Project Title
Lessons from Influenza: Teaching Operations Management via emergency response planning

Summary
This project proposes designing instructional materials that illustrate how Operations Management (OM) concepts can help decision-makers plan actions that mitigate the spread of influenza in a specific setting, namely, an educational institution such as a university or high school. In particular, we propose developing two case studies and a discrete event simulation model to support and inform the cases. The case studies will present planning decisions that can mitigate both disease transmissions and their disruption of normal operations at the educational institution, and a rigorous statistical analysis of the effect of such decisions. By mimicking the spread of influenza after planning decisions are enacted, the simulation model will both inform the analysis of each decisions’ impact on transmission and support the cases by allowing students to see the affect of their actions as decision-maker. The proposed case studies could be used to deliver concepts such as forecasting, aggregate and disaggregate planning, inventory management, capacity management, mathematical optimization, scheduling, and emergency response design. The resulting materials could then be used as modules within courses in the Industrial and Systems Engineering department, the Health Systems Administration program or in the College of Business. Also, by making the materials available online, they may be used by institutions other than RIT.

Targeted learners
This proposal targets advanced undergraduate and graduate students in Industrial and Systems Engineering, Health Systems Administration as well as students in the College of Business with an interest in decision sciences. Specifically, we target students enrolled in the following courses at RIT:
ISE 0303-401 Intro to Operations Research,
ISE 0303-701 Linear Programming,
ISE 0303 420 & 720 Production Control,
ISE 0303 704 Logistics Management,
HSP 0635-441 Health Planning & Program Development,
HSP 0635-830 Health Systems Planning
BBUG 0106-401 Operations and Supply Chain Management.

The number of students in current courses that could benefit from the materials produced by this project could easily exceed 120 students. Furthermore, the proposed case studies will not be limited to current courses at RIT. We envision case studies that are self contained and could be easily integrated into new and novel courses such as “humanitarian logistics”.

Project Description
Along with an RIT student, we will develop course material that illustrates the techniques behind and benefits of simulation modeling and other operations management concepts for managing the spread of influenza. We propose developing a computer simulation model of influenza transmission in a particular setting, namely, an educational institution such as a university or high school. The types of questions we envision the model answering are how frequent classrooms should be disinfected, how many school nurses should be on staff, and at what point classes should be canceled or rescheduled. However, we will approach local school districts to learn what types of decisions or policies they considered making in the face of the recent H1N1 outbreak. We will make the model available online, thus students at RIT and other institutions will be able to see first-hand (through a computer simulation) how they can affect

1 Discrete event simulations are stochastic models that emulate the behavior of system by generating data that describes the state of system at discrete points in time. The state of the system is represented by the values of a defined set of state variables. This type of simulation has nothing to do with virtual worlds.
influenza transmission with their planning decisions. While simulating disease transmission is not new, most existing models are for research purposes and do not evaluate the effects of the specific planning decisions made by an educational institution.

While the model will serve as instructional material for building a computer simulation, it will also be used to design case studies that illustrate how planning decisions can contain disease transmission and mitigate disruptions in the normal operations of the institution. The proposed case studies could be used to deliver the following concepts: forecasting, aggregate planning, inventory management, capacity management, mathematical programming, scheduling, and emergency response design. The resulting materials from the project could be used as modules within a course in the Industrial and Systems Engineering department, the Health Systems Administration program or in the College of Business.

Specifically, for this proof of concept stage of the project, we plan the following actions:
1. We will approach local school districts as well as policy-makers at RIT to learn what types of decisions or policies they considered making in the face of the recent H1N1 outbreak.
2. With the assistance of an RIT student, we will either develop or modify an existing computer simulation model of the spread of influenza to allow students to enact the policies that educational administrators consider and see their effect on a simulated educational environment. In essence, the computer simulation will serve as a virtual laboratory for testing the efficacy of various policies.
We will use the computer simulation to rigorously experiment with and analyze the impacts of such policies. These results will be used as the basis for designing two case studies. Also, we will use the results to outline the structure of other cases that could use the proposed simulation tool.

Anticipated impact on teaching and/or learning.
Traditional college education emphasizes providing knowledge and skills. However, students who know a subject may not recognize all the settings where their knowledge may apply, or, may be uncomfortable applying their knowledge in a setting other than the one in which it was learned. The use of case studies, as an experiential learning opportunity, allows students to understand a topic by creating analogies, learning by doing and hence, developing intuition to know when and how to apply their new knowledge and skills.

Although, there are many business cases available for the instruction of operations management (see Harvard Business Review), we are not aware of cases that provide students with the opportunity to plan how to avoid the havoc created by a potentially disruptive disease on the day-to-day operations of an educational institution. Expectations (fortunately unmet) of a high mortality rate for the recent swine flu pandemic pointed to the danger of ineffective decisions made to contain and mitigate the spread of the disease. For school managers, suspending classes, scheduling classes to reduce the number of contacts for students within a day, and determining a disease preventive cleaning schedule are all decisions whose effectiveness could be measured with the simulation model. Moreover, decision makers must also design the most effective way to implement government interventions. For example, decision makers must determine when students should be offered vaccines, in order to maximize coverage.

