17th MIT-UAlbany-WPI System Dynamics Ph.D. Colloquium

Friday, October 3, 2008
State University of New York at Albany
Room: Arthur Levitt Executive Seminar Room, Page Hall

http://www.albany.edu/~aw955955/colloquium/

Contacts: Andy Whitmore (aw955955@albany.edu) and Joe Hsueh (joehsueh@mit.edu)

Time	Presentation	Speaker
10:00 AM	Issues in the representation of expectation formation in SD models	Switbert Miczka, Mannheim University
10:45 AM	Total Cost of Ownership of Enterprise Resource Planning Software: Simulating a Dynamic Feedback Perspective in the Higher Education Environment	Meg Fryling, UAlbany
11:30 AM	Impacts of parts commonality on reliability of multi-generation products	Gokhan Dogan, MIT
12:15 PM	**Lunch**	
1:00 PM	The Cyclical Nature of Airline Industry Profits	Kawika Pierson, MIT
1:45 PM	Casual causal loop mapping in professional practice: a corrective to systems mysticism?	Don Robadue, UAlbany
2:30 PM	**Break**	
2:45 PM	Integrating System Dynamics with Predictive Learning: a method to rank parameters in order to improve the reliability of a nuclear power plant	Edoardo Cavalieri d'Oro, MIT
3:30 PM	Dynamics of Technological Innovations Diffusion: the case of NFC mobile payment	Mariana Medvetchi-Dahan, ESCP-EAP Business School
4:15 PM	Dynamic Effects of Employee Ownership Structure on Firm Performance	Joe Hsueh, MIT
5:00 PM	**Closing Remarks, Potluck dinner at Andersen's****	

** The Andersens live on Delaware Turnpike (Delaware Avenue and Rt. 443 in Albany) about 8 miles from downtown Albany. Heading West From Albany, a solid landmark is the Bethlehem Central High School on your left. The Andersen house is about two miles beyond the high school on your left, just after the Unionville rail underpass. Turn left into one of two circular drives about 50 yards beyond the railroad underpass and park out back on the gravel driveways (the sheep pastures can get slippery if wet). They live in a white farm house with a pond and two red barns out back.

Participants

Students: Gokhan Dogan, Switbert Miczka, Edoardo Cavalieri d'Oro, Girk Cakmak, Meg Fryling, Joe Hsueh, Bahadir Akcam, Thomas Gerber, Luitpold Staudigl, Jonathan Gumpp, Doug Matty, Donald

Robadue, Hyunjung Kim, John Lyneis, Mariana Dahan, Kawika Pierson, Andy Whitmore, Navid Ghaffarzadegan

Faculty: Eliot Rich, Khalid Saeed, George Richardson, Peter Otto, David Andersen, Oleg Pavlov

Sandia National Laboratory: Aldo Zagonel

Abstracts

Issues in the representation of expectation formation in SD models
Switbert Miczka, Mannheim University

Expectations are a core element of human decision making. A review of literature from management science, psychology, and sociology shows that we use different ways to form expectations, ranging from the numerical extrapolation to complex, causal reasoning processes. As rather simple considerations imply, different approaches may lead to different expectations. Yet, the structures used for representing expectation formation in SD models address only a subset of the different ways used in reality.
The presentation gives an outline of the different ways of expectation formation, and suggests several modeling approaches to complement the current SD practice.

Total Cost of Ownership of Enterprise Resource Planning Software: Simulating a Dynamic Feedback Perspective in the Higher Education Environment
Meg Fryling, University at Albany

Many organizations have purchased Enterprise Resource Planning (ERP) software in an effort to improve the flow of information within the organization and therefore enhance the organization's efficiency and effectiveness. Unfortunately, many institutions, including the University at Albany (UAlbany), have found that the time and resources required to implement and maintain ERP systems far exceed original expectations. UAlbany has long struggled with managing the technical tasks associated with implementing and maintaining its ERP as well as communicating that information effectively both vertically and horizontally with all project participants.

Barely 10% of an iceberg is above water, with the rest hidden from view. Similarly, the purchase price for ERP software is the most visible expense, but implementation and maintenance contain many hidden costs. Organizations fail to recognize the true Total Cost of Ownership (TCO) of ERP systems and often make policy decisions early in the implementation plan that likely have long-term impacts on TCO; such as customizing the product to meet existing business processes (Dodds and Spencer 2007). Although experts strongly encourage Business Process Reengineering (BPR) in order to take full advantage of the software product and reduce long-term maintenance costs, this is often difficult to accomplish in practice because it requires significant enterprise-wide change management (Hammer 1990). Failing to follow BPR has long-term costs that are often not realized until after the initial implementation.

UAlbany, like many institutions, is struggling to move into "Stage 4: Create New Capabilities" of the ERP lifecycle so that it may realize the full potential benefit of this type of information system (West and Daigle 2004). In order to take full advantage of ERP systems and realize a competitive advantage, implementations require drastic structural and cultural changes within the organization. These changes

are difficult to accomplish without a framework to effectively communicate justifications for such radical organizational transformations. The purpose of this research is to develop a framework using system dynamics that will enable organizations to better predict the long-term cost of ERP implementations and identify key cost drivers as well as reveal the impact of and justification for significant organizational changes in such a way as it can be easily communicated to key stakeholders.

