Proceedings of the 29th International Conference

July 24-28, 2011
Washington, DC

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Edited by:
James M. Lyneis
George P. Richardson

Production Team:
Robin S. Langer, LouAnne Lundgren,
Erin R. Sheehan and Joan M. Yanni

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Welcome

Dear Colleagues,

Hello! Welcome to the 29th International Conference of the System Dynamics Society. This year, the conference is located in Washington, DC, the District of Columbia. Officially declared on July 16, 1790, by the Congress of the United States to serve as the nation's capital, Washington, DC is centrally located between the North and South along the Potomac and Anacostia Rivers, on the eastern shores of the United States.

Again this year the program shows that the field of system dynamics is thriving. Conference participants come from more than 45 countries around the world. From the PhD Colloquium on Sunday, through the plenary, parallel and poster sessions Monday through Wednesday, and Thursday's workshops, you will be immersed in conversations and presentations reflecting the state of the art of the field.

This year's conference will benefit from its location in the Washington, DC area by including plenary and convened sessions that focus on applications and impact in governance in the United States and worldwide. Of special interest will be sessions on health dynamics and policy; conflict, defense, and security; sustainability, including energy and climate; diverse issues in public and corporate policy; and K-12 education. Our program schedule also includes exhibits, model assistance workshops, panel discussions, special sessions, topical roundtables, and Society business meetings.

To further increase your enjoyment of the conference, there will be time for social and professional interaction in a relaxed and fascinating setting, including an Informal Gathering on Sunday during and after registration, the Poster Symposium and Buffet on Monday, and the Conference Banquet on Tuesday. Although not included in your registration fee, local tours may be arranged through *Destination DC* via their website http://washington.org. These tours include visits to National Monuments, the Pentagon, the White House, and the Smithsonian Museums. The Travel and Tour Information link on the conference website provides additional information on what to see and do in the Metro DC area.

This year, 32 Thread Chairs, supported by a host of other volunteer reviewers, worked tirelessly to screen and comment on almost 400 submissions. In addition, several dozen volunteers worked many hours to ensure a successful conference. Without the commitment of these reliable volunteers our conference would be impossible. A special thanks goes to all who helped.

In addition to all our other sponsors and our conference hosts, Booz Allen Hamilton and Powersim Solutions, we are also very fortunate this year to have two conference partners, The Boeing Company and PA Consulting Group. We sincerely appreciate the enthusiasm and support of all our sponsors.

We know that you find the conference stimulating and rewarding. We ask that you bring to our attention anything that may help us to ensure the success of the current conference, as well as future ones. Thank you for attending!

On behalf of the hosts and conference committees, best wishes from,

Richard Phares, Imrana Umar, George Richardson, James Lyneis, Jack Homer and Roberta Spencer

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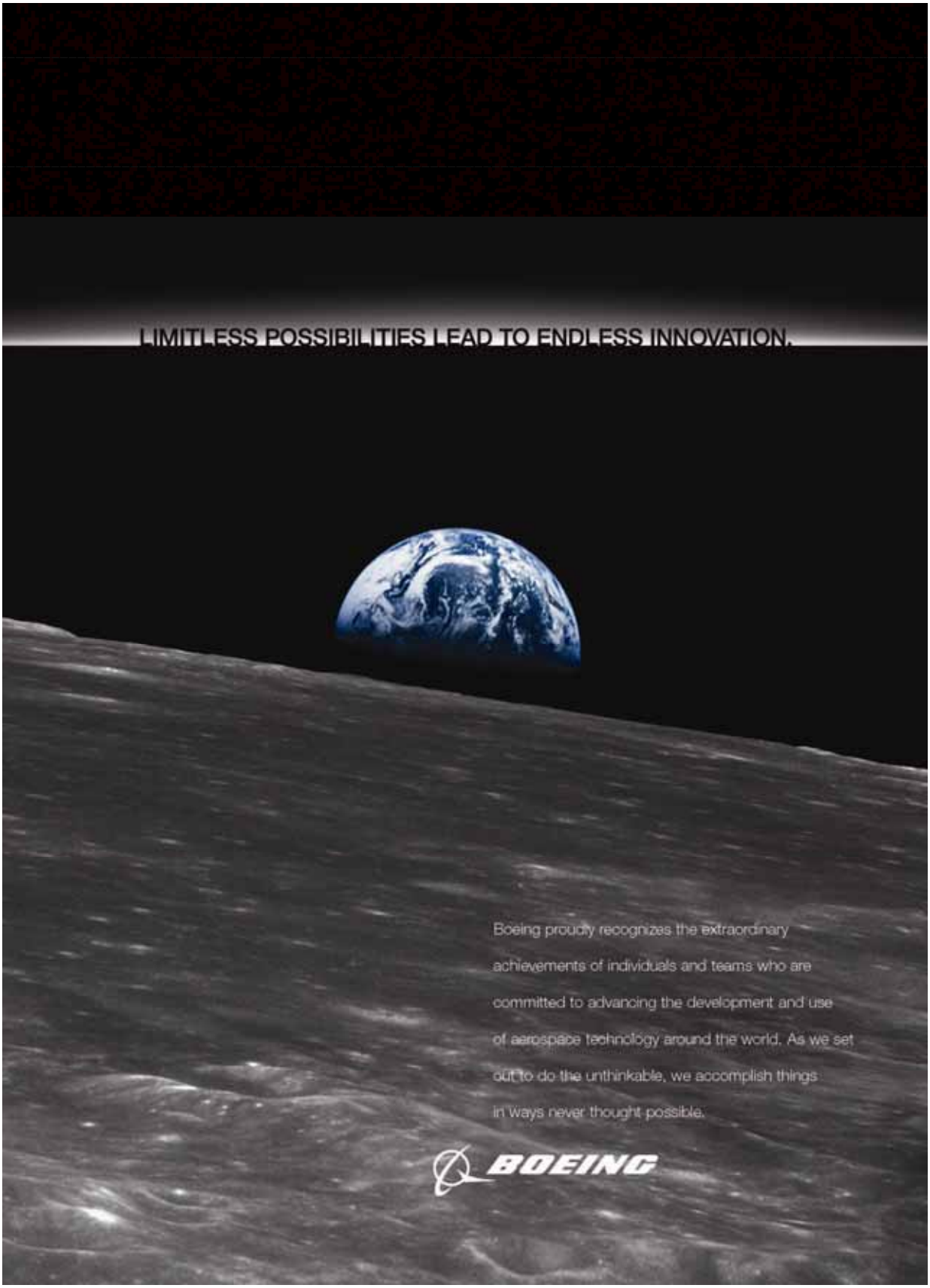
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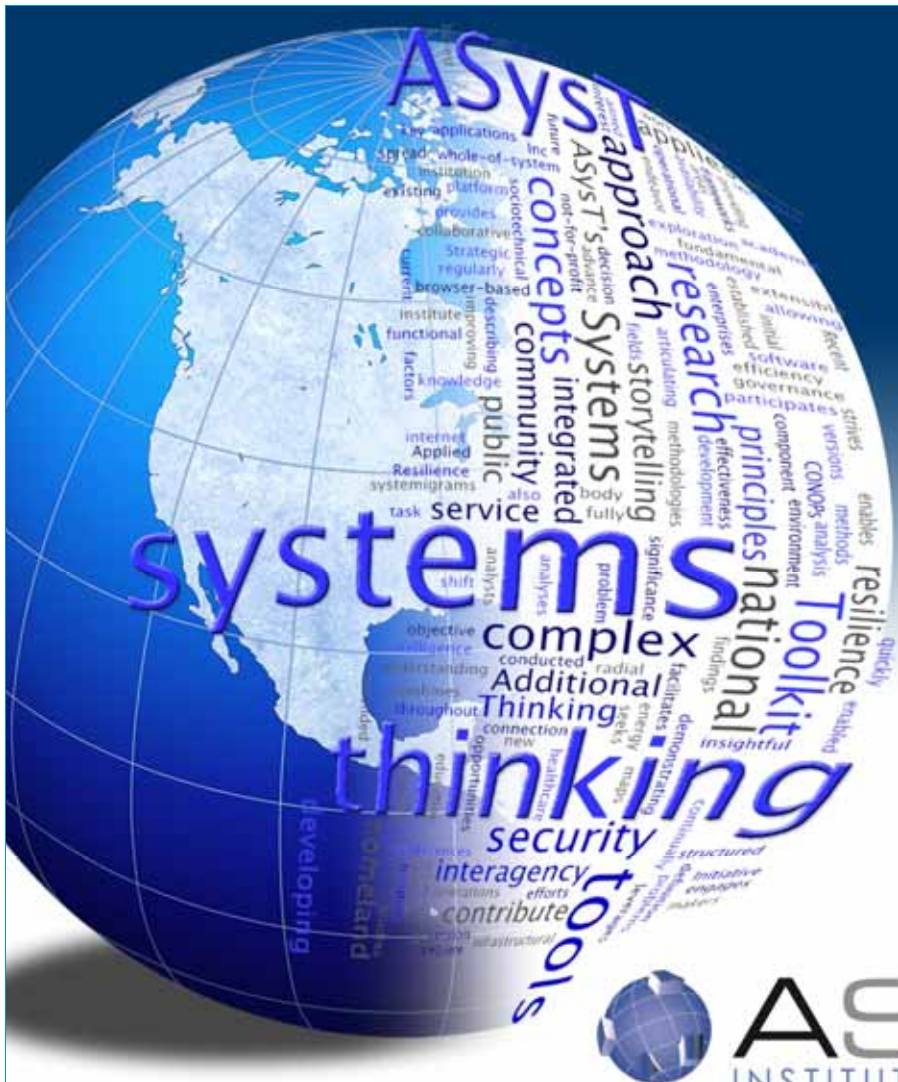

