneously of any and all variables over which the user has control. Finally, the changes introduced in Cases 2 through 6 are realistic in the sense that they represent contemplated and/or anticipated policy and/or environmental conditions for DISD. The cases are defined below:

Case 1: Base Case:
- A. Constant enrollment for three years: Elementary enrollment equals 88,000 pupils, Secondardy enrollment equals 72,000 pupils.
- B. Constant salary structure for three years.
- C. Pupil/Teacher ratios as follows: 25.05 for Elementary; 23.3 for Secondary.

Case 2: All conditions of the Base Case are maintained except that Base Salary will be increased 5% the second year, 9% the third year, and 0% the fourth year.

Case 3: All conditions of the Base Case will be maintained except that the salary index will be changed as follows in order to motivate career-oriented teachers:
- A. Increase salaries 5% for all teachers at Step 4 and above in the Bachelor's, Master's, and Doctoral Degree Pay Grades.
- B. Simultaneously for all teachers (regardless of step) increase the differential between Bachelor's and Master's, and Master's and Doctoral Degrees by 4%.

Thus, for example, a teacher possessing a Master's Degree and five years of experience would receive 9% more salary than he would receive in the Base Case, and a teacher possessing a Doctorate and at least four years of experience would receive 13% more salary under Case 3 than the teacher would receive under Case 1.

Case 4: All conditions of the Base Case will obtain except that Elementary enrollment will have the following values:

School Year	Elementary Enrollment
1971-72	88,000
1972-73	83,550
1973-74	79,450
1974-75	73,500

Secondary enrollment will be maintained constant at 72,000 students for the four year period; thus Elementary school enrollment is declining 5% per year.

Case 5: All conditions of the Base Case will obtain with the exception that pupil/teacher ratios will be changed as follows:

School Year	Pupil/Teacher Ratio Elementary	Pupil/Teacher Ratio Secondary
1971-72	25.0	23.5
1972-73	23.0	22.0
1973-74	21.5	20.5
1974-75	20.0	19.0

Case 6: All conditions of the Base Case will obtain except as follows:

A. Decrease by 10% the students in the following subject areas:
   (1) English Language Arts
   (2) Mathematics
   (3) Social Studies

B. The necessary increases in enrollment in other subject areas resulting from the three decreases in enrollment just detailed will be obtained by spreading the three 10% decreases over the following four subject areas equally:
   (1) Health and Physical Education
   (2) Homemaking
   (3) Industrial Arts
   (4) Science

   The shifts in the enrollment patterns just described will be actualized for the second year of the simulation. (i.e., 1972-73) and will be maintained in that changed status for the 1973-74 and the 1974-75 school years.

Finally, for the 1974-75 school year, the following changes will be made:

1. The number of class sections taught per day by a teacher will be increased by 1 (from five to six) for teachers in the following two subject areas:
   a. English/Language Arts
   b. Industrial Arts
2. The pupil/teacher ratio will be decreased by eight for the subject area English/Language Arts.
3. The pupil/teacher ratio will be decreased by 15 for the subject area Health and P. E.

PRESENTATION OF TEST CASE RESULTS

Only some of the results of the test cases may be presented in the space remaining and what can be presented must of necessity be in aggregate form. However, an attempt will be made to present a limited sample of the detail provided by the model. To this end, the information displayed will begin with the most general or aggregate results and proceed to the most specific, detailed projections.

Fig. 2 displays the total salary cost for teachers for Cases 1, 2, 3, and 5 during the four year planning horizon. It will be noted that although all conditions are maintained constant in the Base Case, the slope of the total cost line in Fig. 2 is not zero, but that the cost increases gradually. This phenomenon arises from two facts:

1. The court-ordered integration of the faculty in DISD has occasioned significant increase in resignations among teachers with five or less years of experience, presumably because seniority is a chief factor used to determine who shall <u>not</u> have to transfer. Thus, low seniority, low salary-cost teachers are leaving the district in ever-increasing numbers.

2. The excess supply of teachers which has appeared recently has apparently increased the retention by DISD of its more senior teachers, especially since these teachers have been least affected by the crossover resultant from integration. The upshot of these two factors has been in an aging of the staff in DISD which, according to the salary schedule, results in an increased salary expenditure by the district of approximately $2,000,000 for the same number of teachers.

