DOCUMENT RESUME

ED 450 722		IR 020 603
AUTHOR	Massy, William F.	
TITLE	Virtual U: The University Simulation Game.	
PUB DATE	1999-00-00	
NOTE	14p.; In: EDUCAUSE '99: Celebrating New Beginnings. [Proceedings] (Long Beach, CA, October 26-29, 1999); see IR 020 580.	
AVAILABLE FROM	For full text: http://www.educause.edu/conference/e99/proceedings.html.	
PUB TYPE	Reports - Descriptive (141) -- Speeches/Meeting Papers (150)	
EDRS PRICE	MF01/PC01 Plus Postage.	
DESCRIPTORS	Computer Oriented Programs; *Computer Simulation; Computer Software; Computer Uses in Education; *Educational Administration; Educational Development; Educational Resources; *Higher Education; Information Systems; Online Systems	

ABSTRACT

The Virtual U Project is a simulation product created to help improve the management of the nation's university systems. Virtual U simulates running a university or college and assists management in allocating resources within the university. It is a powerful and user-friendly software tool that models the attitudes and behaviors of an academic community. The tool is driven by a powerful simulation engine that draws on an extensive compilation of data concerning the United States higher education system. Players determine policies for resource allocation, faculty hiring, and enrollment management; and consider other decisions that college and university administrators face. Virtual U is the beginning of a new genre of interactive tools for educational systems. (Author/AEF)

Virtual U: The University Simulation Game

By: William F. Massy

Virtual U:
The University Simulation Game*

William F. Massy
President of The Jackson Hole Higher Education Group, Inc., and research professor at the National Center for Postsecondary Education, Stanford University.

Virtual U is a computer simulation game under development that will engage participants in exercises designed to improve understanding of universities as systems. Participants will take the point of view of a university president. They will set institutional and departmental budgets and make decisions in areas such as faculty hiring and compensation, enrollment management, incentives for teaching and research, finance, facilities, and even parking. The graphic interface is based on modern computer gaming technology (Windows 95 or 98). The simulation model is based on the latest available research, and it will be documented in due course. The Virtual U team seeks collaborators to help determine the best modes of usage and to explore the possibilities of customization.

Colleges and universities are complex and arcane enterprises. Few people involved in or concerned with higher education understand these institutions as systems. This includes faculty, administrators, students, members of governing boards and state higher education coordinating boards, the higher education press, alumni, parents, and the interested general public. Misconceptions abound, and these adversely affect the higher education policy environment and institutions' ability to govern themselves.

Reacting to the problem, the Sloan Foundation's Jesse Ausubel and I independently conceived the idea of a university simulation game. Simulation provides a tool for the analysis of systems. A game environment invites interaction, which hopefully will motivate the effort needed to grapple with the systems issues. We began outlining the idea in Ausubel, *et al* [1997].

Now Virtual U, also known as "Virtual University," is about to become a reality. Enlight Software of Hong Kong designed and developed the game. Trevor Chan, Enlight's President, is well known in gaming circles for his *Capitalism* and *Seven Kingdoms*. The Jackson Hole Higher Education Group developed the simulation engine, which is an entirely new model although it does draw heavily on my prior work (see the list of resources). Data to drive the engine were collected by the University of Pennsylvania's Institute for Research in Higher Education. The game is now in the last stage of beta testing, and Digitmill, Inc., of Portland, ME, will launch it later this fall. The Alfred P. Sloan Foundation supported the project from its inception.

Overview

Virtual U provides a powerful, convenient, and user-friendly tool by which institutional professional and interested laypersons can participate in leadership challenges in a college or university setting. Users set, monitor, and modify a variety of institutional parameters and policies, allocate resources as they see fit, and watch as results continually unfold. The simulation provides an opportunity to experiment and succeed or fail in a safe and entertaining fantasy environment. While Virtual U is necessarily a caricature of real academic life, it is grounded in authentic conceptual structures and data. It will provide serious lessons in higher education.