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To learn more about the ASysT or Analytic Services, please visit our websites at ASysTi.org, and ANSER.Org, respectively. For specific questions please contact the ASysT Director, Robert Edson, at 703-416-3394 or by email at robert.edson@asysti.org.

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Best wishes to all the students, who are the future of system dynamics.

THE *SYSTEM DYNAMICS CAREER LINK*

What is it? The *SD Career Link*, started in 2000, is hosted by the System Dynamics Society. It provides a valuable forum for the exchange of information about organizations, positions and people in the field of system dynamics.

Career Link Allows Companies and Universities to Describe General Career Information as Well as Specific Job Opportunities. The *SD Career Link* web page of the Society web site has two subsections: (1) specific job listings, and (2) company/university profiles. In the job listings section, employers advertise their current openings. These are for any level of required expertise located in any geographical region. In the profiles section, company and university employers provide general yet descriptive information about how system dynamics fits into their organization, typical jobs, career paths, and other aspects of employment. This subsection allows employers to provide information about system dynamics opportunities within their organizations to supplement the more general information contained on their corporate or academic websites. Such career information is valuable to current as well as future system dynamics students, academics, and practitioners and we urge companies and universities to describe the use of system dynamics expertise in their organization even if they do not have job openings at the present time.

How to participate? Please refer to the *SD Career Link* page at the System Dynamics Society website at http://www.systemdynamics.org/sd_career_link.htm or send an email message to the Society office at <office@systemdynamics.org>. We look forward to your participation.

Announcing the 30th International Conference of the System Dynamics Society

St. Gallen, Switzerland July 22 - 26, 2012

www.systemdynamics.org

Welcome to the University of St.Gallen

Theme: Our conference will focus on "Model-based Management," a topic that will highlight the crucial role of formal models for the effective management of dynamic systems and the reasons why skills in modelling and simulation are becoming essential in policy-making, organizational design and learning. Submissions are encouraged on the conference main theme and all topics relating to the theory and practical application of system dynamics modelling. A special program is also planned so that business participants can benefit from the main theme.

Location: You will be surprised at how easily St. Gallen can be reached, at the beauty of the city and the surrounding lake and mountains. As a place intimately connected with the history of Europe and located in the magnificent landscape of Eastern Switzerland, St. Gallen provides an ideal setting for a conference. Part of the city, the Abbey Precinct, is a UNESCO World Cultural Heritage Site. The city of St. Gallen is within a 55-minute direct train ride from the Zurich Airport. For further information please check http://www.st.gallen-bodensee.ch.

The Conference Venue: The conference will take place at the University of St. Gallen. The University features one of the leading Management Schools of Europe. It is famous for its pioneering achievements, e.g., in ecological economics and in systemic management. The University is located on a leafy campus only a ten-minute walk from the picturesque city centre.

Conference Contacts

Program Chairs: Elke Husemann
David Lane
London School of Economics, England

Conference Chair: Markus Schwaninger
Organizing Chair: Stefan Grösser
System Dynamics Group Institute of Management
University of St. Gallen, Switzerland

Workshop Chair: Jack B. Homer
Homer Consulting, USA

Social Program: St. Gallen is a great starting point for excursions. In cooperation with the local tourist bureau, some group tours will be offered.

Conference Manager: Roberta L. Spencer
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Watch for further announcements and details.
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Reading Supporting Material

Supporting Material files can be found by clicking on the appropriate link in the *Paper Index*, found on the conference website. Papers are listed alphabetically by the last name of the primary author.

- **Viewing/Opening/Reading the Supporting Material:**

Supporting materials will contain either a single file, or a PKZip® format file which can be opened with any number of utilities or directly on some operating systems. Supporting materials may include plain text files or other commonly used file types. In addition, models may be included and these will have file extensions that depend on the software used to create them. Below, find information on how to access freeware/demo/trial versions for regularly used software from several system dynamics software publishers. Follow the links within the descriptions below to the software needed to view the files.

In following chart, find the three-letter extension of the file name, then the software you need to view the file.

File Name Extension:	.itm, .stm	.sip	.sim	.vmf, .vpa, .vpm, .mdl
Software Needed:	iThink, STELLA	Powersim Studio	Powersim	Vensim

STELLA/iThink by isee systems:
http://www.iseesystems.com/player

This link will navigate you to the FREE isee Player. The isee Player lets you view, run, print and share both STELLA (.stl) and iThink (.itm) models. Available in both Windows and Macintosh versions, the isee Player allows exploration of all model layers - map, model, equation, and interface, and never "times out."

Powersim Studio by Powersim Solutions:
http://www.powersimsolutions.com/SystemDynamicConference.aspx

A free and fully-functional 30-day trial version of Powersim Studio 8 Enterprise edition is available for download. Studio 8 contains an array of new and exciting features. In addition it can:

- Perform scenario control, optimization, risk analysis and risk management
- Try setting up a user interface and test it in presentation mode
- Include events, command buttons and actions to set up a cockpit
- Keep your model international using multiple languages on your model
- Share different levels of information using password protection
- Connect to any datasets, Excel, Access, Oracle and SAP NetWeaver

Note that a Studio 8 installation will automatically replace any previous version of Studio.

