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ABSTRACT

A descriptive study was done of a microcomputer-based modeling approach to retention analysis used at the University of Hartford (Connecticut) which relied on an information system which integrates multi-year admissions, financial aid, and academic data with surveys of college student adjustment, involvement, and reasons for leaving. Analyses were performed with an interactive decision support system that enabled users to test hypotheses about high and low risk student subpopulations using a simple system of menus and screens. An executive information system allowed decisionmakers to navigate their way through retention reports and graphs in order to achieve a better understanding of comparative and longitudinal aspects of retention. Using this system, longitudinal and comparative studies of retention were prepared from a multi-year database for all student cohorts entering the University of Hartford between 1984 and 1989. Separate analyses of attendance patterns and degree attainment were prepared for selected student subpopulations and for freshmen and transfers in each of the University's eight colleges. Results of the analyses for retention research are presented for academic prediction studies, student adaptation to college, reasons for leaving, and student involvement. Included are 6 figures and 12 references. (JB)

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An Interactive Model for Studying Student Retention

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Student retention research has a long history in higher education, but only recently have research findings been synthesized to build theories of student withdrawal, to apply those theories to the design of analytic studies, and to use the results to diagnose problems and devise strategies for increasing student retention. This paper describes a microcomputer-based modeling approach to retention analysis. This approach relies on an information system which integrates multi-year admissions, financial aid, and academic data with surveys of college student adjustment, involvement, and reasons for leaving. Analyses are performed with an interactive decision support system that enables users to test hypotheses about high and low risk student subpopulations using a simple system of menus and screens. An executive information system allows decisionmakers to navigate their way through retention reports and graphs in order to achieve a better understanding of comparative and longitudinal aspects of retention.

Conceptual Framework

The conceptual framework for the design is based on recent reviews of the student retention literature (Tinto, 1987; Noel et al., 1983; Hossler, 1984; Pascarella, 1982). Tinto recognized the importance of the interactions that take place over time between individual students and the academic and social systems of colleges and universities. A student's decision to pursue a degree at a particular college begins with the skills, abilities, interests, prior school experience, and family background the student brings to the campus, and the students' expectations about what will be experienced in that college. The motivation to persist towards successful completion of a degree in that college very much depends on the student's becoming involved in the academic and social life of the college, achieving a satisfactory academic record, and forming satisfying relationships with faculty, students and staff at the college. Colleges vary widely in their admissions selectivity, intellectual orientations, academic demands, social life, and campus environment. Consequently, at any point in time, the college's requirements and academic and social climate may be a good match or poor match with the expectations of a particular student or student subculture. From national longitudinal studies of degree attainment, it is clear that prestigious institutions that practice selective admissions have much higher rates of student retention and degree attainment. Furthermore, over the entire range of College Board SAT scores and high school class rank, academic measures are highly correlated with retention (Dey and Astin, 1989). Changing the admissions selectivity of a college requires a long-range effort to have any major impact on student retention. Moreover, nearly 85 percent of the departures from college are voluntary, and most students leave in good academic standing (Tinto, 1985). Reasons for students leaving college vary widely and may be as difficult for an experienced counselor to interpret as it is for the student, without adequate longitudinal data and dialogue about the student's adjustment, involvement, and response to academic and social life at the college (Anderson, 1985). In order to diagnose student retention problems and to devise effective intervention strategies, college administrators and institutional researchers need to build a comprehensive, multi-year longitudinal student database that incorporates both student records and student survey data. They also must have access to easy-to-use, flexible and powerful tools for performing analyses and reporting the results of student retention studies.

Methodology and Approach

This paper describes the design and implementation of a microcomputer-based decision support system (DSS) that enables users to test hypotheses about high risk and low risk student subpopulations. The analysis system is interactive in the sense that a decisionmaker can use an on-screen menu to select a student subpopulation, quickly view the aggregate retention patterns of that subpopulation, and refine the selection criteria as hypotheses are modified. For

example, the decisionmaker can select various ranges of SAT scores and high school rank to discover whether the retention of "well prepared" students surpasses the retention of others.

Using this system, longitudinal and comparative studies of retention were prepared from a multi-year database for all student cohorts entering the University of Hartford between 1984 and 1989. Separate analyses of attendance patterns and degree attainment were prepared for selected student subpopulations and for freshmen and transfers in each of the University's eight colleges. The implications of this interactive approach are discussed in the context of enrollment management and institutional research practice.

The University's Office of Planning and Institutional Research has developed a microcomputer-based decision support system for college administrators that uses a report directory, data dictionary, and user-friendly menus and screens to control database and statistical analysis reporting. The primary goal is to satisfy the user's information requirements with minimal programming assistance. The design concepts used in building the University's DSS for retention analysis are presented below, followed by a discussion of the integration of data sources. Sample screens illustrate how the user prepares report requests for an analysis of student retention patterns in the College of Engineering for six entering cohorts (Fall 1984 through Fall 1989).