Virtual U has been designed as a computer game to help establish motivation and guide users through scenarios and problem-solving challenges. The game will be distributed via CD along with a manual and strategy guide. It is programmed in C++ and operates in a Windows environment. My colleague, Ben Sawyer from Digitmill, will begin demonstrating it shortly.

The game is driven by a powerful simulation engine that uses a combination of micro-analytic and system dynamics methods and draws on an extensive compilation of data on the U.S. higher education system. (CDs with data from other countries could be produced with modest effort.) The simulation specification will be in the public domain, and technical papers describing it will be produced in due course. An expressive graphical interface with extensive help screens and tutorials provides access to the simulation's rich systems environment.

By taking the point of view of the university's president, users get a unique opportunity to see the operation of the institution as a whole. Virtual U's presidents are endowed with an uncannily high degree of omnipotence. They choose the kind of institution they wish manage: e.g., public or private, large or small, prestigious or not. They can make decisions or view operating and financial reports at any time, and they can drill down to the department or even the individual professor level. They determine policies for resource allocation, faculty hiring, enrollment management, and many other decisions faced regularly by college and university administrators. They can set policies consistent with long-term strategies or intervene in specific decisions as desired. Custom simulations allow them to determine their own goals, or they can select scenarios with preset goals. The simulation can continue as long as the institution remains financially viable.

Presidents also must confront chance events: for example, the governor makes a sudden change in the state appropriation, Congress adjusts research funding, or there is a serious fire or scandal on campus. The events may have good or bad consequences, and they may or may not call for an explicit response. The resulting unpredictability can add a useful element of excitement to the simulation, or the chance events can be turned off as in our demonstration today.

Our tour of Virtual U begins with the simulation's startup options and continues through its main interaction screens. At each stage we will demonstrate the interface and briefly describe the key elements of the underlying model. The model will run during the demonstration to allow viewers to experience the evolution of our virtual university.

[*Launch the simulation; pause to view the opening animation.*]

What Issues? What University?

Players may choose a custom simulation, a scenario simulation, or an express simulation. Scenarios present a specific challenge and offer particular success criteria. For example:

Allocate new money:

New money provides an opportunity to improve academic quality and institutional prestige, but it is all too easy to disburse the funds ineffectively. Having just received a pledge for a major gift to endowment, you will be asked to allocate the extra income flow to one or more departments in a broad field specified by the donor. You will be judged by the increase in institutional prestige and by the institution's overall performance over a ten-year period.

The complete list of scenarios follows:

Balance the budget

Pay better

Allocate new money

Teach better

Improve research performance

Win games

Control tuition increases

Limit enrollment shifts

Enroll more minority students

Hire more minority faculty

Each scenario may be run for a college or university with public or private control.

The *custom setting* allows presidents to choose their own issues and fine tune their environment. The first step is to select up to fifteen departments from a list of 38 departments for which data have been provided. Departments can be added to or subtracted from a ten-item default set. The selected departments will operate throughout the simulation.

The two *advanced options* screens present presidents with choices about student numbers and characteristics, institutional prestige and financial condition, and various other attributes of the school and its students. For example, the school can cater to traditional, nontraditional, or distance students, be mainly residential or non-residential, include graduate students as well as undergraduates, and stress research or not.

The model uses data from 1200 four-year institutions to produce a realistic representation based on the president's specifications. The inputs provide targets and weights for a distance index (a weighted sum of squared deviations), which is calculated for each institution in the database. Average financial and operating information for the ten institutions with the smallest indices provide the simulation's initial conditions. The model runs for an academic year (year 00) to dissipate startup transients and then turns itself over to the president at the beginning of year 01. A "welcoming letter" from the simulated Board of Trustees orients the president to the kind of institution he or she has created.

[*Launch a simulation. Stop it early in August before the first budget round.*]

Express simulations provide a quick-start capability for people who want to move immediately to a challenging situation. They were generated using the custom procedure, run to a point judged to be interesting, and then saved and stored on the CD. The express simulations offer no design options or welcoming letter.

The Campus

The campus map provides visual orientation and one of several navigation tools. Clicking on a building brings up information relevant to that activity—for example, an academic department, Old Main (administration), the Development or Admissions Office, or the stadium and field house. The map is static during play (moving figures would have consumed too many machine cycles), but it depends on whether the campus setting is urban, suburban, or rural.