Vensim by Ventana Systems:
http://www.vensim.com/reader.html

The Vensim Model Reader can be used to open Vensim models which are files with extension .vmf, .vpm or .vpa. This is free software which will allow you to view and simulate models changing the assumptions but not model structure. Many models (.vmf, .vpm, and .mdl) can also be opened using Vensim PLE which is free for educational use. Both PLE and the Reader are available from:
http://www.vensim.com/freedownload.html

PhD Colloquium Presentations

Plenary Presentations

Chris Browne
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Australian National University

Haley Jones
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Australian National University

Insulating Expectations: A Dynamical Perspective of the Assumptions Used in Australia's Home Insulation Program

Zerrin Doganca
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Bogaziçi University

Teaching Dynamic Ecological Problems with Systems Based Approach

Rhonda Jordan
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MIT

Incorporating Electricity Demand Dynamics into Capacity Expansion and Electrification Planning Models in Developing Countries

Tom Rust
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Worcester Polytechnic Institute

Dynamic Modeling of Service Delivery in Health Care: VA Compensation and Pension Exams

Heather Skaza
hjskaza@hotmail.com
University of Nevada Las Vegas

Using systems simulations in STEM education: An example from an undergraduate environmental science course

Bert L. P. J. van Nistelrooij
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Ilse Verstijnen
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Radboud University Nijmegen

Jac A. M. Vennix
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Radboud University Nijmegen

The effect of modeling support and power on communicative exchanges.

POSTER PRESENTATIONS

Fernando A. Arenas
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Universidad ICESI

The Dynamics of the Relationship between Knowledge and Organizational Performance

Wibke Avenhaus
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Modelling the Consequences of Biodiesel Production in Remote Areas in Brazil – A System Thinking Approach

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Ferkauf Graduate School of Psychology

Psychosocial syndemics of women living with and at-risk for HIV/AIDS

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Prince of Songkla University

Integration of GIS and system dynamics approach for climate change perspective of soil erosion and sedimentation problem

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HMS Conseil

Restoring the social dynamics overlooked in a project context: A path towards (re)discovery

Nishesh Chalise
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Adaptive Capacity among Forest Dependent Communities Arid Regions of India

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A meta-analysis of the ecological, hydrological and economic impacts of restoring natural capital in South Africa

Katherine Dykes
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Simulating Investment in Wind Energy with Technical System Integration Issues

Nicolas Escalante
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Sustainable Waste and Resource Management Policy Design in Low and Middle-Income Countries

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Modelling the impact of managerial and organisational factors on operational risk

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Simulating Emergent Learning Behavior: A System Dynamics Approach for Learning Agents

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Carbon fuel taxes in emerging passenger vehicle markets

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Towards the complex systems research: Reflection by system dynamics approach

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A Review of Factors Affecting Seaport Capacity: System-wide Performance Management

Naomi M. Jacob
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A System Dynamics Evaluation of Whether 'Food' could be the new 'Water' for Singapore

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Dealing with Policy Paradox by employing Failure Management and Success Management

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Long-Term Performance Evaluation of Electric Power System in Nigeria

Helge Restad
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Ctr for Higher Education Policy Study

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Application of Stock Management Heuristics to Mechanical Engineering Control Problems

Mauricio Uriona Maldonado
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Federal University of Santa Catarina

Dynamics, structure and performance of Innovation Systems: A complex systems modeling approach

Jessica Wong
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Canadian Memorial Chiropractic College

Marion McGregor
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Canadian Memorial Chiropractic College

Examining the relationship between theory-driven policies and the number of back claims in workers' compensation

Plenary Session Papers

Listed alphabetically by first author

Tarek K. Abdel-Hamid
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Naval Postgraduate School

Thinking in Circles about Obesity

Human energy and weight regulation is a complex of nested feedback processes at multiple levels-the homeostatic processes at the physiologic level, between the physiologic and the behavioral, and between people and their external environment. While our bodies work in circles, people tend to think in straight lines. A perfect example of straight-line-thinking is the energy balance equation (EBE)-the staple energy calculus by which dieters (as well as many health care professionals) explain weight gain and predict treatment outcomes. It is linear, open-loop, unbounded (taking weight loss projections to absurd values)... and can be way off. It is truly a legacy of earlier times when we were computationally poor. In this talk, I argue for and aim to demonstrate the feasibility and utility of a new generation of dynamic feedback tools that support interaction and customization for personal weight management.

James Baker
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Joint Chiefs of Staff

Tom Mullen
tom.mullen@paconsulting.com
PA Consulting Group

Lots of Loops: Lessons from using System Dynamics for Complex Governmental Decisions

The US Government faces some of the biggest strategic challenges with very high stakes. When should we use military power and how do we use it to improve stability rather than worsen it? How should we manage a huge but limited budget to achieve a wide range of big, unstructured, and evolving strategic objectives? Can we help struggling regions develop and if so how? These questions involve highly complex systems with many dynamics over time. They have the further challenges of a lot of uncertainties, limited data, wide boundaries, many stakeholders, and the need for rapid decision-making. In an environment fraught with politics and skeptics, how can we use analysis to improve the rigor of decision-making on such big and important questions? The authors will use examples from the last 8 years of policy and decision analysis work to illustrate lessons both positive and painful for successful use in government and business, speaking from the perspectives of both modeler and decision-maker, inside and outside the government.

Kenneth G. Cooper
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Kenneth Cooper Associates

The State of System Dynamics Consulting - 2011 Survey

Results from the recent System Dynamics Society global survey, yielding participants' views of the state of SD-based consulting. How widespread? What are the growth prospects? In what industries is the most work occurring? What issues are getting the most attention? What client prospect objections are heard most often? What are the observed benefits? In providing this first snapshot, the intent is that this will be followed by future surveys that track the growth, patterns, and trends of SD in consulting.

Navid Ghaffarzadegan
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University at Albany

Beyond Personality Traits and Financial Incentives: Bias and Variation in Medical Practices as Results of Experiential Learning

Physicians are far from optimal decision makers: they overuse defensive medical practices such as medical tests (bias), and they disagree on their diagnoses and treatments (practice variation). Besides the regional factors (such as culture), at the individual level, the most common explanations for these phenomena are linked to physicians personality traits (e.g., risk aversion) or their financial incentives. We develop a theory that offers a new explanation. With the help of a simulation model, we show that practice variation and bias does not have to be caused by personality traits and financial incentives, but can endogenously emerge through daily practices and outcome learning even for physicians with similar trainings working in the same region. Specifically, a physicians exposure to outcome feedback and her accumulated experience and skill contribute to variation and bias. A preliminary validation is achieved by comparing simulation results with the data from c-section surgery in the states of New York and Florida.

Alan K. Graham
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Varieties of System Dynamics Practice

What is system dynamics? Traditionally, the explanations have been complex and implicit, e.g. 10 steps, 25 types of validation, and 33 questions model users should ask. Such elaborate explanations can create hurdles in teaching SD, innovating within SD and communicating about it and its value to the wider world. This paper examines several varieties of system dynamics practice, with classic SD more or less at the center. All of the variations of system dynamics can be described as different elaborations and iterations of testing only three hypotheses: our understanding of 1) the situation or problem to be improved, 2) the system in which the problem is created, and 3) the actions that will improve the situation. We use diverse sources of knowledge for all three, especially general knowledge about how people interact, expert participant knowledge, and statistics. We use computer simulation to test the system and candidate actions. This comprehensive reality-checking is what makes system dynamics a trustworthy approach to complex situations. This simple definition of system dynamics is a movement toward a simple, compelling elevator explanation, which should also useful for teaching about the complexities of SD within a simple overarching structure.