Case 2 shows cost effects when the Teacher Base Salary is increased 5% for 1972-73, 9% the next year, and zero percent the succeeding year. As shown by the graph over the four year period these changes increased the total salary expenditure by more than $9,000,000. In Case 3, salaries were increased 5% for all teachers at Step 4 and above in the Bachelor's, Master's, and Doctoral Degree pay grades. Simultaneously for all teachers (regardless of step) the differential between Bachelor's and Master's, and Master's and Doctoral Degrees was increased by 4%. Comparison of Case 3 with the Base Cases indicates two facts:

1. For the year 1972-73, the Salary Cost for Case 3 is approximately 3% greater than Case 1.

2. The difference between the salary levels for the two cases increases slightly with time, which results from the fact that the salary increases in Case 3 are applicable only to the senior teachers and the fact that the staff is aging.

The fact that the increase in total salary cost is only approximately 3% when the increase in salaries was 5% is recognized as rational when one realizes that the 5% salary increase is applied only to teachers with four years or more of experience. More than 1/3 of the teachers in DISD have less than four years of experience, so the 5% salary increase was applied only to 2/3 of the teachers in the district.

Case 5 posits a decrease in the pupil-teacher ratio for both elementary and secondary levels which averages to approximately 23% over the four year projection. In Fig. 2, the corresponding increase in the number