Over the past five decades, engineering, logistics, and business students have learned the principles of supply chain management through the well-known Beer Game, a role-playing game developed at MIT in the early 1960’s. Much of the Beer Game’s success can be attributed to the fact that it requires students to actively participate in decision-making process of a supply chain. We hope to replicate this success in the context of health care policy-making by giving students the ability to immediately see the impacts of their decisions.

Project Impact on Student Success

Hewitt, Proano, PLIG 2010
The experiential nature of this proposal provides students with different opportunities for learning, in which group work will be essential. We believe that an offer of different learning experiences helps students who traditionally do not do well in a lecture-format course perform better. Moreover, the opportunity of using OM tools in less conventional environments can motivate students in industrial engineering and decision sciences to explore career opportunities in health care and public policy.

Evaluation

To evaluate the effectiveness of the proposed project, we will coordinate with the instructors of the courses ISE 420, and ISE 720 (the undergraduate and graduate level courses of Production Control), to compare the performance of students exposed to the designed material and those in a control group not using the designed case studies. In one of the courses a topic such as forecasting will be delivered through the simulation tool and the proposed case studies. The other course will serve as control group, delivering forecasting through a recommended course textbook. Students in both courses will be tested with the same exam about applications of forecasting to manufacturing and service examples. Additionally, students exposed to the case studies will be asked to respond a survey about their experience using the proposed simulation tool and the case studies. It is important to note that ISE 420 and ISE 720 are offered in different quarters.

Dissemination

The results of this project will be presented in conferences of different communities, such as the American Society for Engineering Education (ASEE) and the educational tracks of the Institute of Operations Research and Management Science (INFORMS) and the Institute of Industrial Engineering (IIE). Finally, based on the materials produced in this project, we plan to submit a TUES (former CCLI) proposal for developing a case-based course in OM that focuses on disease management and emergency response planning.

Rationale

a. This proposal is not part of regular college business

This project develops course materials that apply OM techniques to a problem outside the traditional manufacturing, business, and logistics domains, but in public health care policy. We expect that the project will provide an opportunity for students with engineering backgrounds to gain familiarity with the many issues of public policy, and for students in health care public policy to understand the impact that analytical methods can have in implementing health care interventions.

b. Proposal’s relevance to ISE competencies

Discrete event simulation and OM techniques are core competencies of Industrial Engineering programs. Students are expected to use them to facilitate decision-making in business and manufacturing settings.

c. Proposal’s portability

The proposed case studies will be self-contained, and designed as modules that could be easily adapted to any course offering.

d. Credentials of the PI’s

Dr. Ruben Proano (University of Illinois, 2008) has taught at RIT and is interested in the application of
industrial engineering and optimization methods to improving health care systems. His research deals with solving vaccine supply chain issues via optimization methods. Dr. Mike Hewitt (Georgia Tech, 2009) has developed simulation and statistical analysis software for Chrysler. Dr. Hewitt’s research agenda focuses on applying industrial engineering and operations management techniques to improve health care delivery and quality.

e. Proposal’s primary innovations
   1. A simulation model of influenza transmission in a school setting that allows one to evaluate the impact of the planning decisions education administrators consider.
   2. A rigorous analysis, through the use of the simulation model, of the effects of these planning decisions.
   3. Course materials, based on the above-mentioned analysis that can be used in a course in ISE or Health Systems Administration. While the application of OM techniques to health care problems is a hot research area, educational materials that synthesize the two have lagged behind. This project presents an opportunity for RIT to be a leader in the education of how OM techniques can impact health care and public policy.

Project timetable

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<tr>
<th>Task</th>
<th>Start Date</th>
<th>End Date</th>
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<tbody>
<tr>
<td>Consult with local educational institutions</td>
<td>May 1, 2010</td>
<td>July 1, 2010</td>
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<tr>
<td>Develop simulation model</td>
<td>May 1, 2010</td>
<td>July 1, 2010</td>
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<tr>
<td>Develop and test case studies</td>
<td>July 1, 2010</td>
<td>September 1, 2010</td>
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<td>Case studies used in ISE 720</td>
<td>Start of winter quarter</td>
<td>End of winter quarter</td>
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<tr>
<td>Evaluation</td>
<td>May 1, 2011</td>
<td>August 1, 2011</td>
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Budget

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<th>Item</th>
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<td>Summer support – 1 graduate student</td>
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<td>Summer Support – Mike Hewitt</td>
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<tr>
<td>Summer support – Ruben Proano</td>
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<tr>
<td>Total</td>
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