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Inadvertent Inequality: The Unintended Consequences of the Major League Baseball Free Agent Compensation System

In this paper we demonstrate how the Major League Baseball (MLB) free agent compensation system (FA-CS), intended to achieve parity across MLB teams, has the unintended and adverse consequence of increasing inequality. The FA-CS compensates teams that release a Type A Free Agent by giving them a compensation pick the highest draft pick from the team that signs the free agent. The cost of each lost pick decreases as teams sign multiple Free Agents. This characteristic lowers the cost per Free Agents, when multiple Free Agents are signed. However, such benefits are solely accessible to teams that are relatively resource unconstrained, giving rise to an inequality-increasing positive feedback. To explore the importance of the FA-CS positive feedback, we develop a dynamic

model of the flow of Type A Free Agents through their MLB career, including their maturation from draft picks, to minor league, to major league, to free agency, and finally to retirement. Additionally, we model teams free agent hiring process to understand free agent dispersion within the league. Isolating the FA-CS feedback from other scale effects and calibrating the model to MLB data we estimate the strength of this adverse inequality-increasing effect.

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Applying System Dynamics to Overcome Unsuccessful Success Factor Research

In order to cope with the vast range of ambiguous, multi-causal and multi-faceted potential causes for firm success, managers tend to look for critical success factors as a reduced number of essential factors that determine future business success. Although scholars have been serving this need for more than four decades, the insights derived from empirical research on critical success factors have low impact on strategy in practice. We take this phenomenon to discuss potential causes and propose to complement empirical methods with the dynamic feedback perspective of System Dynamics modeling. In the present paper we first portray benefits and limitations of both empirical methods and System Dynamics regarding critical success factor research. We then take a PIMS-based case example to contrast and combine the two methods. We compare insights from the PIMS study to observations from a System Dynamics-based strategy project conducted by PA Consulting Group for a large European automobile manufacturer. We discuss differences in the analysis of the two studies and conclude that empirical success factor research could overcome its practical shortcomings when accompanied by firm-specific System Dynamics modeling based on the main characteristics of System Dynamics models, including feedback processes, time delays, and non-linearity.

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Crafting System Dynamics Models and Making them Accessible: Lessons from 40 Years of Practice

This paper shares lessons derived from experiences crafting and commenting on policy-relevant modeling, System Dynamics and otherwise, for more than 40 years. Projects included a control theoretic interface for Forresters Urban Dynamics model, model-based recommendations to alleviate eutrophication in Lake Erie, a food and agriculture sector for Mesarovic and Pestels regionalized global model and a model-based theory of political-conflict and development linkages. A collaborative book, Groping in the Dark, recounted and sought lessons from The First Decade of Global Modeling. Among fifteen lessons presented, among the most important are these: (1) Policy-relevant research that links System Dynamics models with those from other paradigms can be an effective communication device and may offer opportunities to broaden System Dynamics modelings reach. (2) When considering how to make work you believe is important accessible and impactful, it is worth taking risks and affronting conventional wisdom. (3) Often, a good System Dynamics model may cast significant light on a problems causes and even point to possible solutions. But, even when senior government officials view the model - and modeler - as credible, effecting meaningful change based on inferences from model results can be difficult or impossible.

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Individualized Medicine and Biophysical System Dynamics: An Example from Clinical Practice in End Stage Renal Disease

Erythropoietic Stimulating Agents (ESAs), have been used in hemodialysis patients since 1988, largely eliminating the need for transfusions to correct the anemia of chronic renal failure. However, current ESA protocols lead to suboptimal anemia control. Questions about the safety of ESAs and clinically desirable hemoglobin levels remain open, despite a series of clinical trials. Moreover, ESAs are expensive: Medicare reimbursements for ESAs in 2008 approached two billion dollars. A process improvement project conducted at Mayo Clinic initiated in 2007 revealed that current ESA protocols lead to (undesirable) oscillations in hemoglobin levels. Recognizing the behavior as a system signature, we developed a bio-pharmacokinetic model of erythropoiesis. Using prior data for a specific patient, the model provides parameters for individualized ESA response profiles. Parameter values are then used to design dosing regimens that achieve the desired results. 650 patients are enrolled in this prototype information system. The percentage of patients who achieved target and stable hemoglobin levels has improved by 40%, ESA costs have been reduced by 35%, and anemia management resource requirements have been reduced by more than 50%. Indications that hospitalizations may have been reduced by 25% are currently under study. Commercial development is underway.

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Modeling the Dynamics of Thyroid Hormones and Related Disorders

In this study, a dynamic simulation model for thyroid hormone system is constructed. The objective of this work is to first generate the dynamics of the hormones involved in thyroid hormone system in healthy body, and then to adapt the model to portray the dynamics of certain common thyroid disorders. The ultimate aim is to provide a platform to conduct scenario analyses without risking patients health. Thyrotropin-releasing hormone (TRH), thyroid-stimulating hormone (TSH), thyroid hormones, weights of hypothalamus, pituitary and thyroid gland are the basic variables in the model. Scenario experiments are simulated and outputs consistent with the data in literature, both qualitative and quantitative, are obtained. As future work, the model will be extended to cover more disorders and the parameter values will be more realistically calibrated.

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The Dutch Taxation on Airline Tickets: A system dynamics approach to model airport choice

In July 2008 the Dutch government introduced a tax on airline tickets in order to internalize the negative externalities associated with air travel. As a result of the increased ticket price in The Netherlands a substantial number of passengers decided to depart from airports outside of The Netherlands. However, after the tax was abolished one year later passengers kept using foreign airports. Because existing traditional discrete choice models do not explain this asymmetric response a system dynamics model was developed to model mechanisms of information exchange related to airport choice. The simulations show that the

development of awareness of an airport plays an important role in the asymmetric response. Further research should be conducted to assess the influence of macro-economic factors and specific airline strategies.

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Developing a theory of the societal lifecycle of cigarette smoking: Explaining & anticipating trends using information feedback

Cigarette smoking presented the most significant public health challenge in the United States in the 20th Century, and remains the single most preventable cause of morbidity and mortality in this country. A number of System Dynamics models exist to inform tobacco control policies. We reviewed them and discuss contributions. We developed a theory of the societal lifecycle of smoking, using a parsimonious set of feedback loops to capture historical trends and explore future scenarios. Previous work did not explain the long-term historical patterns of smoking behaviors. Much of it used stock-and-flow to represent the decline in prevalence in the recent past. With noted exceptions, information feedbacks were not embedded in these models. We present, simulate, and discuss our feedback-rich concept model. A formal analysis shows phenomena composed of different phases of behavior with specific dominant feedbacks associated with each phase. We discuss the implications of our society's current phase. We conclude with simulations of what-if scenarios. We expanded this body of work to provide an endogenous representation of the century-long societal lifecycle of smoking, because System Dynamics models must contain information feedback to be able to anticipate tipping points and to help identify policies that exploit leverage in a complex system.

Parallel and Poster Session Papers

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Major Issues in Mixed Use of Grounded Theory and System Dynamics Approaches in Qualitative Secondary Data

This article explores the methodological issues in mixed use of Grounded Theory and System Dynamics approaches in a research project. We discuss how analysts dealing with qualitative secondary data in the conduct of System Dynamics Modeling work through the questions of the role of existing literature and generic structures in system dynamics, directions of research (inductive, deductive, or abductive), the mixed methods ability to extract system dynamics modeling information, and potential outputs of such research. These discussions are based on an analysis from an empirical research project. The article describes a research design and suggests next steps to develop a coherent analytical technique for researchers.