PERSIM

BASE CASE AND CASES 2, 3, AND 5
TOTAL COST VERSUS TIME

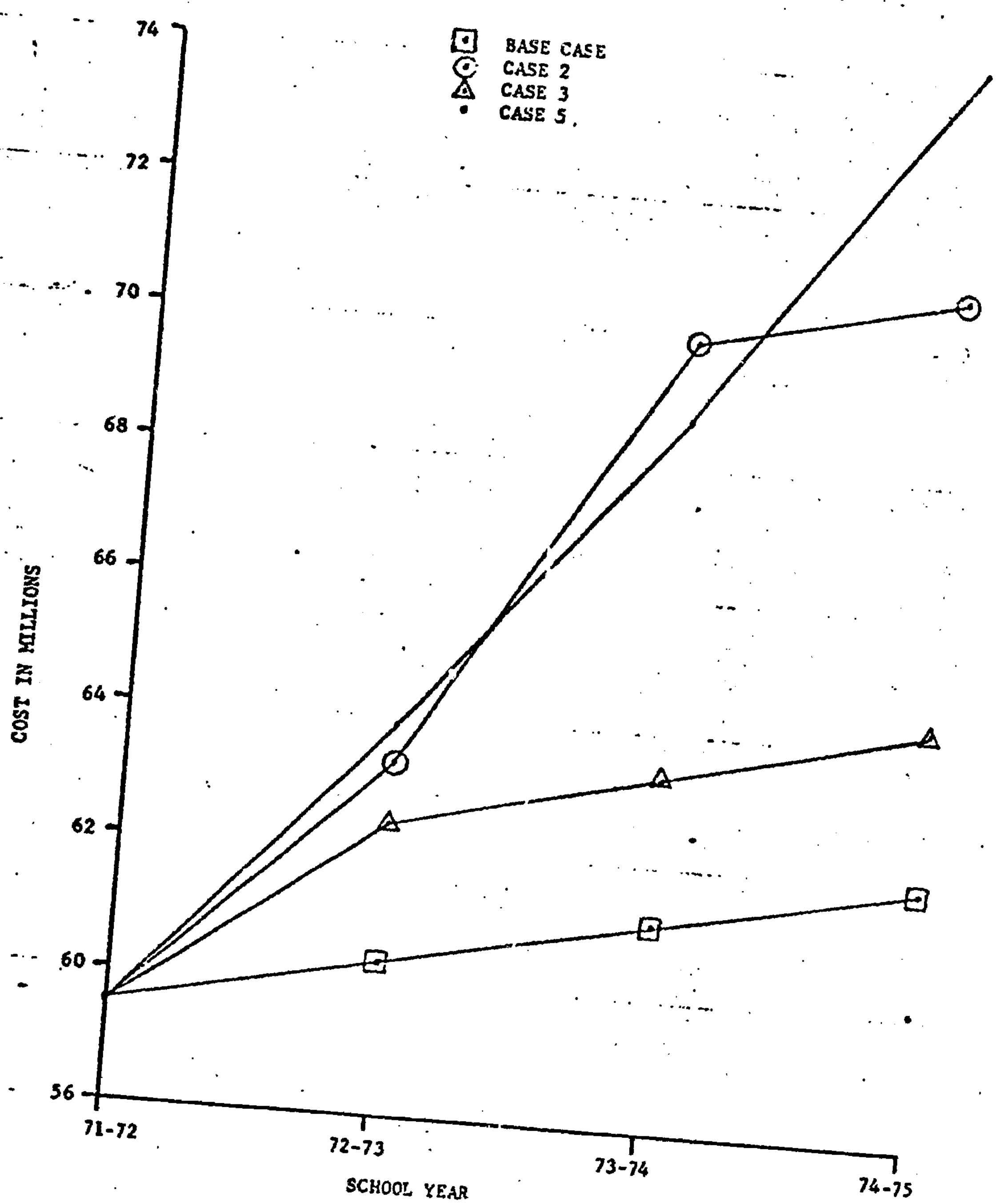

Fig. 2

of teachers required for the smaller pupil/teacher ratios is seen in the sharply rising line indicating the cost of teacher salaries over the four year period.

Case 6 presents the opportunity to observe the operation of PERSIM at the subject area (as contrasted with district-wide or elementary/secondary) level of detail. For each year of the simulation Exhibit VI displays the four vectors associated with each of three subject areas that experienced a decrease in enrollment. The vectors are the required vector, the output vector (defined as the vector sum of the remaining vector and the termination vector), the termination vector, and the hiring vector. Also indicated in parenthesis for the required hiring, and output vectors are the cost levels associated with employing that number of teachers. As illustrative of the relationship which PERSIM maintains between the four vectors and the operation of PERSIM in adjusting to the changes imposed by Case 6, consider the Mathematics, Health and P. E., and Industrial Arts subject areas in Figs. 3 and 4. In Fig. 3, it is apparent that 401 Mathematics teachers are required for the 1971-72 school year. The remaining teachers at the end of that year may be determined by subtracting the termination vector from the output vector in order to obtain the remaining vector. Thus, the teachers remaining at the end of that school year is equal to the difference between 392 and 23 or 369 teachers. It is also apparent that 9 teachers (401 minus 392) transferred from teaching in the Mathematics subject area to another subject area, in accordance with the Markov Chain. Thus, there are but 369 Mathematics teachers remaining at the end of the 1971-72 period. It may now be remembered that according to Case 6, this subject area was to suffer a 10% decrease in enrollment from the 1972-73 school year; as shown in Figure 3, PERSIM determines the adjusted number of Mathematics teachers required to be 355. Since there are 369 teachers remaining from the previous school year, 14 teachers must be either shifted to teaching in a different subject area or dismissed from an LEA; this is the significance of the minus 14 in the hiring vector column for 1971-72.

Examination of the four vectors for the remaining three years of the simulation for this subject area indicates that operations within this subject area settled down after this large perturbation. Also note, that while 21 teachers terminate from the Mathematics subject area annually, they need to be replaced by only 19 new hires. This phenomenom is explained by the fact that two teachers transfer from other subject areas into the Mathematics subject area each year, as indicated by the difference between the required and output vectors. This fact is also an illustration of the probablistic nature of the model in that 9 teachers transferred <u>from</u> Mathematics to other subject areas the first year of the projection and thereafter, two teachers transferred <u>into</u> the Mathematics subject area.