Impacts of parts commonality on reliability of multi-generation products
Gokhan Dogan, MIT

We analyze the quality improvement process for multi-generation products using data from a major manufacturer of construction equipment. Multi-generation products are updated periodically by changing a fraction of parts of the product. Data analysis shows that carryover problems, which are identical parts that fail on both generations, are responsible for around half of warranty cost. This is a surprising finding since these problems were known by engineers before the production start of next generation. Organizational issues and long time delays to learn about these problems are identified as reasons of this finding. Long time delays to learn about field problems make it very important to leverage all available data. A disaggregated simulation model, that models each problem separately to capture the big heterogeneity of problems, is used to test three policies. First policy assigns higher priority to carryover problems. Second policy uses failure information from previous generation to identify carryover problems. This approach is based on the idea that it will be too late to wait and see carryover problems fail on next generation. Third policy solves carryover problems for only next generation, saving the engineers from the work of designing and implementing changes for the current generation. Simulation results show that the policies may yield significant improvement.

The Cyclical Nature of Airline Industry Profits
Kawika Pierson, MIT

Previous work in System Dynamics has sought to fit the profits of the airline industry, however as Hansman and Jiang 2004 show industry level profits approximate a second order un-damped oscillatory system with a period of ten years, and so the structure required to fit this curve is minimal and previous work has been parsimonious. Objections to the existing models of airline industry profits focus on this, claiming that some policy implemented by the industry and left un-modeled by existing work will change the fundamental behavior of the system. We break the problem of what is causing airline industry profits down further to ask what is causing each component of the overall profits: demand, prices, capacity, and costs. We then aggregate these up and show that a model with standard system dynamics modules can fit the airline industry's evolution since deregulation well, and that several policies intended to smooth profits over time do not affect the fundamental structure causing oscillations. If time permits (and we get this much done) we will discuss some policy recommendations that could actually improve the system's behavior.

Casual causal loop mapping in professional practice: a corrective to systems mysticism?
Don Robadue, University at Albany

In *The Necessary Revolution,* Peter Senge et al. (2008) demystify systems thinking approaches to the contemporary challenge of sustainable development. "Systems thinking....simply means stepping back and seeing patterns that are , when seen clearly, intuitive and easy to grasp." The authors do not wish to conjure the impression that these approaches are "reserved for PhD's." Daily practice in seeing the

patterns that underlie development problems is perhaps not helped much by either system-mystics or dynamics-doctoring. This presentation provides some personal examples of a casual approach to causal loop diagramming on sustainable development issues in training settings and in the areas of biodiversity conservation and HIV/AIDS, climate change adaptation, and water resources management/environmental sanitation. It concludes with the puzzle of a widely endorsed conceptual model of systems approach in environmental policy, pressure-state-response, and the question of whether it is a roadblock or springboard to further progress in using systems approaches in marine and coastal management.

Integrating System Dynamics with Predictive Learning: a method to rank parameters in order to improve the reliability of a nuclear power plant
Edoardo Cavalieri d'Oro, MIT

Design of future generation nuclear power plants must adhere to three fundamental principles: safety, economics, and non-proliferation. Safety systems serve to mitigate nuclear accident consequences. A special subset of these is passive safety systems, which operate autonomously – without human intervention or external sources of energy. Passive systems rely entirely upon natural laws rather than mechanical moving parts to function. Passive System Reliability (PSR) is not easily measurable because it requires understanding how physical natural laws fail and deals with the uncertainties associated with modeling physical phenomena. In this work, a passive safety system is modeled and a methodology is established to detect the parameters most likely leading to plant failure. A System Dynamics model is chosen to simulate the system; the methodology is built around two techniques: screening of parameters and learning machines for classification. Their union yields a learning algorithm capable of identifying and classifying failure patterns as a function of the model's key parameters. This iterative methodology reduces the simulations required to compute the PSR by 25%. Implications of this benefit, extended to thermo-hydraulic codes, are discussed via an example. This paper contributes to the development of risk-informed procedures for power plant designers and regulators.

Dynamics of Technological Innovations Diffusion: the case of NFC mobile payment
Mariana Medvetchi-Dahan, ESCP-EAP Business School

In today's highly interrelated environments, the diffusion of the innovative products and new technologies is complex and the whole process is affected by a number of factors. Although a great deal of work has been done on innovation diffusion by various disciplines from numerous perspectives, the influence of these factors, along with the interdependencies among them, have not been yet extensively studied.

Through relevant literature review, field interviews and case studies, this research suggests a holistic approach to the technological innovations diffusion. Building up a conceptual model for the technological innovations diffusion in the telecommunications industry, through the scope of System Dynamics approach, should allow us to explore the major variables at play affecting the successful course of some of the major technologies diffusion in Europe and abroad.

Since the first NFC mobile payment applications have been grounded in Japan and then pioneered to USA, we should consider analyzing the main loops at play in these countries as well, thus providing us with comparative variables for an analysis framework more akin to generalization. This study should help gaining understanding not only about the diffusion of NFC mobile payment solutions per-se, but also about the national differences and competitive dynamics complexities.

Dynamic Effects of Employee Ownership Structure on Firm Performance

Joe Hsueh, MIT

In this brief talk, I will share with you a very preliminary research proposal on studying the dynamic effects of employee ownership structure on firm performance. I will talk about various employee ownership structures, how they could be potentially modeled in a system dynamics framework, and how they might influence employee behavior and firm performance dynamically. Since this is at a very early stage, I would appreciate your feedback on the literature review and research design.