Overview of Design Principles

Prior to the construction of a tracking record, a transaction processing system must exist on a mainframe or minicomputer. Information Center personnel maintain the integrity and security of the data and facilitate downloads. A data dictionary provides the linkage between the data fields in these files and those in the micro-computer databases which are used to generate summaries and statistical analyses. Using the data dictionary to specify the necessary data fields for retention analysis, personnel in Institutional Research generate download requests. At the microcomputer level, student retention tracking records are compiled and updated from downloaded files using fourth-generation relational database tools. Once the tracking database is constructed, a microcomputer-based decision support system (DSS) is used to enable a decisionmaker to create and modify retention report requests. A query-by-example procedure is used to construct subpopulation selection statements and/or reusable selection files from on-screen menus. Help, whether global or context-sensitive, is accessed by pressing a function key or mouse button.

Typically, indexes and subset files are used to process small numbers of student records rather than reading all records. A tracking record is summarized by using naming conventions and constructing macros from student-level data to point directly to columns and rows in the aggregate database.

A menu-controlled program passes parameters to the program which produces retention summaries. Those parameters typically include record-selection criteria, report title, and destination (disk drive, subdirectory, and file). Retention statistics and academic prediction analyses are executed at the microcomputer level. Summary data, prepared by the analysis program, may then be browsed in multiple windows or printed.

Named report images are stored in directories accessible by the Executive Information System (EIS). A decisionmaker navigates EIS to retrieve retention tables, graphs, and interpretive summaries. The decisionmaker asks "what-if" questions in spreadsheet format. He or she can then review trends and evaluate key performance measures. Based on these observations, the decisionmaker revises hypotheses and generates new report requests.

Student Retention Tracking Database

Research from the literature on student retention, together with a simple set of design concepts, guided the development of the student retention information system. The student tracking database for each entering student cohort is created by integrating data from each student's admissions application and financial aid records with each semester's attendance and grade performance record accumulated over a six year period (see Figure 1). Academic prediction studies are performed using multiple linear regression to derive prediction equations and to determine the accuracy with which first semester grades can be predicted for each college subpopulation. Retention or withdrawal rates are monitored each semester for high risk subpopulations to assess their academic adjustment.

The University's student database was created initially using Systems and Computer Technology's (SCT) Integrated Student Information System, which first became operational in the Fall of 1984. The student database that resides on the IBM 4381 mainframe includes student master records and detail records for each academic term, including data on prospective applicants, admissions applicants, student financial aid, student academic history, accounts receivable, and extracurricular activities. The mainframe database, while containing all of the necessary data elements for student retention tracking, is designed for efficiency in maintaining and viewing detail records for individual students, rather than being well integrated for flexible and responsive summary analysis and reporting.

Using a microcomputer based master data dictionary system, programmed in Fox Pro, Easytrieve programs are generated and uploaded to the IBM mainframe to select records and to format the necessary data fields for each academic term for a student cohort (e.g., all new full-time undergraduates entering in the fall term in 1984). The extracted records are downloaded from the IBM mainframe using either the DEC 6310 computer network or going from tape to Bernoulli cartridge off-line. The downloaded files are then imported through a Fox Pro menu system to create the student retention tracking database.

Using student social security number as the key for matching records, the applicant, financial aid, and student records are integrated to create the initial student retention tracking record. The tracking record is processed through a Fox Pro computation program that uses first semester accounts receivable data and student credit hours to validate which of the students who paid tuition deposits actually enrolled as full-time students in each entering cohort. Detailed records for each academic term are then matched against each student master record to compute the retention tracking history. Variables are computed for each term indicating whether a given student:

(1) is enrolled or not enrolled;
(2) is enrolled full-time or part-time;
(3) has completed a four-year degree; or
(4) has completed a two-year degree.

Figure 1

DATABASES USED IN STUDENT RETENTION ANALYSIS

DATABASE 1: CALENDAR SEMESTERS

ADMISSIONS CHARACTERISTICS
- Name of Student
- Student Number (IDNO)
- Freshman or Transfer (FT)
- Final Application Status (example: Paid Tuition Deposit)
- U of H College of Application
- U of H College of Referral
- College Transferred From
- Entry Semester
- First College and Major at U of H
- Resident or Commuter

DEMOGRAPHIC CHARACTERISTICS
- Sex, Ethnicity, and Citizenship
- State, Zip, and High School Codes at Time of Application
- Last known State and Zip Code

RETENTION CHARACTERISTICS
- Cohort Membership, Based on Amount Billed and Credit Hours Completed in First Semester
- Last Known College and Major
- Last Semester with Data
- Cumulative Credit Hours Completed
- Highest Degree Received
- Titles of 2-Year Degree, 4-Year Degree
- College and Major at Time of Graduation
- Date(s) Received Degree(s)
- Last Known Grade Point Average
- Grade Point Average at Completion of 4-Year Program

QUALITY MEASURES
- Financial Aid Rating
- SAT Verbal and Mathematics Scores
- High School Rank
- Predicted Grade Point Average
- First and Second Semester Grade Point Averages (SEM1GPA)

ENROLLMENT CHARACTERISTICS BY CALENDER SEMESTER
- College in Each Calendar Semester (Fall 84 – Fall 90; example: COL851*)
- Credits Completed (CRC864)
- Credits Toward Grade Point Average (CRG871)
- Quality Points Earned (PTG871)
- Academic Standing (ACADS874)