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Sustainability of Self Sufficiency Level of Rice in Malaysia under Trade Liberalization

Malaysias stance on food security is largely translated in terms of achieving self-sufficiency in rice production which is currently set at about 65-70% of domestic consumption. Since Malaysia does not have the comparative advantage in rice production, it implements a wide range of market interventions to achieve the intended level of rice production. The policy instruments include among others: a guaranteed minimum price for paddy, various cash and input subsidies to farmers and millers, and price control for rice. For the future, Malaysia needs to dismantle all the policy instruments to comply with the WTO agreement. This paper examines the influence of the fertilizer and cash subsidies, as well as land conversion and fertility on the level of self sufficiency in rice. A system dynamics model is applied to analyse the causal and feedback relationships of these variables in the paddy production system. The study shows that Malaysia may be able to sustain the targeted self sufficiency level with adequate investments in R&D to address the production constraints, particularly the low level of productivity. This is important as the consumption of rice is expected to rise due to the increase in population.

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Diabetes Learning Lab - Glucose Concentration Levels in Blood

In this activity, the body reaction in the intake of food will be simulated: Food amount; type of food; when the intake of food took place; how fast the digestion occurs; reaction time of the pancreas; the connection between the blood glucose concentration and the insulin production. The content will also cover the subject

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between the coordinated and harmonious functioning of the pancreas (which secretes insulin), the liver, and the body's cells (insulin receivers). The Homeostasis: Process that regulates the blood concentration. Together well discover the cause-effects cycles that characterize the problem and how they become an important part of the solution. This article will span the effect of pancreas insulin production in diabetes type I, as well as the cells glucose uptake and their rejection to insulin, all this with the intention of visualizing how it breaks into the cause-effect cycles that regulates the blood glucose concentration in the body, triggering the imbalance in health.

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A Pilot Project to Teach the Characteristics of Complex Systems

This poster session will describe the progress of a pilot project initiated by Professor Jay Forrester through the Creative Learning Exchange. The project goal is to create online curriculum materials for K-12 students and interested adults that will illustrate the characteristics of complex systems: 1. Cause and effect are not closely related in time or space 2. Action is often ineffective due to application of low-leverage policies (treating the symptoms, not the problem) 3. High-leverage policies are difficult to apply correctly 4. Cause of problems is within the system 5. Collapsing goals results in a downward spiral 6. Conflicts arise between short-term and long-term goals 7. Burdens are shifted to the intervener This initial project addresses The cause of problems is within the system through the creation of a family of models that share the generic 2nd order negative feedback loop that generates oscillation. Students will encounter these models in various formats and subject areas. Through repeated exposure to these models and experimentation with various non-oscillating test inputs, they will recognize that the perceived problematic behavior exhibited is a consequence of the internal system structure.

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On the Integration and Cospecialization of Emerging Complementary Technologies: The Case of Renewable Power and Energy Storage

We develop insights into the problems of managing firms in emerging complementary industries by developing a stylized model motivated by the current state of the renewable energy industry. Several immature entrants, including wind and solar power contest the energy generation portion of this industry. However, all of these technologies present integration issues that prevent large-scale market penetration. In particular, the ultimate success of these generation technologies depends upon developing a cost-effective energy storage technology. Interestingly, storage manufacturers can co-specialize their systems to a generation technology so as to reduce overall generation-storage costs. However, this implies that a storage entrant must make a bet on a particular generation complement because co-specialization is expensive and these investments are unlikely to fully transfer between generation technologies. The paper describes conditions under which a storage entrant should bet on what it perceives as the most likely winner in the renewable generation arena versus when it should pursue a more balanced strategy. Factors influencing this decision include uncertainty, market competitiveness, and sources of finance, among others. Finally, the paper discusses policy implications with respect to vertical integration and market competition.

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Innovation Projects & Portfolios: Admitting Change and Rework to Meet Escalating Expectations

The system dynamics contribution to project management research is one of the jewels of the crown with respect to our field. One of its key contributions is to understand how iteration of tasks in the form of project rework influences key outcomes measurable such as cost and timing. We build upon this tradition in a conceptual paper that suggest that other types of iteration, which are mindful and beneficial, need to be considered. When considered, two particular concerns fall out with respect to innovation projects that need further exploration by system dynamicists. One is that some projects, particularly innovation projects, may need to change scope mid-way through the project if they are to be successful, and there is no way to anticipate this ex ante. The other is that innovation projects tend to iterate in scope from project to project and that this iteration is necessary because of the escalation of market expectations. We explore the implications of these ideas and how they should impact the course of future system dynamics research.

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Dynamically Stress Testing Financial Systems

Turmoil in financial markets revealed a need to advance analytical and monitoring frameworks at central and national banks, specifically in the area of systemic risk. System Dynamics offers an innovative approach to assessing financial sector performance and inform policy reform for global regulators by employing tools to diagnose the strength of the finance and banking system. Banking entities can examine the intersections and interactions between the banking system value chains, analyze the various economic subsystems that affect overall banking system stability, and model the complex system relationships through causal feedback loops and system flows. As a result our system dynamic models assist banks in planning for emergency liquidity assistance by determining when the risk occurs and quantifying losses.

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System Dynamics of Hypothetical and Realistic Demographics: Implications of Foreign Labour Policy

Understanding population dynamics is crucial to understanding current and future health care needs and designing systems to meet those needs. In this paper, we provide a methodological approach to answering questions of population dynamics in a system dynamics model configurable to initialise in dynamic equilibrium or disequilibrium. Some questions include: how does current measured population compare to a population of the same size in equilibrium, and how would a change from current observed birth rate to equilibrium birth rate affect population levels and the dependency ratio over time? To illustrate the methodology, we apply our approach to Singapore, which is experiencing an increasing proportion of the elderly population.

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Future research directions in Governance and Policy Making under the UE prism of ICT for Governance and Policy Modelling

The role of Government has evolved over the last thirty years and while its role in service provision has diminished, its regulation activity is growing. The world has become increasingly interconnected, complex, and fast-evolving and the effects of individual behavior and policy choices are not predictable. The paradox is that while the amount of data available to governments has increased exponentially, yet policymakers clearly struggle to make sense of it so that during the last years, the European Commission has decided to invest heavily in research on this issue. In this paper, the authors report about the experience of the CROSSROAD Project, whose main goal was to build a roadmap in order to provide strategic directions for future research in the domain of ICT for Governance and Policy Modeling. The roadmap, recently approved by European Commission, intends to be the basis for developing a shared vision, inspire collaborative and interdisciplinary research between academia, business, civil society and government, and provide support and orientation to policy-modelling also after the project end. In this context, the paper analyzes the Model-based Governance issue as the part of the roadmap that suggests the development of advanced tools for an efficient and effective decision- making process.