Six "dashboard" indicators track the evolution of key data series: for example, enrollment and sponsored research, selectivity, faculty and student morale, and financial performance. The president can gain more information by clicking on the appropriate building or toolbar item.

[*Click on the Faculty tool and follow along with the text.*]

The Faculty

"The faculty *are* the university," so the saying goes. Virtual U simulates each faculty member as an individual—that is, as a "sim" with its own characteristics, behavior, and history. The sims are organized by departmental affiliation, gender, ethnicity (majority or minority), and academic rank (assistant, associate, or full professor, short or long term adjunct). The two *Profile* screens report numbers and percentages at the departmental and institutional levels.

The *Detail* screens illuminate the simulation's operation at the micro level. Faculty attributes include talent for teaching, scholarship, and research, current performance on each dimension, age, salary level, and degree of job satisfaction (morale). Scholarship has its own category to emphasize its breadth relative to traditional research [Boyer, *et al,* 1991]. Subject to presidential influence, departments assign teaching loads and professors allocate their discretionary time among class preparation, out-of-class student contact, course development, scholarship, and research (see Zemsky, *et al,* 1999, for a sample time utilization model). The total workweek varies due to teaching loads, research projects, morale, and other factors. Professors submit proposals for sponsored research that may or may not result in project awards. The president sets policies that govern the kinds of faculty to be hired and the distribution of salary increases. Professors become happy or frustrated, and they may retire or leave the institution for other reasons. While the president may not wish to view the individual faculty sims, the information is there if needed.

The *Activities* screens summarize the faculty's behavior as it evolves during play. They also allow players to influence the behavior. For example, departments develop norms for teaching load [Massy and Zemsky, 1994], but actual loads may deviate from the norms due to presidential policy and enrollment demand. The sims' talent profiles affect their intrinsic preferences for use of discretionary time (e.g., high research talent means a stronger desire for research time) but this, too, may be influenced by presidential policy. Attempts to influence teaching loads and discretionary time may or may not produce significant change, but they always carry morale and performance penalties.

Faculty submit *sponsored research* proposals according to a Poisson process with probability dependent on field, research talent, time spent on research, and the school's research emphasis. A proposal gestates for a period of months, after which an award of a particular size may or may not be forthcoming. The award probabilities depend on the researcher's talent and recent performance, applicable infrastructure, the department's and school's research reputation, and the overhead rate charged on sponsored research projects. A project generates direct research expenditures for the department and overhead recovery for the institution until it expires after about a year. Time series provide research volume data and a bar chart shows proposals, awards, and rejections. The panel at the right of the screen allows the player to change the overhead rate either immediately or prospectively. (Similar panels appear on other screens.) I'll explain its operation in the context of budget setting.

Faculty morale (on the *Activities* screen) depends on factors like salary, teaching load, presidential efforts to influence discretionary time, and performance. Faculty and student diversity influence minority and female professors' morale. Teaching, scholarship, and research performance depend on talent, time on task, morale and other factors like expenditures on libraries, information technology, and facilities. Faculty teaching performance, student quality, teaching load, instructional methodology, and class size affect teaching quality.

These effects (and many others) operate through single or dual logistic response functions, classic s-shaped curves or stacked pairs of s-shaped curves, which have been parameterized judgmentally. The single logistic's maximum sensitivity occurs at the center of its range. The dual logistic allows for low sensitivities at the center and then asymmetrically larger ones on each side until the upper and lower asymptotes are approached. Both functions constrain their outputs to a preset range, which prevents the model from running away. Latency functions of the form $y_t = l\, y_{t-1} + (1\text{-}l)\, x_t$, where x_t is the response function output, provide additional stability and realism.

Professors progress from year to year according to a Markov process with transition probabilities for "promote", "depart", and "continue in rank but one year older." (Parameterization was informed by Massy and Goldman, 1995.) A sim's transition probabilities depend on salary, morale, and performance. The president can influence them by adjusting the policies on the *Promotion* screen. The continuation probability for assistant professors goes to zero after seven years, and the one for full professors declines as the sim passes age 55. Associate and full professors have tenure, but the president may induce them to take early retirement with a suitable buyout offer.