DATABASE 2: SEQUENTIAL SEMESTERS

BINARY VARIABLES BY SEQUENTIAL SEMESTER
- Retention: Student Received Degree and/or Was in Attendance (RET01–RET12)
- Attendance (ATT02)
- Full-Time Attendance (FUL03)
- Four-Year Degree Completion by End of Semester (DEG04)
- Two-Year Degree Completion by End of Semester (TWO05)

OTHER SEQUENTIAL VARIABLES
- Number of Credits Completed by End of Semester (CRC06)
- College Attended (COL07)
- Academic Standing (ACADS08)
- Grade Point Average (GPA09)

DATABASE 3: SUMMARY DATABASE STRUCTURE

- Cohort Label (ex: Fall 1984)
- Cohort Identifiers: Entry Semester; Freshman / Transfer / Combined
- Label for User's Chosen Subpopulation (ex: College of Engineering)
- Cohort Size

NUMBERS BY SEQUENTIAL SEMESTER (1 THROUGH 12)
- Number of Students Retained (RET01)
- Number in Attendance (ATT02)
- Number Attending Full-Time (FUL03)
- Number Completing a Four-Year Degree by End of Semester (DEG04)
- Number Completing a Two-Year Degree by End of Semester (TWO05)

PERCENTAGES BY SEQUENTIAL SEMESTER
- % of Cohort Retained (RPC01)
- % of Cohort in Attendance (APC02)
- % of Attendees Who Were Full-Time (FPC03)
- % of Cohort Completing a Four-Year Degree by End of Semester (DPC04)
- % of Cohort Completing a Two-Year Degree by End of Semester (TPC05)

* Note: Selected field names are shown as illustrations of the naming conventions used in Fox Pro programming.

These criteria are not mutually exclusive, since a student may be enrolled during a semester and receive a degree at the end of the semester. The tracking record is typically updated in May or June of each academic year so that degree attainment as well as attendance and credit hour consumption can be recorded. Each cohort's tracking is updated for a maximum of twelve semesters (six academic years). The student retention record also keeps track of the student's college, major, credit hours and quality points earned, and semester and cumulative grade point average for each academic term the student is enrolled through graduation or departure from the University.

There are three types of databases used in retention analysis: calendar semesters; sequential semesters; and

summary (aggregate; See Figure 1). A calendar semester database is constructed from the downloaded applicant file. It is updated using accounts-receivable files, end-of-semester enrollment files, and completion files (degree attainment). The applicant database for a given fall semester is the pool from which cohort members are selected. An applicant is considered to be a cohort member for retention purposes if at least one of two conditions is met: completion of at least twelve credit hours by the end of the semester of matriculation or being billed as a full-time student.

Once a cohort is defined, each member is tracked over twelve semesters by matching student identification numbers across semester-specific databases. At the end of each academic year we update the tracking record with the number of credit hours and quality points completed, the college and major, and any degree the student earned. For example, COL854 represents the college code in the Fall 1985 semester.

Figure 1 lists the variables organized into several blocks: admissions characteristics, demographic characteristics, quality measures, retention characteristics, and semester--specific information. A sequential semester database is constructed by reading the semester of matriculation and consulting a translation table to convert calendar semesters into sequential semesters. For example, a student who matriculated in Fall 1985 is considered to reach his fourth semester in Spring 1987. Summers are not counted in the assignment of sequential semesters. The attributes recorded for each student are analogous to those in the calendar semester database. For example, a student who completed fifteen credit hours in her tenth semester and graduated at the end of the semester received a "1" for ATT10, a "1" for FUL10, and a "1" for DEG10. The critical admissions variables, demographic characteristics, and quality measures from phase 1 were repeated in the sequential semester database, thereby allowing any of these variables to be included in the user's selection statement.

The sequential-semester records are aggregated according to a selection statement. Most of the fields in the summary database contain the totals of the corresponding binary variables in the consecutive-semester database. For example, the field ATT03 in the student-level database is summed into the field ATT03 in the aggregate database for all Engineering students. The result is a count of the number of students in that college and cohort who were attending classes in the third semester following their matriculation.

For each combination of entry semester and Freshman/ Transfer/ Combined subpopulation, sets of numbers and percentages are computed (Database 3 in Figure 1). Rather than relying on a single measure of retention, we calculate five summary measures and allow the user to view each measure over twelve semesters in a separate window onscreen. The outcome measures are the percentages of the initial cohort who, in each semester, were:

(1) either still attending or recipients of four-year degrees;
(2) still attending the university and completing at least one credit hour;
(3) full-time students who completed twelve or more credits;
(4) recipients of four-year degrees; and
(5) recipients of two-year degrees.

Using the Decision Support System

Access to the decision support system is controlled through a Common User Environment (CUE), a questionnaire type system of menus and screens the user enters to specify or execute a report request. Using either a screen view or printed copy of the master data dictionary, users specify through CUE the name of the database file and directory path of the file on which the analysis is to be performed. They specify record selection criteria, fields used to sequence records, data fields to list or summarize, type of report (e.g., Fox Pro or SPSS PC), report title, the name and directory path of the data analysis program, and the name and location of the print file where the report will be sent to EIS. Having prepared a report request, the information in CUE is saved in a report database (i.e. parameter file) which can be retrieved and modified or used to execute a report program under the user's control.