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The Dynamics in the Dairy Cattle Sector: Policies on Cow Milk Production Can Reduce Greenhouses Gas Emissions and Land Use

This paper was aimed to understand the key components affecting the dynamics of world milk production and consumption and their effects on CO2 emissions (CO2eq) and grassland use. The model had two major balancing loops: world milk demand (MD), and world milk production (MP). The MP consists of three balancing loops: cow number (CN), cow productivity (CPr), and feed cost; they represented the indirect and direct ways to change the MP rate in order to meet MD, and the positive relationship between cost and demand of feed, respectively. The model consisted of 6 sub-models: people and milk market; cows; milk production; energy requirements; economics; environment. Simulated scenarios were performed between 2007 and 2052. The structural loops affected the output behavior: when MD>MP farm profitability described goal seeking patterns, while when MP>MD, it described constant oscillatory patterns. Scenarios with low CPr did not meet the MD. Scenarios with greater CPr and policies to improve CPr and cattle efficiency met the MD while reducing the CN and used fewer inputs per kg of milk. The model suggested that CPr and cattle nutritional efficiency were the key factors in mitigating anthropogenic environmental impacts by reducing total energy demand, grassland use, and CO2eq/kg milk.

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Reflections on the Validity of T21 and PCM, System Dynamics Integrated National Development Planning Simulation Models

The impossibility to identify and represent events and emergent characteristics of the system analyzed with computer simulation models aimed at projecting future

events has posed serious questions about their validity in the field of social science. While methodological issues, both concerning the foundations of the methodology and the formulation of models, are identified, the System Dynamics methodology seems to allow modelers to gain a deep understanding of the systems studied while answering the four dilemmas identified in this study. These models allow for the structural representation of the system through the identification of causal relations underlying its main functioning mechanisms, represent both dynamic and detailed complexity using wide social, economic and environmental boundaries. Dynamic simulation models are by no means perfect and will never be; nevertheless, modelers have the responsibility to use our best scientific understanding to develop reasonable and sustainable policies. T21 and PCM, integrated national development models, allow us to do so by enhancing the understanding of systems.

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Learning from System Dynamics Simulations: Simulations for Time Compression or for Time Dilation

Powerful models have been used to simulate the vulnerability of the electric power system however changes in regulatory structure and increases in intermittent generation challenge even the best power system simulators. As a part of our research into mathematical methods to help power system planners deal with operational stability questions we look to previous system dynamics studies using model- based simulators. System dynamics simulation could add insight on the role of power system operators behavior in maintaining control of large, interconnected power systems. We review previous work in both the power industry and in the system dynamics community on the use of training simulators. Most system dynamics simulators, board and computer assisted games tend to compress time. Training simulators in the power industry act to stretch time to allow subjects to monitor and react to power system changes that can unfold in seconds and may be evident in a few minutes. Rather than time compression, the power industry looks to simulations for time dilation. Our research looks at the challenge of designing a time dilating system dynamics model for human subjects to experiment with, and at the process of measuring their improved performance as a result of this simulation training.

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Understanding Sustainability, Quality of Life and Resilience

Las Vegas is faced with three important challenges: promoting sustainability, quality of life and resilience. Sustainability is the ability of Las Vegas residents to meet current needs without compromising the ability of future residents to do the same. Quality of life (QOL) is the level of satisfaction of those residents needs and personal preferences. Resilience is a measure of how the city responds to disturbance. A strong city needs a high degree of all three. This paper uses a system dynamics model to explore the relationships that underlie sustainability, QOL and resilience. Stocks of physical, social, natural, and human capital monitor sustainability. Quality of life is the level of satisfaction of residents needs and personal preferences. It is measured as the amount of capital available for a given population. Resilience is how quickly the city responds to shocks to its system and continues satisfying quality of life. Model analysis shows how these relationships must be balanced so sustainability is not sacrificed in pursuit of preference satisfaction, and buffers are developed to shield growth and development.

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21st Century Modeling and Collaboration: Building a Learning Ecosystem and Expanding the Reach of System Dynamics

The Internet and new collaborative technologies are transforming the world. By lowering communication and organizational costs they allow the free flow of information and ideas to an extent that was unimaginable just a quarter of a century ago. The disruptive power of the Internet is visible all around us from the recent protests against totalitarian governments in the Mediterranean region, to the now routine ability to carry on a video conference with a colleague or family member located on the other side of the globe. The Internet magnifies peoples ability to communicate and creates new possibilities. Given System Dynamics emphasis on communication and accessibility, it is well positioned to take advantage of the new connective opportunities provided by the Internet. In this paper, we first present the development of three tools Insight Maker, Systems Thinking World Discussion Group, and SystemsWiki for using System Dynamics on-line. After discussing the practical factors in the relative successes of these tools, we then map out one approach to using the Internet to build a Learning Ecosystem that engages and involves people with System Dynamics and Systems Thinking in general.

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Quantitative Evaluation of the Performance of Water Management System in the Washington Metropolitan Area

The water management system for the Washington Metropolitan Area (WMA), like many other public utilities, is reaching its maximum service potential in the face of this rapid growth and climate change. Frequent droughts have not only prompted pricy withdrawals from reserve water supplies more than once, fall of 2010 being the latest case of such water releases, but also have generated varied responses from different local governments that make up the WMA, reflecting lack of cooperation. This also reflects that WMA water supply system is not adequate enough to meet daily demand using only Potomac, Patuxent and Occoquan resources. Prior information about time and volume of releases will not only help in the efficient allocation of water but it will also help in well-informed decision making. Therefore, this paper does the following: 1) Model the demand and supply dynamics for the WMA; 2) Analyze the impact of historical droughts on water availability; and 3) Assesses the performance of the system under various demand scenarios and drought conditions. Finally, the paper concludes that WMA water supply system is susceptible to shortages in future and performance of the system is expected to deteriorate in the coming years with recurrence of historical droughts.

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Athens vs Sparta. When ethical choices enable to reach sustainability

Critical decisions need to be made to face global crises. Modeling and simulation can help to make these decisions effective and shared. Ethical issues are involved in this process and should be included for better quality decisions. Looking at the past helps us to cast light on how ethical choices can be important in resolving critical situations. The ancient Greek city-states of Athens and Sparta show opposed paradigms in policies and life-style, but only one proves itself stable and

lasting. Surprisingly, its not the city-state we all would had lived in. Human activities in both city-states cause, in time, internal instabilities. Crises that will be solved through expansionist policies, migrations and colonies settlement. Athens faced seven migrations in less than five centuries. Instead, Sparta, after its first (and only) dramatic migration event, introduced corrective actions to contrast instabilities. The change is ascribed to the mythical lawgiver Lycurgus, but it could likely be the consequence of a shared vision. A simulation model fitting the two city-states behavior has been developed and its structure comprises seven interconnected sectors. The paper includes model description and its interpretation, a brief overview on ethics in modeling, and a note on our project ethics in the evolution of societies.

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Sensitivity Analysis Techniques for System Dynamics Models of Human Behavior

Human and social models are an important capability of system dynamics, and sensitivity analysis can be used to strengthen and better understand these models. To learn about which sensitivity analysis techniques are most suitable for models of human behavior, different promising methods were applied to an example system dynamics model, tested, and compared. The example model simulates cognitive, behavioral, and social processes and interactions, and involves substantial nonlinearity, uncertainty, and variability. Results showed that some sensitivity analysis methods create similar results, and can thus be considered redundant. However, other methods, such as global methods that consider interactions between inputs, can generate insight not gained from traditional methods.

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Using a Hybrid Cognitive-System Dynamics Model to Anticipate the Influence of Events and Actions on Human Behaviors

Political dynamics often arise from within a political system, but can also be affected by outside forces. In order to understand the potential effects of these forces, we created a model to simulate political dynamics in a society under different internal and external conditions. The system dynamics model uses a cognitive modeling framework to determine human behavior. We present the results of the model under four different scenarios, including a base case, a case where an outside government provides support for the opposition, an information operations case, and a show of force case. The model shows that there is potential for these different conditions to have significant effects, including higher-order effects that may be unanticipated if a systems perspective is not taken.