The *Salary* screen allows the president to set policy for distributing the university's annual faculty salary pool. Preference may be given to certain departments, ranks, and/or gender ethnic groups. They are implemented each August after the budget has been determined. The *Hiring* screen sets policy for faculty hiring, which also takes place in late August. Policy variables include preferences for rank (e.g., leadership or new blood), gender-ethnic status, and different kinds of talent. All policies stay in place until modified. The budget determines how many faculty members each department can hire. Then a linear program maximizes the president's preferences subject to the hiring limit and market constraints based on salary and availability.

[*Click on the Students tool and follow along.*]

Students

Students are simulated as individuals just like faculty, but there are no detail reports. (Student sims can run in the high thousands, whereas faculty sims number in the hundreds.) *Profiles* by student type and gender-ethnic group summarize the composition of enrollment at the departmental and institutional levels. Students may be full-time or part-time undergraduates, masters, doctoral, or distance learners (for simplicity they are also undergraduates). Student attributes include academic talent rating, academic performance, morale, major department, and number of courses accrued for graduation. Full-time undergraduates also possess extracurricular and athletic talent ratings.

Virtual U's *Admissions Office* (a freestanding operation with its own building and interface screens) extends offers to prospective students, manages financial aid, and tracks applications and yield rates. The president determines target student numbers for each level except doctorates and set priorities governing the kinds of students to be admitted and the allocation of financial aid. (Departments admit their own doctoral students without presidential intervention, and all doctoral students receive full financial aid.) For example, admissions and financial aid for full-time undergraduates may favor academic, extracurricular, or athletic talent, and aid may be need based or merit based. The Admissions Office sets intake targets to maintain the president's desired student numbers after taking account of graduations, dropouts, and expected yield rates. It uses linear programming to maximize the priorities for full-time undergraduates, subject to the intake target and market conditions.

The market model for full-time undergraduates classifies potential applicants into seven market segments. (Such students represent the bulk of Virtual U's enrollments and more data are available for them than for other student types.) The segments are:

- *Blue Chip:* students with top academic and extracurricular qualifications
- *Scholar:* students with top academic qualifications
- *Extracurricular:* students with top extracurricular qualifications
- *Athlete:* students with top athletic qualifications
- *Balanced:* students with respectable academic and extracurricular qualifications
- *Average:* students with unremarkable academic, extracurricular, and athletic qualifications
- *Stretch:* students for which college represents a "stretch" goal because of shortfalls in ability or preparation

I used data from the National Education Longitudinal Study (NELS) to determine segment sizes and characteristics and the effects of institutional attributes on application and yield preferences. Institutions were classified according to Zemsky's seven-way typology [The Landscape, 1997] for purposes of model calibration. Virtual U's current characteristics are mapped into the typology as the simulation proceeds.

The admissions algorithm generates the number of applications, admissions offers, and matriculations for each full-time undergraduate segment. A simplified algorithm not involving segments or linear programming generates applications, offers, and matriculations for the other student levels. Reports on the process are available within the Admissions Office.

The *Student Activity* screen reports on student talent, morale, degrees awarded, average time to degree, and dropout rates—again, both at the departmental and institutional levels. Students graduate when they have accumulated the requisite number of courses (a full load is four courses per trimester). The requirement is 32 courses for undergraduate degrees, 8 for masters degrees, and 16 (plus a dissertation period of about a year) for doctoral degrees. Students may speed their progress by taking courses in the summer, and the president can encourage them to do so. Year-around operation (which requires the strongest intervention) optimizes the use of facilities and other scarce resources, but at a potential cost in student and faculty morale. Students who do not graduate during a given year may drop out with transition probabilities determined partly by academic performance.

Additional information specific to full-time undergraduates can be found on the *Undergraduates* screen: for example, the extracurricular and athletic ratings. The *Student residences* screen shows the fractions of full-time undergraduates who live on campus, plus the tuition and room and board rates.