For analyzing student retention patterns interactively, a customized system of menus and screens was developed, thereby providing users with a simple means to select subpopulations for analysis and to review the results interactively in a matter of minutes, notwithstanding the large volume of records in the multi-year student retention tracking database. Figures 2 and 3 are samples of the report request screens used to select student subpopulations.

The user prepares report requests by responding to a screen-based questionnaire implemented in Fox Pro. From a light-bar menu, the user selects "Retention Analysis". Fox Pro begins to execute a compiled program which presents the user with a choice of either constructing a student selection statement or proceeding immediately to data analysis. Assuming that this is the first analysis of Engineering freshmen, the user will proceed to the selection screen (see Figure 3). The three columns of the questionnaire screen correspond to the criteria of greatest interest to administrators:

(1) Quality Measures;
(2) College, Major, and Financial Aid Rating; and
(3) Sex, Freshman/Transfer status, and Ethnicity.

However, the user may make other selections on a separate line. The user who needs examples of selection statements or access to the data dictionary may press a function key for access to a pop-up database of help topics (not shown).

If a user wants to select students regardless of their quality measures, he presses "0" in response to the prompt in column 1, and no further choices appear. If the user presses "1", a sub-menu drops down, allowing the specification of a range of values for SAT verbal and mathematics scores, high school class rank, and first semester grade point average. Similarly, one may select all colleges, all majors, and all financial aid ratings, or view a sub-menu in the middle column of the screen. In this case, one first types "0" to view the colleges available, then enters a "1" next to the College of Engineering.

In the third column, one may select men, women freshmen, transfers, or a particular ethnic group by using a drop-down menu, or bypass these selections by pressing "0" at the top of the column. At the completion of the student subpopulation selection screen, the user will normally proceed to data analysis.

Additional record selection criteria can be specified by entering a Foxbase statement using any combination of logical expressions and database fields. The Fox Pro DSS program converts the user's choices into record selection statements which are mirrored back on the screen. When the user indicates that the record selection statement is correct, the program either selects records directly for

Figure 2

SUBPOPULATION SELECTION SCREEN

QUALITY MEASURES

_ 1 ALL

SAT Verbal
_ 200 Low
_ 800 High

SAT Math
_ 200 Low
_ 800 High

HS Class Rank
_ 0 Low
_ 100 High

GPA First Sem
_ 0.00 Low
_ 4.00 High

COLLEGE/MAJOR/FAID

_ 0 ALL
_ 1 First _ 0 Last

Select One:
_ 0 Art
_ 0 A & S
_ 0 Barney
_ 0 C B S
_ 0 E N H P
_ 1 Engineering
_ 0 Hartt
_ 0 Ward
_ 0 Other: ____

MAJOR: 000
Financial Aid
Rating ____

STUDENT GROUP(S)

_ 1 ALL

Select 1 or More:
_ 1 Women
_ 1 Men

_ 1 Freshmen
_ 1 Transfers

_ 1 Foreign
_ 1 Black
_ 1 Hispanic
_ 1 Asian
_ 1 White
_ 1 Other

A subset of students will be analyzed using the following CRITERIA:
VAL(FCOL)=6

=======> Are you FINISHED selecting students? <Y> or N ======

Do you want to save your selection as a file of ID numbers? <Y> or N
=======> Name the file: TRFCOL6.DBF

summarization or creates a file depending on the user's menu choice.

As one can see from Figure 3, the student retention analysis is controlled by a file of student identification numbers (TRFCOL6.DBF). Because this file is linked to the student tracking database by Social Security number, only the records that match are processed. Hence it is possible to process records interactively in a matter of minutes regardless of the large volume of records in the student retention database. After the user selects an input file, he or she is prompted for the name of an output database; this is the file name assigned to the output file where the summary data results are stored and later retrieved through the EIS menu system (RETFCOL6.DBF).

When the student retention analysis is completed for the selected student subpopulation, a DSS light-bar menu and screen appears for displaying the results. Figure 4 shows a snapshot of what the menu and screen look like for this example. The light-bar menu at the top of the screen enables the user to select two windows per screen. Each window displays a student retention analysis for freshmen in the College of Engineering for six entering student cohorts (1984-1989) for 12 semesters. The upper window presents the percentage of the entering cohort who have received a degree or are still enrolled. By using the arrow keys and enter key with the light-bar menu, the user can select the results of other student retention analyses. For example, the lower window of the screen in Figure 4 shows only the percentage of students in the entering cohort who received a four year degree.

The advantages of using interactive computing to assess student retention patterns are readily apparent. Hypotheses about high and low risk student subpopulations can be tested by using any combination of variables in a user defined record selection statement, performing the student retention analysis for that subpopulation in a matter of minutes directly from the database without having to write a program. For example, the user could compare the student retention patterns of freshmen receiving financial aid in the College of Arts and Sciences with first semester GPA's above 3.0 with those having first semester GPA's below 2.2, to determine if the college is relatively successful in retaining its better students.