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Outlining Long Term Corporate Social Responsibility Strategies in a Non Profit Organization: a Colombian Health Care Insurance

In spite of the growing attention Corporate Social Responsibility (CSR) strategies has received in the last decade, very often both profit and Non Profit Organizations (NPO) shown to be unsuccessful to implement long term CSR strategies. Several could be the reasons of such failures. In order to try to find an

answer to such mistakes, the author assumes that by making explicit the main feedback loops structure underlying CSR strategies, decision makers can better understand, outline and implement effective long term CSR strategies, which are coherent with the organization mission. The paper initially offers an analysis of the literature in the field of CSR. In the next session, some preliminary findings of an empirical study carried out by the author in a Colombian NPO are provided. Such research allowed the author to build a cause-and-effect relationships model, based on the System Dynamics methodology, aimed to outline opportunities and pitfalls in designing and implementing long term social initiatives in an health care insurance NPO.

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Why Formal Housing Alternatives in Developing Countries are Insufficient, Inadequate, and Unaffordable?

In this paper, I present a model of the articulations between the formal and informal mechanisms of housing production with the objective to analyze the causes of the rise and persistence of informal settlements in the developing world. The model is based on System Dynamics, a method of simulation that deals with complex systems characterized by dynamic behavior, and is tested using the case of Bogot, Colombia, a city known by the prevalence of informal housing markets and its rich experience in the implementation of public policies to address informality. The final results and policy experiments show that informality arises from the inadequacy of a system of infrastructure financing based on tariffs and cross-subsidization and from the unintended consequences of classic interventions to deal with this problem such as settlement up-grading and the provision of public housing. A preventive policy based on dismantling these interventions and increasing the supply of land with urban services through a change in the system of infrastructure funding shifting the source of financing from cross-subsidies to property taxation is proven to be a more cost-effective method to mitigate the negative consequences of informality.

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Reducing the gender gap: biases in understanding delays in personnel policies

This paper builds on previous research in stock-flow experiments. 168 participants were asked to recommend a hiring percentage of female professors they thought necessary to reach gender balance in an unbalanced personnel situation. They were also asked to estimate the timeframe needed to reach this. Additionally, participants were asked to write down a justification for their choices. These justifications provide insight into the reasoning people use in stock-flow tasks. The experiment confirmed that people have difficulties understanding the distinction between stock and flows, and in particular underestimate the effect of average delays. Moreover it showed that not only cognitive bias, but also political considerations play a role in reasoning on this task. Further research is needed to examine the interplay between these two.

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Residential Energy Efficiency Policy in Latvia: A System Dynamics Approach

To ensure implementation of requirements of EU Directive 2006/32/EC on energy end-use efficiency and energy services in Latvia First National Energy Efficiency Action Plan (EEAP) 2008 2010 is approved where the goal is

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established to reduce energy consumption by 3483 GWh by 2016. The greatest energy savings 77% or 2701 GWh are planned in the residential sector as it is the major energy end user in the country. The largest part of it is multifamily buildings with every flat owned by individual owner. Although Latvia has huge building energy efficiency potential former policies are not noticeably facilitating its use an increase of number of renovated buildings is insignificant only 100 of more than 30 000 apartment buildings are completely renovated. It indicates that energy efficiency measures have to be reviewed in wider socioeconomic context considering that inhabitants motivation is impacted not only by rational reasons but also by combination of complex socioeconomic factors. In order to understand how building renovation process is affected by different energy efficiency policies a system dynamics model was developed. With the help of the developed model it was possible to determine whether the goals set in the First National Energy Efficiency Action Plan are achievable.

System Dynamic Analysis for Development of Renewable Energy Resources in Country

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The events in the energy sector which are evolving globally put more and more emphasis on renewables, through the use of which it is possible to reduce not only impacts on climate change but also to place a more gradually decline of expendable fossil fuels. Countries more and more are placing importance on development strategies and applying the principles of greening the environment. The article looks at a situation where it is possible to significantly increase the proportion of renewables in the energy balance, particularly wood fuel, but this is not done due to political reasons. The energy dependence of the country on natural gas and its political dependence on its neighbouring countries increases. This model is applied in order that the economic circumstances within the next decade can be improved, thus allowing for biomass to replace fossil fuels as an energy source in the centralised heating. Three political instruments are chosen in this model: national-level financial support for the replacement of fossil fuel with biomass, information package at all heating supply levels and energy efficiency measures for improving the effective running of technological apparatus which use biomass as an energy source.

Object use as a framework to study model use in group model building

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This study presents a framework for considering group model-building focusing on the different object roles (boundary object, epistemic object, representational object & technical object) which the model can take during the group development process based on its use in facilitating communication, enabling learning, policy evaluation, etc. The framework is applied in the evaluation of parallel modelling observations and follow-up interviews for two model-building exercises covering the same health-sector problem and decision area. While both adopted the same basic facilitated multi-meeting expert group model-building process, this paper considers the differences in the modelling and the model role which result from the difference in the expert group participation and the expected users of the resulting model. The use of the model shifted over the development cycle as well across the two observed parallel projects. Among the initial results highlighted in the paper is the locally-built model for internal-use being characterised by more of a role for knowledge sharing and knowledge creation and how the national tool-building exercise reflected the technical and

representational roles for the model. This was based on two factors: intended final usage mode for the resulting model and the characteristics of the experts brought in for the two exercises.

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The Evolutionary Economic Geography of Regional Economic Development in Asia

The paper will review representations of regional development models in terms of their assumptions (peeled away like an onion) and in terms of their level of complexity, very much in the tradition of Peter Allen's classification system. Some applied models of regional economic development in Asia will be presented in more detail and compared to each other in terms of their ability to understand development and to gain knowledge about real world problem solutions. Understanding reality and gaining knowledge about a problem require us to reduce the real complexity of any particular situation to a simpler, more understandable system by making specific simplifying assumptions. It is shown that there exist representations that, while being sufficiently simple to be understood, remain sufficiently representative of reality and yield significant power to make a big difference to regional economic development in Asia when compared to other, less useful representations. For instance, what is important to be explained in dynamic socio-economic systems is the structural change in terms of degree of heterogeneity of agent populations in space, the modularity and hierarchy of a system, and similar aspects of composite structural existence.

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A Simple System Dynamics Model for the Collapse of Complex Societies

This paper aims to show that incremental stress over environment can lead civilizations to overshoot their resource base as it has been suggested, for instance, by Jared Diamond. Despite this author has recently been criticized by scholars of different orientations, we think this criticism has likely been exaggerated. Diamond`s answers to the critics are not always entirely convincing indeed, but that is because he apparently does not have a clear understanding of stock-flow dynamics. Hence, it seems likely that system dynamics reasoning might give more solid grounds to some of his insights under criticism. In this paper we intend specifically to show that, unlike the dominant view in the recent literature on the subject, societal collapses can occur even in the absence of extreme unexpected events, but just because the society has crossed a turning point beyond which traditional social practices can become inadequate to deal with environmental shocks like droughts. In order to accomplish this goal, the paper builds a model for the Maya society based on the Rudolph and Reppening`s model for explaining the role the quantity of non-novel events play in precipitating disasters in organizations.