The *Athletics Program* (reached by clicking on the stadium or arena) fields football and women's basketball teams at a presidentially determined level of intercollegiate competition. Win-loss records depend on student athletic talent, which is influenced by the player's admission and financial aid priorities, and on athletics program expenditures in relation to the level of competition. Revenue depends on the level of competition and the win-loss record. The record also affects student and alumni morale, fund raising, and other aspects of university life.

[*Click on the Courses tool and follow along.*]

Courses

The *Course* report arrays the number of enrollments—the result of matching course supply and demand—by department and for the institution as a whole. Full-time students seek to take four courses in each of two trimesters. Generally these are in the fall and spring, but some students select the summer as a regular trimester. Part-time students and distance learners take half the normal number of courses. Professors want to teach at or below their normal loads, but they will accept somewhat higher loads if the occasion demands.

Undergraduates use a probability vector based on empirical enrollment data to select a major at the end of their first year. Masters and doctoral students enter directly into a department. We estimated the concentration, distribution, and elective requirements for each major (and for general education) by sampling course catalogues. Following research on curricular structure [Massy and Zemsky 1997], the model categorizes each department's courses according to "depth" and "focus." Depth refers to the number of departmental courses typically taken before this course. Focus refers to whether the course is usually taken during an undergraduate's first two years (lower division), last two years (upper division), or by graduate students.

Each major's requirements database specifies the number of courses needed from each department-focus combination and depth classification, which determines the number and precedence of prerequisites. Each sim accumulates a list of requirements completed and selects the next semester's courses according to the most pressing requirements yet to be attained. (For example, a requirement with a prerequisite is more pressing than one with no prerequisite.) Two problems may delay a student's orderly progression toward graduation: denial of entry into courses or failure after a course has been taken. (These are reported in the last two columns of the enrollment table.) Denial occurs when the supply of spaces in a particular course category falls short of demand as described below. Students may try to substitute another course in this case, but it will be one of lower priority. Low student academic talent and poor educational quality may conspire to produce course failure. Failure means the student must retake the course, which slows progress toward graduation.

Supply side effects derive from the faculty's preference for one or another teaching method, faculty size, and permissible teaching loads. Again following Massy and Zemsky [1997], the three teaching methods are large lectures with breakout sections, small seminars, and general courses. Seminars produce more learning and large lectures less, other things being equal, but resource requirements differ. Departments have a preferred teaching method mix, which the president may seek to influence, and each method has an ideal class size that may vary by department. Actual class size may exceed the ideal by a certain percentage, but this will erode morale and educational quality.

Supply-demand matching starts with course selection by doctoral students, who have first priority for spaces. Then come masters students, full-time undergraduates, nontraditional undergraduates, and distance learners. (Substantially larger class size limits for distance students simulate a virtual learning environment.) The first selection initiates a new course in the indicated department and depth-focus category, to which a randomly selected faculty member will be assigned. The teaching method also will be chosen at random based on the department's current preference vector. Then the process continues until all students have made the requisite number of selections for the trimester, at which point the demand-supply matching will have been completed.

The demand limit is reached when all sims have selected their complement of courses. Supply limits arise when (a) all faculty have been assigned their maximum teaching loads and (b) all courses have reached their maximum enrollments. The supply constraint can bind in some departments and not others. Demand shortfalls reduce teaching loads. Such shortfalls boost the unit cost of instruction but give faculty more time for other activities including research. Supply shortfalls increase time to degree and, therefore, dropout rates. Players can increase demand by admitting more students and increase supply by adding faculty, pushing up teaching loads, or shifting the teaching method mix away from seminars and toward lectures. Each act carries its own set of consequences, so tradeoffs will be required.

[*Click on the Finance tool.*]

Finance and Related Offices

Teaching and research form the academic heart of the university, but the heart can't function without money to circulate. The *Finance* tool provides visibility on the university's sources and uses of funds and balance sheet, and access to the policies that guide the annual budgeting process.

