

**A**n extensive literature base concerning the purpose, philosophy, design, instructional format, and the most appropriate and effective teaching aids for teaching introductory statistics and management science at the MBA level has been established over a period of years (e.g., Starr [1970], Zahedi [1984], Roberts [1987], Ho [1988] and Borsting *et al.* [1988]).

While many feel that these decision sciences (DS) courses should have a

providing a systems-oriented, integrated approach to "problem management." The four modules comprising this 1 1/2 semester course are:

1. Review of college level mathematics.
2. Basic probability, statistics, data analysis, regression analysis and forecasting.
3. Model development with sequential activities and constraints (e.g., PERT/CPM, linear programming, goal programming and sensitivity analysis).
4. Modeling and decision-making un-

der risk and uncertainty (e.g., decision theory, utility assessment, Bayesian analysis, queueing theory and simulation).

Placing the responsibility for finding an appropriate project with the students has many advantages.

First, students are free to attack problems which interest them. Second, the instructor is freed from generating large numbers of projects on an ongoing basis. The projects have been developed from many sources, including:

- student family businesses and farms;
- recent alumni;
- companies providing previous student employment;
- former professional associates;
- small businesses frequented by students; and
- nonprofit and community service organizations.

While most students select projects from the above sources, roughly 10 percent are unable to secure project sponsors. For these students, we typically use our campus admissions, placement, security, traffic, health care, maintenance, athletic and other campus administrative offices to provide projects.

A project prospectus (providing details about the project) is due after 75 percent of the course is completed. The project prospectus must report (with the completed project report providing the final results and details):

1. The problem the students have selected to address, and for which company, institution or government agency.
2. The name of the company liaison(s).
3. A sample of the raw data to be used, how it will be collected, how much will be collected, and how it will be manipulated into the form desired.
4. How the modified data (aggregated, standardized, etc.) will be processed (software, model employed) to arrive at the information or solution desired.
5. The results they expect.
6. What criteria will be employed to measure the degree of success or progress.
7. How the results will be used for managerial decision making and for how long;
8. Means of implementation, expected difficulties and how they expect to overcome these difficulties.
9. The means for ongoing control and improvement.

# How Student DS Projects Benefit All

By Roger J. Gagnon and Gregory C. Taylor

more applied, managerial decision-making orientation (Marks and McClure, 1989), the precise "knowledge" the students should obtain, the selection, depth and sequence of topics to be covered, and the instructional formats used (homework problems, mini-cases, full cases, projects, course papers, etc.) are still areas for experiment and discussion.

This article:

1. Relates what we feel are the objectives of the DS sequence and the difficulties in achieving them.
2. Lists the educational objectives and benefits we feel an integrated, experiential DS project offers.
3. Provides examples of student projects.
4. Gives initial student feedback.
5. Offers future extensions.

## Educational mission

The graduate program with which the authors are associated emphasizes an applications, decision-making approach for the general manager. The decision sciences course supports this mission by

der risk and uncertainty (e.g., decision theory, utility assessment, Bayesian analysis, queueing theory and simulation). The instructional formats steadily progress from the lecture-homework problems format for the earlier modules to the use of problems, mini-cases and group assignments in the latter. Thus, the students are progressively introduced to the larger "systems view" of the business as the sequence develops, with the experiential project serving as the broadest and most realistic capstone activity.

MBA student groups of five to six students are required to complete a project. The DS professors act as advisers for the groups for the duration of the project.

## Integrated decision sciences project

Each student group is free to select, with faculty approval, any real problem in any company or institution. The problem must focus on managerial decision making and have aspects which are addressable by one or more of the topics discussed in the DS course. The final project must clearly demonstrate how the results of modeling efforts are used to make decisions. The problem should also be of appropriate size — neither insignificant nor insurmountable.

The project and project prospectus constitute 20 percent of the overall course grade — a portion which should reflect more than one month (250 hours) of total effort from each group. This effort reflects the time period to complete an acceptable project and the importance the faculty places upon the learning experience provided.

### Educational benefits

The benefits accruing from the project are impressive and are encapsulated as follows:

1. Spans and helps to interrelate the mathematics, statistics and management science topics within the decision science course, and helps to integrate these topics with other business courses.
2. Allows the students to experience each facet of the systems approach to problem solving, including:
  - identification of real problems (apart from the "mess");
  - determination of the importance of the solution, to whom, and for how long;
  - selection of the criteria (single or multi-criteria, whose criteria) upon which to judge success or performance;
  - initial model concept;
  - determining which variables are relevant and selecting a measurement scale for each variable;
  - designing a data collection strategy (sample sizes, sources);
  - modifying the raw data into the correct form;
  - detailed model/solution methodology construction (e.g., qualitative versus quantitative; optimal, heuristic, or simulated);
  - output assessment (need more data, different data, more trials needed, etc.);
  - communication of results to management and acceptance or rework, if necessary;
  - assuming acceptance, implementation issues and difficulties and future control-strategy development;
  - communication of the implementation/control strategy to management (acceptance or rethink);
  - full acceptance by management and users; and
  - final report generation.