Executive Information System

The Executive Information System (EIS) is a vehicle for the timely delivery of summary information to decision makers so that they can monitor strategic plans, external trends, and institutional performance. EIS is implemented using sets of stored keystrokes (macros), in Lotus spreadsheets. The result is an easy-to-use system of menus and screens that performs several functions:

(1) navigate through menus;
(2) import text files and graphic images;
(3) retrieve spreadsheet files;
(4) perform computations and what-if analyses;
(5) view reports;
(6) prepare graphs; and
(7) print reports.

Figure 3

INPUT/OUTPUT SCREEN

UNIVERSITY OF HARTFORD

Interactive System for Analyzing Student Retention

INPUT (Trigger file)= TRFCOL6 OUTPUT (Aggregate)= RETFCOL6

=========> Are you FINISHED making selections? <Y> or N

========== Beginning to Process Student Retention Data ==========

Current Record	773 of 773 in Trigger File
	773 Matched in Retention Database

========== The computation pass is finished ==========

==========> Press ANY KEY to continue . . .

Figure 4

RETENTION AND FOUR-YEAR DEGREE COMPLETION

ALL		DEG%	ATT%	FT%	RET%		DegN	AttN	CrHr		QUIT
====== ======		Percentage RETAINED (Enrolled or Received Four-Year Degree)								====== ======	======
Cohort		**Csize**	**Rpc01**	**Rpc02**	**Rpc03**	**Rpc04**	**Rpc05**	**Rpc06**	**Rpc07**	**Rpc08**	**Rpc09**	**Rpc10**
FRESHMEN												
Fall	1984	79	98.7	94.9	81.0	77.2	69.6	65.8	62.0	62.0	62.0	62.0
Fall	1985	67	100.0	95.5	85.1	80.6	76.1	74.6	73.1	71.6	70.1	68.7
Fall	1986	74	94.6	91.9	82.4	71.6	64.9	63.5	59.5	60.8	52.7	0.0
Fall	1987	50	100.0	94.0	80.0	72.0	62.0	62.0	62.0	0.0	0.0	0.0
Fall	1988	57	100.0	93.0	73.7	61.4	56.1	0.0	0.0	0.0	0.0	0.0
Fall	1989	62	98.4	93.5	71.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
====== ======		====== ======		Percentage With FOUR-Year Degree						====== ======	======	======
Cohort		**Csize**	**Dpc01**	**Dpc02**	**Dpc03**	**Dpc04**	**Dpc05**	**Dpc06**	**Dpc07**	**Dpc08**	**Dpc09**	**Dpc10**
FRESHMEN												
Fall	1984	79	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.8	38.0	55.7
Fall	1985	67	0.0	0.0	0.0	0.0	1.5	1.5	3.0	20.9	37.3	53.7
Fall	1986	74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.3	20.3	0.0
Fall	1987	50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fall	1988	57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fall	1989	62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Access to EIS information is provided by linking report files produced by DSS analysis programs to a light-bar menu system. To access information, an EIS user has only to scroll through organization, subject, and report menus, making a single choice at each level of the menu system. The light-bar menus, and up and down arrow keys, are used to navigate through all the reports that are available. When the user's menu choice is highlighted by the light-bar, he hits the enter key to make his selection, and the requested information is instantly retrieved for viewing, graphing, or printing.

The following example illustrates the ease-of-use, flexibility, and power of EIS in analyzing student retention trends for a selected college or student subpopulation. When the user enters EIS, the organization level of the light-bar menu system appears. Selecting the "College of Engineering" on the organization menu retrieves a new spreadsheet which contains the subject menu for that college. Again using the light-bar, the user selects the subject, "Student Retention Trends". This brings in the next spreadsheet and report menu for monitoring student retention trends in the College of Engineering.

A summary report prepared by DSS, as described in the preceding section, is automatically imported into the reporting spreadsheet as a print file when the appropriate EIS menu choice is selected. The spreadsheet automatically converts the text files into spreadsheet columns, performs computations, and links all the data to macros and spreadsheet areas for viewing, printing, and graphing. The screen and print format for the student retention tables, prepared in Lotus 2.2 with Allways, is presented in Figure 5.

The table presents the number of students in each entering cohort for Freshmen in the College of Engineering and the percentage of entering freshmen receiving a four year degree or still in attendance at the end of each semester over a six year period. The analysis shows the cumulative retention rate for each row, or entering cohort, across the twelve columns representing Fall and Spring semester. Separate student retention tables are prepared for freshmen, transfers, and all entering students for each college. The user can example, one can view the percentages of each cohort who were attending in each semester, and contrast this pattern with the timing of four-year degree completion. The tables can be printed or viewed depending upon the user's menu selections.