Funds sources include net tuition revenue (tuition rate times student FTEs minus financial aid), sponsored research, gifts for current use, spending from endowment, and (for public institutions) state appropriation. Uses are classified by function and type. Functions, shown on the *Revenue and Expenditures* display, include departmental expense, direct sponsored research expenditures by principal investigators, libraries, information technology, student life, athletics, fund raising, and administration. There are three expenditure categories: faculty salaries, staff salaries, and "other" (e.g., supplies, communication, and travel). The types are shown along with the functions on the *Detail* display.

Players may transfer funds to a capital reserve for use by the *Facilities Office* in the construction of new buildings and parking structures. Building demands depends on faculty and student numbers, expenditures on research and support services (such expenditures reflect staff numbers), and the depreciation of existing plant. (Space norms like those in Virtual U are used by many public systems around the world.) Parking demand depends on the same factors plus campus setting—urban campuses need more parking structures than rural ones. The Facilities Office tracks space supply, space demand, and space under construction. (Construction takes a year to complete once the work is initiated.) Failure to meet demand erodes educational quality, research performance, and morale.

Facilities can be constructed with *debt*, providing that borrowing limits have not been exceeded, and also with gifts designated for plant. The president decides the fraction of construction to be debt financed and sets the university's debt limit. The bond market sets the ultimate debt limit depending on the school's financial performance and balance sheet.

The *Development Office* reports on fund raising and allows the president to determine how the gifts will be allocated. Gifts for current operations go to support the budget while endowment and plant gifts are added directly to the balance sheet. Fund raising success depends on university academic, financial, and athletics performance and on expenditures for development.

The *Investment Office* reports endowment total return and allows players to set the spending rate and allocate assets among bonds and large and small capitalization stocks. Small-cap stocks offer the highest return but they are the most risky. The spending rate is set during the budget process, but it can be adjusted within the Investment Office. The president also can choose the degree of smoothing to be applied to endowment spending. Smoothing dampens stock market fluctuations at the cost of larger asset value variations.

[*Click the Budget button under Finance.*]

Resource Allocation

The *Budget* report displays the policies that govern resource allocation. Budgeting proceeds in three stages: determination of (a) overall revenues and expenditures, (b) the distribution of budget enhancements and cuts by function, and (c) the allocation of faculty hiring authorizations among departments. The model's default setting requires hands-on attention each year to the trustees' evaluation letter, the year-end financial statements, and the details of budgeting. The menu tool allows conversion to automatic mode, where the president sets budget policies in advance for execution without pausing at year end.

[*Run the game to the annual budget exercise and cycle through to the stage 1 budget.*]

Overall revenues and expenditures depend on what financial officers call "budget guidelines." These include the planned growth rates of tuition and financial aid, the endowment spending rate, the research overhead rate, the size of the salary increase pools for faculty and staff, and the transfer to the capital reserve. (Provision for other expense growth has been preset and debt service depends on the amount of borrowing.) The overhead rate will be applied to new research proposals and the faculty salary pool will be allocated to individual sims once budgeting has been completed.

Two more policy variables are required to complete the budget guideline specification. Following Hopkins and Massy [1981, Chapter 3], "net budget change" represents the total spending increase or decrease after taking account of salary change and other cost-rise factors. The "surplus-deficit" variable represents the budget's bottom line expressed as a percentage of total expenditures.

Players can manipulate the target, the acceptable upper and lower limits, and the priority to be associated with each policy [*demonstrate*]. The overhead rate is further constrained by the university's simulated A-21 calculation. The display also reports the last available result—either from the prior year's budgeting cycle or, in hands-on mode, the last iteration of the current cycle.

Clicking the *Optimize* button [*demonstrate*] activates a quadratic program that simulates the budget staff's efforts to achieve the president's policy targets and limits. Hitting all the targets would require the policies to be mutually consistent, a condition that is unlikely to be met in practice. The model does the best it can by minimizing the weighted sum of squared deviations between the guideline variables in their targets, subject to the acceptability limits and a linear identity that approximates the surplus-deficit in terms of the other variables.