## Examples of Student Projects

Student decision science projects address a variety of problems and span a wide cross section of industries, management applications and decision science techniques. Some examples:

1. Forecasting the likelihood and number of aggressive behavior incidents at an acute care psychiatric hospital.
2. Using project management techniques to plan the relocation of a hospital laboratory within a critical time frame. Required the cost analysis of activity crashing and acquiring additional resources to achieve crash times.
3. Integrated project planning for the efficient renovation of a former university president's home into an admissions office and the installation of data communications with the central university campus system.
4. Using project management techniques to plan, manage and control the resources necessary to design, purchase, construct, and set up the facilities and train the necessary personnel to open a number of manufacturing outlet stores.
5. Using queuing analysis and simulation to assess the work design and allocation of ticket counters for an international airline operating at the Tokyo International Airport.
6. Assigning multi-regional electronic repair projects to a fixed repair force using linear programming.
7. Deciding whether or not to sell a wholly-owned company by forecasting its future sales and determining its growth or maturity life cycle position.
8. Determining the future staffing requirements for damaged goods inspections for regional centers in a rapidly growing, national corporation.
9. Assessing the regional truck delivery system design and capacity needs for a national chemical company.
10. Determining the cost effectiveness of a cattle food supplement with a statistically designed experiment.
11. Developing a multi-criteria decision model to predict student success in an MBA program from application information such as GMAT score, work experience, age and undergraduate grade point average.

3. Provides the students with the motivation and opportunity to apply their classroom DS knowledge and increase their knowledge through self study in order to complete the project selected and solve the problems identified.
4. Requires the students to step into the real world and work directly with managers to solve DS problems in a dynamic business environment.
5. Gives students the experience of

working in groups and, therefore, an opportunity to sharpen their project/group management, interactive and communicative skills.

6. Requires students to seek and learn sources of data (e.g., census data, forecasts of area buying power, government statistics, and industrial experts) not normally required in DS courses but used in business studies.

7. Requires the students to use computer

software to confront real-world-sized problems, to assemble and analyze large data bases, and to achieve high quality, useable solutions.

8. Presents the students with an additional opportunity to sharpen their writing skills, since a project prospectus must be prepared and a final project report must be completed and submitted to both the course professor and the professional client.

9. Provides students, particularly those with no prior professional experience, with a slice of exposure to the real world and the personnel within it. They should also possess a sense of achievement for having learned from their experience and for offering a beneficial solution to a real problem.

10. Increases student/faculty interaction.

11. Benefits managers through the analysis and perhaps solution of real problems.

12. Gives the students, faculty and managers an opportunity to interface and share their problems, ideas and resources to the mutual benefit of all.

### Student and management feedback

Student and management feedback has been generally positive about the projects. The executive and evening students, generally selecting problems in their own companies, have understandably perhaps benefited the most professionally from the project and its solution. Testimonials include the following:

1. An executive MBA student used a time series forecasting model to project the future sales, earnings and return to stockholders for a company owned by her corporation. This input was used to assess whether or not the wholly owned company should remain in the corporate portfolio or whether it should be sold. The student, in turn, introduced the promising forecasting technique to upper levels of corporate management. She is now the manager of the newly created forecasting staff for her corporation.

2. Another successful project used multiple regression, residual analysis and statistical process control to determine the number of laboratory samples to be taken and tested to assure statistical quality conformance in the production of phar-

maceutical products. The results of the project were immediately adopted by the company.

3. One student found linear programming to be extremely useful in determining which maintenance repair projects should be selected by his company given different benefits and repair resources needed per project and fixed maintenance resources. Perhaps the most significant finding from the study was the sensitivity of

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project selection given different management objectives and instructions.

While not all projects have achieved such success, these results are at least indicative of their potential merit. To ensure satisfactory results for clients and students, both parties (along with faculty approval) carefully examine and agree on: (1) their project mission, problem scope and requirements; (2) the students' time and resource constraints; and (3) realistic expectations. To date, we have experienced no dissatisfied project sponsors. This is likely due to the client/student project planning and because the services are provided without charge.

### Future extensions

While other MBA programs have fortuitously used external projects, we believe that the student selection of problems and problem identification, the emphasis on data gathering and analysis, the deliberate organization and use of student groups with a diverse spectrum of educational and professional backgrounds, the use of the systems approach to problem management for integrating decision science topics, and the projects' integrative nature all add to previous successful efforts.

We are currently evaluating the use of the following educational enhancements:

- written critiques of group projects by other students (or groups);
- oral presentation of prospectus and final report; and
- changing group size. Smaller group sizes may provide a richer, more intense learning experience.

We hope that the educational concepts and applications mentioned here can provide one additional link towards excellence in the design and instruction of decision sciences and its useful integration with professional management.

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