Graphs of student retention trends can be prepared for viewing or printing either using Lotus graphs interactively or by exporting the tables to custom graphics packages. The EIS graphing menu asks the user to select the table for Freshmen, Transfers, or All Students (Freshmen in this example). The menu then branches and asks the user to select an entering cohort (1984 in this example). The graphing macros point to the correct table and row and automatically prepare the graph for viewing or printing. The bar graph below shows the cumulative percentage of freshmen entering the College of Engineering in Fall 1984 who either received a four year degree or were still in attendance for each of the 12 semesters included in the analysis (see Figure 6).

EIS is employed throughout the retention research program as a presentation strategy that makes it easier for users to retrieve the information they want, while making it easier for developers to deliver the information decision makers need. Information accessible through EIS includes: student retention plans, profiles of enrolled students, enrollment forecasting models, student retention analyses, financial aid profiles, and survey research results. Reports can be delivered through EIS for any organizational unit, subject, subpopulation, or type of report, limited only by the developer's imagination in producing text, graph, and print files. Research designs for the University's student retention analysis program are described in the sections that follow.

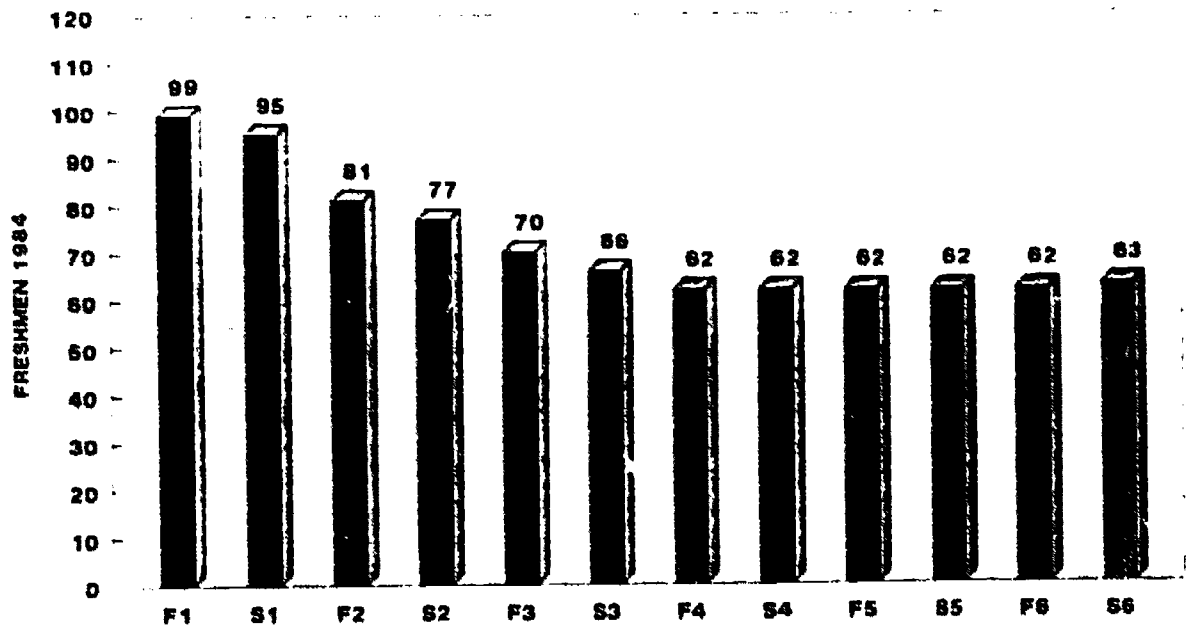
Figure 5

UNIVERSITY OF HARTFORD
COLLEGE OF ENGINEERING

4 YEAR DEGREE + RETURNING

Freshmen Cohort	---Year 1--- F	S	---Year 2--- F	S	---Year 3--- F	S	---Year 4--- F	S	---Year 5--- F	S	---Year 6--- F	S
Fall 1984	99	95	81	77	70	66	62	62	62	62	62	63
Fall 1985	100	96	85	81	76	75	73	72	70	69	61	0
Fall 1986	95	92	82	72	65	64	60	61	53	0	0	0
Fall 1987	100	94	80	72	62	62	62	0	0	0	0	0
Fall 1988	100	93	74	61	56	0	0	0	0	0	0	0
Fall 1989	98	94	71	0	0	0	0	0	0	0	0	0

Figure 8
UNIVERSITY OF HARTFORD
COLLEGE OF ENGINEERING
4 YEAR DEGREE + RETURNING



IMPLICATIONS FOR RETENTION RESEARCH

Academic Prediction Studies

Traditional academic prediction studies are used as the first phase of an early warning system that deals with the student's academic adjustment. Although national follow-up studies indicate that institutional admissions selectivity, scholastic aptitude tests and high school class rank predict college grades and student retention, each college or university has to perform its own validation studies to determine the predictive value of traditional academic measures for admissions selection and student retention. Multiple-linear regression is the statistical method used to determine the optimum combination of weighted scores for predicting first semester grade point average from College Board SAT Verbal and Math scores and high school class rank. Having derived prediction equations (i.e., optimum combination of weighted scores for predictors), the equations are applied to each student's scores to obtain a predicted grade point average. The predicted grade point averages and actual first semester grade point averages are correlated in a cross- validation study to determine the predictive accuracy of the equations derived from the validation study.