The *Help* screens point out that the simulated budget staff will not be able to honor the whole set of acceptability limits if the limits are too stringent relative to the current financial situation. The model always produces internally consistent budget guidelines, but some of the limits may be violated. The president can redefine the policies and repeat the optimization if the results leave too much to be desired [*demonstrate*].

This is a good time to explain the sponsored research screen's overhead rate adjustment, and by extension the similar adjustments found on other screens. Recall that the president can set a numeric value and then choose among three options: "Consider for next year", "Promise for next year", and "Implement now". The numeric value adjusts the policy target no matter what the option: for example, –3.0% decrements the overhead rate target by three percentage points. "Consider for next year" sets the priority to 2 ("medium", the default value) and "Promise for next year" sets it to 3 ("high priority"). These changes affect the next budget cycle. The president can make further changes during the year, but actions that go against these commitments risk backlash in terms of principal investigator morale.

"Implement now" effects the change immediately, then locks the rate so that it cannot be changed during the ensuing budget cycle.

Stage 2 of the budget process allocates the net budget change, produced in stage 1, across the expenditure functions [*advance to stage 2*]. The targets, limits, priorities, and quadratic program work just as for stage 1. An identity constraint links the sum of the dollar changes to the total change (expressed in dollars) provided for in the budget guidelines.

Departmental expense appears first in the list of expenditure functions. More money for departments means more faculty hiring, and conversely. Additional funds come from vacated positions. The available funds are converted to numbers of faculty positions, which are allocated across departments by linear programming in stage 3 of the budget process [*advance to stage 3 and demonstrate*]. Players can override the calculated numbers of new hires [*demonstrate*], with attendant consequences for the surplus-deficit. Hiring proceeds as described earlier once the budget process has been completed.

[*Finish resource allocation, then click on Performance and follow along.*]

Presidential Performance

Simulations can just run, but games also require a sense of winning or losing. Virtual U players are scored in several ways. All runs produce annual "performance evaluations" and an "ultimate score" that the president may wish to maximize. Scenario simulations bring additional goals that add bonus points to the ultimate score if achieved. Players can view their scores using the *Performance* tool. Additional devices such as the annual trustee evaluation letter and plaques for achieving scenario goals add emphasis and interest.

Maintaining financial viability represents the threshold criterion for presidential success. The university goes bankrupt [*use hidden key to display the graphic*] if deficit spending triggers short-term borrowing needs in excess of what bankers will lend. The player will be warned in time to take remedial action. Failure to do so will terminate the game and negate all other accomplishments [*use the hidden key to exit the graphic*].

The president's annual performance evaluation depends on four groups of factors: output measures, institutional performance indicators, attitudes toward the institution, and financial indicators. There are sixteen factors in all, each of which enters with a particular weight. For example, the *performance indicator* group counts for 35% of the overall evaluation. It consists of institutional prestige (20% of the 35%), educational quality (20%), scholarship (20%), student and faculty diversity (10% each), and the percent of alumni who have given anytime during the last five years (20%). Help definitions are provided and players can track their performance by looking at time series. Each year the simulated Board of Trustees sums up the president's performance in a letter that lists the areas needing improvement.

The ultimate score is calculated according to the following formula, which is displayed prominently [*demonstrate*].

ultimate score = current trustee evaluation x (number of gaming years) +
(current trustee evaluation – initial trustee evaluation) x 10 + total bonus points

The formula recognizes improvements relative to the game's initial conditions, and it also rewards longevity and cumulative accomplishment. Voluntary termination of the game posts the score in the Virtual University Hall of Fame.

[*Terminate the game and demonstrate the Hall of Fame.*]

Concluding Comments

The Virtual U team set out to produce a simulation game that would encourage users to explore the university as a system. We believe we have pushed the state of the art on the simulation side and achieved sufficient playability to make interaction with the simulation an enjoyable experience. Virtual U represents an advance in educational software, and we think the lessons learned can be applied to other subjects.

Virtual U's target market will be, broadly, anyone with an interest in how colleges and universities work as systems. More specifically, we envision the market as:

•higher education administrators

•faculty, especially those in leadership roles (e.g., department chairs)

•trustees

•education analysts, writers, and policymakers

•students of higher education, and in general

•alumni and interested public

Virtual U will be sold to individuals and to institutions for use in connection with retreats and training programs. A separately available strategy guide will help users develop intelligent modes of play and maximize their learning. A Web site is under development.