The subject area Health and P. E. (Fig. 4) is interesting in that it exhibits the effects of two of the three changes introduced by Case 6. It may be seen that 157 teachers are required in this subject area for the 1971-72 school year. However, 176 teachers are required for the next year owing to the increase in enrollment postulated by Case 6. Examination of the output and termination vectors indicates that there are only 150 (162 minus 12) teachers remaining in this subject area at the close of 1971-72. Hence, it was necessary to hire 26 teachers as is indicated in the hiring vector for the first year of the simulation. Examination of the termination and hiring vectors for the 1972-73 school year indicates

Fig. 3

BEHAVIOR OF SELECTED SUBJECT AREA VECTORS

CASE 6

YEAR	REQUIRED	OUTPUT	TERMINATION	HIRE
		SOCIAL STUDIES		
1971-72	514(46289)	535(47121)	22	- 57
1972-73	456(42739)	481(44159)	16	- 10
1973-74	456(43436)	480(44644)	16	- 8
1974-75	456(44069)			
		MATHEMATICS		
1971-72	401(35777)	392(33631)	23	- 14
1972-73	355(32575)	357(31306)	21	19
1973-74	354(32648)	356(31495)	21	19
1974-75	355(33024)			
		ENGLISH/LANG. ARTS		
1971-72	518(44900)	507(41251)	42	- 5
1972-73	460(40895)	459(38134)	40	41
1973-74	460(41296)	454(38398)	36	111
1974-75	529(47037)			

NOTES: (1) Output Vector = Remaining Vector + Termination Vector

(2) Values in Parenthesis Denote Cost Levels in Hundreds of Dollars

Fig. 4

BEHAVIOR OF SELECTED SUBJECT AREA VECTORS

CASE 6

YEAR	REQUIRED	OUTPUT	TERMINATION	HIRE
		HEALTH & P.E.		
1971-72	157(14033)	162(13709)	12	26
1972-73	176(15682)	174(14755)	13	15
1973-74	176(15944)	173(14881)	13	94
1974-75	254(22091)			
		HOMEMAKING		
1971-72	136(11976)	139(11848)	7	41
1972-73	173(15019)	167(13891)	11	15
1973-74	173(15165)	167(14240)	8	15
1974-75	172(15216)			
		INDUSTRIAL ARTS		
1971-72	161(14103)	159(13712)	6	47
1972-73	199(17237)	189(16200)	5	17
1973-74	199(17461)	189(16446)	7	- 16
1974-75	166(15291)			
		SCIENCE		
1971-72	302(26331)	297(25148)	17	53
1972-73	333(29247)	319(27180)	21	34
1973-74	334(29875)	325(28435)	16	26
1974-75	333(30363)			

NOTES: (1) Output Vector = Remaining Vector + Termination Vector

(2) Values in Parenthesis Denote Cost Levels in Hundreds of Dollars

that two teachers more than terminated (13) must be hired (15), due to the fact that two teachers transferred from the Health and P. E. subject area to another subject area during the year. Hiring the 15 teachers rated the staffing level in that subject area to 176 teachers, the number required for the 1973-74 school year. Operations in that school year virtually replicate the previous school year since Case 6 postulates no changes between those two years. However, it will be noted that 94 teachers are hired at the end of that year in order to obtain the 254 teachers required for the 1974-75 school year. This increase in the required vector is occasioned by the dramatic decrease in the pupil/teacher ratio for this subject area specified by Case 6. It is also interesting to note that PERSIM projects a 6.1 million dollar increase in salary cost associated with this change in the pupil/teacher ratio as indicated; a 1.6 million dollar increase is associated with a shift in enrollment pattern (for this subject area only).

In Figure 4 the Industrial Arts subject area manifests the same pattern of behavior as the Health and P. E. subject area because both subject areas were similarly affected by Case 6. However, it will be noted that the required vector decreases from 199 to 166 between the 1973-74 and 1974-75 school years. This decrease of 33 teachers is the result of causing teachers in the Industrial Arts subject area to teach six class sections per day instead of five. Since 182 (189 minus 7) teachers remained at the close of the 1973-74 school year and only seven teachers terminated, it is necessary to reassign or dismiss 16 Industrial Arts teachers in order to obtain a staffing level of 166 such teachers.