Separate academic prediction studies are performed for freshmen in each college, because each of the eight colleges at the University is distinctive with respect to academic mission, curriculum, admissions selectivity, grading standards, and student retention. Fortunately, the CUE menu system makes it possible to select the student subpopulation for each college, to send the database to the SPSS-PC multiple-linear regression program, to perform the necessary analysis, and to send the report results back where they can be viewed or printed from an EIS menu.

The first semester college grade point average is an appropriate measure of the student's academic adjustment during the transition period, and it correlates highly with the cumulative grade point averages of students who enroll in subsequent semesters. The problem for the University of Hartford is that first semester GPA can be predicted from SAT scores and high school class with reasonable accuracy only for freshmen in four of the eight colleges (multiple correlations of .50 to.65). SAT scores and prior college grade point averages are not sufficiently complete to permit reliable academic prediction studies for transfers. Moreover, the large majority of students who leave the University are eligible to return. Some do have marginal grades, but others have grades that qualify them for transfer to highly selective colleges.

Student Adaptation to College

Student retention is a multifaceted process that can be understood only when information the college has about the student's biographic, demographic, and academic data are supplemented with surveys that enable students to share their perceptions about what they are experiencing in their adjustment to college life. During the early period of college, students experience a separation from their families, high school peers, and communities. Students can expect to experience a period of transition before they can incorporate and feel comfortable with the values, attitudes, norms, and behaviors of the student subculture and the college they have selected (Tinto, 1989).

To supplement the information available for studying student retention, the University has selected a recently published questionnaire that was designed specifically to assess student adjustment to college, the Student Adaptation to College Questionnaire (SACQ; Baker and Siryk, 1989). SACQ is a 67 item, self report questionnaire that can be administered individually or in groups, and takes about 20 minutes to complete. The questionnaire is organized into four principal subscales, each of which focuses on a different

aspect of student adjustment:

(1) Academic Adjustment deals with educational demands of the college experience (24 items);
(2) Social Adjustment pertains to interpersonal and social demands of college adjustment (20 items);
(3) Personal/Emotional Adjustment refers to how the student is feeling psychologically and physically (15 items); and
(4) Goal Commitment-Institutional Attachment explores the student's feelings about being in college and attending the particular college he/she selected (15 items).

SACQ has been administered at the University under the direction of the Counseling Office to all freshmen and transfers entering in the Fall, 1989 and 1990 student cohorts. A pilot test of the unpublished version of the instrument was given through the Art and Sciences Dialogue program two years ago, and preliminary research findings were encouraging in predicting student retention over the first two semesters. As the authors of SACQ have suggested, the Office of Planning and Institutional Research is conducting its own local validation studies following guidelines suggested by the research at Clark University. When the SACQ database was complete, a factor analysis was performed to compare the locally validated factor scales with the factor scales used in scoring the instrument. Cluster analysis was performed to create student subgroups that have similar adjustment profiles across the major scales and to identify high and low risk populations for student retention. Discriminant analysis studies were then used to identify scales and items that predict group membership for:

(1) different adjustment profiles;
(2) high and low risk groups for student retention;
(3) students continuing and leaving; and
(4) freshmen and transfers in each college.

The SACQ database is being integrated with the student retention tracking database, making it possible to use interactive computing to perform statistical analyses or ad hoc queries for student subpopulations selected using any combination of predictors or criteria in the database. Multivariate analysis procedures, including cluster, discriminant, and log-linear analyses, are being used to predict retention from the combined information provided by surveys, unobtrusive measures, and biographic, demographic, and academic data. In an attempt to better understand the retention patterns of Engineering freshmen, one could use the interactive DSS approach to compare the student retention patterns of students identified as high and low risk based on their responses to SACQ.

Reasons for Leaving

Since over 85 percent of the students who leave college are in satisfactory academic standing when they leave, it is important to gather data on the student's reasons for leaving, either during the student's exit interview or as soon as possible after it becomes known that the student is leaving. When students are being counseled about their leaving, the counselor needs to discriminate between those situations where the student's educational, career, and personal goals are really better served by leaving or transferring to another college, and those situations where the institution is in a position to respond effectively, thus enabling the student to decide to continue his or her enrollment. If the institution is to take effective action, it needs to understand the types of adjustment problems students are having and why they decide to leave, not just to describe the biographic, demographic, academic, or extracurri-cular differences between students who stay and those who leave.

The University has administered surveys to departing students in the past, but now plans to revise that instrument to reflect recent research findings, to administer the instrument more systematically to increase response rates, and to incorporate reasons for leaving more directly into the student retention research program. A well balanced "reasons for leaving" questionnaire should present a comprehensive and representative list of reasons which parallels the factors encompassed in the Student Adaptation to College Questionnaire: academic, personal, social, and institutional. The attrition questionnaire should also make provisions for identifying how important each reason is to the student's decision to leave, asking the student to rank the three most important reasons for leaving, and using an open ended question asking for the student's impressions of his or her college experience. A follow-up survey is being sent to students withdrawing from the university each semester to obtain information about their reasons for leaving. Requests for transcripts are also being monitored to learn about student plans for transferring to another college.