The team would like to develop a network of expert partners who can design and facilitate group learning approaches based on Virtual U. The team also would like to hear from parties interested in customizing the game to fit new countries or particular institutions. The program is database driven, so it should be possible to tailor the student, faculty, and financial profiles without great difficulty. We also envision a program of research aimed at improving the game's databases, structures, and response functions. Persons interested in any of the above should visit our Web site or contact Ben Sawyer at Digitalmill, Inc., 2 Customs House Wharf, Suite 201, Portland, ME 04101 (207.773.3700, bsawyer@dmill.com).

We are proud of the Virtual U package but also conscious of the improvements that might have been—given less stringent limits on time and money, and if we had known what we know now at the beginning of the project. Virtual U is still very much a work in progress, and it will remain so after launch. The team looks forward to creating a Version 2 if the simulation gets used and produces valuable learning. In closing, let me thank all that worked on the project as well as the Sloan Foundation for its support and patience.

Resources

Ausubel, J. H., Herman, R., Massy, W. F., & Massy, S. V. (1997). "Simulating the Academy: Toward Understanding Colleges and Universities As Dynamic Systems." In W. F. Massy and J. W. Meyerson (Eds.), *New Models for Higher Education*. Princeton, NJ: Peterson's, pp. 107-120.

Boyer, E. L. (1991). *Scholarship Reconsidered: Priorities of the Professoriate*. Princeton, New Jersey: Carnegie Foundation for the Advancement of Teaching.

Hopkins, D. S. P., & Massy, W. F. (1981). *Planning Models for Colleges and Universities*. Stanford, CA: Stanford University Press.

Massy, W. F., & Goldman, C. A. (1995). "The Production and Utilization of Science and Engineering Doctorates in the United States." Stanford University, Stanford Institute for Higher Education Research; report to the Alfred P. Sloan Foundation.

Massy, W. F., & Zemsky, R. (1994). Faculty Discretionary Time: Departments and the Academic

Ratchet. *Journal of Higher Education*, 65:1 (January-February), pp. 1-22.

Massy, W. F., & Zemsky, R. (1997). "A Utility Model for Teaching Load Decisions in Academic Departments." *Economics of Education Review*, 16(4), pp. 349-365.

The Landscape (1997). "In Search of Strategic Perspective: A Tool for Mapping the Market in Postsecondary Education." *Change* (November/December), pp. 23-38.

Zemsky, R., Massy, W. F., Shapiro, D., Shaman, S., Dubrow, G., & Giancola, J. (1999). *Market, Price, and Margin: Determining the Cost of an Undergraduate Education*. University of Pennsylvania, Institute for Research on Higher Education.

EDUCAUSE Information Resources Library

Transforming Education Through Information Technologies

Abstract

Category: Papers Presented at EDUCAUSE annual conferences

ID Number:	EDU9937
Title:	Virtual U: The University Simulation Game
Author:	William F. Massy
Organization:	The Jackson Hole Higher Education Group
Year:	1999

Abstract: The Virtual U Project is a simulation product created to help improve the management of the nation's university systems. Virtual U simulates running a university or college and assists management in allocating resources within the university. It is a powerful and user-friendly software tool that models the attitudes and behaviors of an academic community. The tool is driven by a powerful simulation engine that draws on an extensive compilation of data concerning the U.S. higher education system. Players determine policies for resource allocation, faculty hiring, enrollment management, and consider other decisions that college and university administrators face. Virtual U is the beginning of a new genre of interactive tools for educational systems.

This material is available in the following electronic formats:

html

Select one of the icons above to retrieve the material in that format. We also have definitions and instructions for setting up your computer to download these formats.

Home | Feedback | Search | Copyright

NOTICE

REPRODUCTION BASIS

☒ This document is covered by a signed "Reproduction Release (Blanket) form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.

☐ This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").

EFF-089 (9/97)