It is of interest to note the effect of the changes in Case 6 upon the total count and cost of teachers. The shift in enrollment patterns resulted in the necessity for 8 less teachers in DISD but increased the total salary cost from $59,680,900 to $60,839,700 a difference of $1,158,800. This increase of teacher salary cost in the face of a decrease in the required number of teachers may be explained by two factors: the relative seniority of teachers in the seven affected subject areas and the general staff aging phenomenon. The result of increasing the teacher work load by 20% in two subject areas while at the same time dramatically decreasing the pupil/teacher ratio in two subject areas may be seen in the fact that there was an increase of 113 in the required number of teachers and an increase in total salary cost from $60,839,700 to $62,479,200, a net positive change of $1,639,500.

The accuracy of the PERSIM model in predicting future conditions in an LEA may be seen by examining the data in the following table:

Comparison of PERSIM Projections with DISD Estimates
1971-1972 School Year

TEACHER COUNTS

PAY GRADE	DISD	PERSIM	DIFFERENCE	PERCENT DEVIATION
1	4760	4771	+11	0.231%
2	1865	1859	- 6	0.322%
TOTAL	6625	6630	+ 5	0.0755%

TEACHER COSTS

PAY GRADE	DISD	PERSIM	DIFFERENCE	PERCENT DEVIATION
1	$39,940,300	$39,758,800	$ - 181,500	0.465%
2	19,689,200	19,922,100	+ 232,900	1.18%
TOTAL	$59,629,500	$59,680,900	+ 51,400	0.0863%

The count and cost values under the caption "PERSIM" were obtained by taking five years of the historical personnel data base (1966-67 through 1970-71) as a basis for projecting the 1971-72 school year. The PERSIM projections were then compared with the actual DISD values as shown under the caption "DISD." It may be seen that PERSIM's accuracy is exceptionally good in that the percent deviation for both teacher counts and teacher cost is less than 0.1%.

SUMMARY

Th uses of a many faceted model such as PERSIM are indeed legion. Some of the more significant applications are:

1. Teacher contract evaluation: PERSIM makes possible the evaluation of literally hundreds of contract alternatives rapidly by a computer. By hand methods usually less than a dozen proposed alternatives may be evaluated. It is also important to note that PERSIM's accuaracy will be exceedingly good as contrasted with hand methods because the exact distribution of teachers and their exact salaries (not average salaries) are employed in the calculations.

2. Evaluation of proposed legislation: PERSIM may be used by school district administrators to evaluate proposed bills and thereby inform applicable legislators of the impact of these bills upon the school districts within their legislative district. In the last session of the Texas Legislature, 218 bills were amenable to PERSIM analysis.

3. Five Year Manpower Projections: PERSIM provides the admi; ,trator of the faculty-flow process with the ability to develop a five-year plan for staffing levels utilizing all known policy/environmental alternatives. These alternatives may be revised periodically to reflect changing conditions by specifying these new conditions to the PERSIM Model; the process of revising and evaluating new operating conditions is thus simplified by the existence of PERSIM.

4. Prediction of Hiring Requirements: The number, cost, type of teachers needed in future years under a variety of proposed educational programs may be rapidly evaluated by PERSIM. Moreover, it is not inconceivable that the classification of teachers (e.g., by certification area) needed and not needed by a school district could be provided by teacher training institutions for use in their counseling of prospective teachers into specialty areas.

5. Analysis of Terminations: Termination patterns may be studied by race, sex, subject area, certification area, and other variables in the PERSIM data base. It may be possible to develop other relationships which predict termination-prone teachers, methods of hiring for maximum retention, etc.

6. Ad-hoc Analyses: The scope, flexibility, and ease of use of the PERSIM Model make it an ideal vehicle for performing day-to-day analyses as required by the personnel department. Moreover, the structure of the model is so modularized that it may be easily changed and added to. This last feature is quite important since there is a virtually irresistible

proclivity on the part of the hard-pressed administrator to seek from the model more than it can initially produce.

The management of the faculty flow process is of such political and monetary importance that no superintendent can afford to ignore it; while he may delegate to others the details of the supervision of something like the construction and condition of school buildings, in many school districts it is a fact that the superintendent is aware of even the details of the faculty flow process. So many factors affect this area that evaluation of proposed changes is a way of life for most personnel departments within LEA's in order to serve their superintendent. PERSIM was designed as the planning tool for these evaluations and the management of the faculty flow process.