Student Involvement

Astin and Pace have argued persuasively that active student involvement is the key to learning and personal growth in college, to student achievement and satisfaction, and as a result to student retention (Astin, 1984; Pace, 1984). Their model of student involvement is as promising a research paradigm as any currently available for studying student retention. Research has demonstrated rather clearly that the breadth and quality of student involvement in selective liberal arts colleges and research universities is highly correlated with perceived gains from college experiences, with student satisfaction, with high student retention, and with high rates of alumni participation (Pace,1984; Astin, 1984). Relatively few colleges and universities have the admissions selectivity, the physical facilities, the quality of academic programs and student services, or the housing, athletic and extra-curricular facilities to match that high level of student involvement and quality of effort. However, within the limits of its own resources, and the students it recruits, every college can seek effective ways to motivate students to become more actively involved in their own learning and personal growth.

Creating an environment where students are actively involved begins with student recruitment; identifying students who are interested, actively involved, and committed to improvement in some area of activity the college offers. For colleges that are moderately selective academically, it means finding students whose academic interests and abilities match the college's teaching strengths, and whose extracurricular interests and abilities match the college's offerings for student life. The student has to be sufficiently motivated to invest in his or her own learning; that is the student's responsibility. Given the resources the college has to offer, the college at the very least can help the student make the interpersonal and activity connections that build on motivations that are already there.

The University currently is exploring ways to study the impact of student involvement in extra-curricular activities and how that participation contributes to academic achievement, satisfaction with the college experience, and student

retention for different student subcultures. To augment the SACQ data and traditional archival data, student involvement data will be gathered unobtrusively through student activity rosters and a student leadership transcript program.

Activity codes in the ISIS database can be downloaded for prospective students, applicants and enrolled students to track involvement in extracurricular activities. With this database it is possible to identify new students and returning students who share common interests, to help them to connect, and to pursue their interests actively while building friendships. The same activity database will be valuable for recruiting students for participation in extracurricular activities, for building a leadership transcript for students, for responding to NCAA compliance in monitoring intercollegiate athletics, for studying the impact of financial aid programs on student mix, and for assessing the impact of activity involvement on student satisfaction and retention.

Quality of Student College Experiences

Institutional effectiveness in student recruitment and retention ultimately depends on the perceptions prospective and enrolled students have of the quality of academic programs, administrative services, and physical facilities, and the feelings of stimulation, friendliness, warmth, and support that come from relationships with faculty, staff and fellow students. Colleges and universities concerned about improving quality recognize the need to ask students to share their perceptions about the quality and value of their college experience. At the University of Hartford each college uses an instrument to gaher data on student evaluations of instruction. Such instruments provide useful feedback to individual faculty members and department heads which helps them to increase teaching effectiveness within the department. With appropriate levels of summarization, student evaluations of instruction can also make a valuable contribution to improvement through program level reviews. The American College Testing program has developed two survey instruments that appear promising for gathering student evaluations on the quality of the campus environment, physical facilities, and administrative services: College Student Needs Assessment Survey, and Student Opinion Survey. Questionnaires of this type should be especially useful as the University gathers data for an accreditation review which will take place within the division of student affairs this year.

The College Student Experience Questionnaire (Pace, 1984) is a unique self-report instrument for gathering data from students about the quality of their undergraduate education and examining the sources of student progress towards important goals of a college education. The instrument has a behavioral orientation the asks students how frequently they participate in each of a comprehensive list of learning activities which are widely available on college and university campuses. Quality of effort is measured by arranging the activities into hierarchical scales, with individual activity items at higher or lower levels on the scale depending on the time commitment and level of difficulty the activity represents. The student also is asked to assess the quality of his or her undergraduate experience and the progress made toward achieving important educational objectives. At the University of Hartford we plan to administer the College Student Experiences Survey as a senior survey for four purposes:

(1) to perform an assessment of academic outcomes and administrative services;
(2) to gain a better understanding of the benefits students gain from their activity involvement;
(3) to stimulate student thinking about how to relate their undergraduate experience to careers and life after college;
(4) to identify students whose involvement as undergraduates suggest that they will be active contributors as alumni.

SUMMARY AND CONCLUSIONS

This paper presents an overview of a design for improving the quality of information available for continuous operational study of student retention at the University of Hartford. The theoretical and conceptual frameworks currently available clearly are useful for the design of a comprehensive database for conducting longitudinal and comparative studies of student retention. The University is fortunate to have access to a comprehensive operational student database, and to a cost-effective decision support and executive information system that promises to deliver better and more timely information to decision makers. A successful student retention research program, however, requires more than operational student data. The database must be enriched with student surveys to provide feedback on student college adjustment, reasons for leaving, and quality of college experiences. Improvements will have to be made in our survey research system to provide feedback that is timely, not only for purposes of research but for operational use in improving student recruitment and retention strategies.

As in any research effort of this type, the University recognizes the importance of maintaining the security and confidentiality of individual student data. These concerns must be balanced against the necessity of providing information access to professional administrators, student counselors, and faculty advisors who have the responsibility of helping undergraduate students take maximum advantage of the full range of experiences the university offers.

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