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Closing the Leadership Gap: One Step Closer using System Dynamics

Social science theories are developed to understand problematic behavior and describe the social structure believed to be the cause. Only occasionally used, system dynamics has long been considered an ideal testing ground for such theories. Most Americans believe in equal opportunity for men and women, yet the difference between the number of men and women in leadership positions, the

leadership gap, continues to be significant. In Justice, Gender, and the Family, Susan Moller Okin presents a feminist theory of a social structure that perpetuates the U.S. gender gap in leadership. This paper interprets Okins theory by translating the descriptive theory into a system dynamics model and analyzing whether the structure Okin presents produces the behavior she describes. With an eye to closing the leadership gap, the purpose of this research is to more deeply understand Okins theory and the ability of system dynamics to advance social science theory in general and feminist theory in particular.

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CA_RE: Assessing Carbon Reduction through the introduction of a carbon tax. The case of Italy

In this model, we assess the impact of the introduction of a carbon tax on CO2 emissions in Italy. Tax revenue is redistributed between investments in photovoltaic installations and in energy efficiency interventions in the building sector. Results show high potential of environmental taxation as a complementary tool of market based instruments (i.e. tradable permits) in achieving environmental quality.

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Modeling the Diffusion of Energy Performance Contracting

The Portuguese Energy Policy considers the development of a commercially viable and competitive market for energy performance contracting (EPC) as a main mechanism to achieve the objectives of energy efficiency improvement. This paper proposes a study to investigate how to achieve widespread adoption of energy performance contracting by means of system dynamics modelling and simulation. To explore and gather insights on this question, a system dynamics model representing the system of the Portuguese EPC market at industry level will be created. The simulation of that model will provide a helpful basis for analysing and explaining the development of key variables, and accel-erating learning on the managerial, organizational and political adaptation processes that foster the diffusion of EPC adoption. The first phase of this research project aims at identifying and analysing the key factors and critical cause-effect relations that drive the adoption of EPC. With this purpose, a qualitative content analysis on relevant documents was performed and a set of interviews was conducted. That data was ana-lysed to capture the critical variables and its interrelation to formulate a preliminary representation of the system structure as stock and flow diagrams.

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A system dynamics model for assessing the UK carbon market

The emissions of greenhouse gases have become a great worldwide concern due to their effects on climate change. This led to determine, through the Kyoto Protocol, goals to decrease at least 5% of the GHGs by 2012, with respect to the 1990 levels. This agreement established three explicit mechanisms: joint implementation, clean development mechanism and emissions trading. In this context, the European Union created an Emissions Trading Scheme EU ETS (EU Emissions Trading Scheme) that committed 73% of the global carbon market in

2009. Given that the electricity sector is the main contributor of GHGs, it is important to assess the impact of the EU ETS on this sector. This article undertakes this task with the support of a system dynamics model, using the United Kingdom as a case study. Preliminary results indicate that even under a scenario of low prices for emission allowances this would induce significant changes in the installed capacity of the electricity sector, replacing fossil-based technologies by cleaner ones, such as wind and nuclear energy; and also significant reductions of CO2 emissions.

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Management of Voltage Control Using Distributed Generation in the Colombian Power System: a system dynamics approach

This paper presents a study on the penetration of Distributed Generation (DG) under the consideration of a proposal for trading, environmental, and technical incentives, in the Colombian power system. To quantify the technical incentives, we simulated a part of the Colombian grid presents some busbars, low levels of voltage. We connect the busbars "problem", distributed generation and we found an increase in voltage that in a controlled manner can to help to better quality and continuity of electricity supply. Environmental and trade incentives were quantified using international experiences. In addition, we built a system dynamics model to evaluation the complete proposal. We found that the current incentives presented in the Colombian regulation such as tax breaks are insufficient to cover the total costs. Moreover, environmental incentives can be an efficient way to promote renewable energy use in Colombia, in order to achieve, more generating capacity with less pollution indices; and technical incentives in conjunction with environmental incentives can improve further the growth of DG in Colombia. Thus, the DG diffusion become an additional tool for the operator of the interconnected system to make voltage control, improve the quality, and security of electrical power systems.

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Application of System Dynamics Modelling in support of Microsoft's Automation Strategy

Development of software is a dynamic and complex problem. A number of software development methodologies exist to enable software to be produced effectively. Software development methodologies, such as Waterfall and Agile consist of a set of activities that are carried out in the production of software. Activities include Requirement Capture, Design, Development and Testing. Elements of key software development tasks can be automated to improve quality and free up resource capacity. For example, performing software tests can be a laborious activity which if automated can be carried out quickly and repeatedly without error. However, developing automation takes time and is more cost effective for applications with a long shelf life. This paper describes an innovative System Dynamics based strategy tool, called the Automated Decision Support Tool (ADS Tool), developed by QinetiQ Ltd and Microsoft. The purpose of the ADS Tool was to assess the optimum level of automation to be used in the development of a software application. The model is a key element of Microsoft IT (MSIT) Engineerings three year automation roadmap for increasing delivered scope and quality across MSIT Engineering, and is being successfully used by MSIT engineers in Seattle, India and China to develop automation strategies for a number of their internal IT applications.

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Challenges of energy as a tool for sustainable development in isolated rural areas

Community development has been widely discussed among scholars, (Shortall 2008; Soesastro 2004), Normally sustainable development of rural communities is directly linked to the ways in which people that are in the community react to new conditions or adjust to situations in a constructive way. Many studies have shown that power supply to rural communities contribute to development and growth (Berglund & Soderholm 2006; Borroto et al. 1998; Department For International Development 2002). However this has fallen short of expectation as the approaches have either been too technical, using only econometric views or coefficient based like misery line. This paper seeks to contribute in a holistic way to identify economic and social development, when energy is a crucial factor, because it allows making different approaches to education and technical development in the geographic region, using information technologies and better health services. The social and human capital raise when people inside the community identifies this connection, and make the energy a way to get better social and human services, granting a sustainable development.

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A System Dynamics Model for the Clinical Risk Management: a preliminary analysis

Clinical risk management has gained an increasing relevance because of the higher monetary and no monetary effects of clinical errors on healthcare companies performance. For this reason, different risk management techniques from the industrial sector have been adopted by managers of healthcare companies in order to reduce the occurrences of errors and their relative impacts. Although the reduction of clinical errors obtained by adopting clinical risk management techniques have been widely described, in most of developed countries such policies are not very widespread. Such circumstance can be explained by the costs healthcare companies have to bear to invest in clinical risk management in order to improve their risk profile. In fact, these techniques, based on a linear and static perspective, do not properly support the healthcare companies management in the identification and assessment of policies aimed at improving the clinical risk profile without reducing financial performances. Therefore, it is necessary to adopt a systemic and multidimensional approach that supports cost-and-benefit analysis of the identified policies. Based on preliminary results of a research project on system dynamics methodology applied to clinical risk management in Italian healthcare companies, some peculiar aspects are analyzed and discussed.

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Modeling asset and liability dynamics for pension funds defined benefit plans

This article describes the results of a research in Information Science field that aimed to verify how System Dynamics could be applied to manage, in a systemic perspective, the information of risk factors in Pension Funds assets and liabilities management (ALM) processes. Delphi technique was used to get data and to identify risk factors with two financial managers and actuaries from 20 Brazilian Pension Funds. By system dynamics, system thinking and agent based modelling techniques it was possible to represent factors cause and effect relations in order

to get a function of their expenses and the actual and future payments of the retirements. The conclusions propose a methodology combining these three approaches and show some particularities and benefits of system dynamics to model financial and actuarial assumptions in such organizations and in Information Science research.

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System Dynamics Modeling of Livelihoods and Forest Commons in Dryland Communities of Andhra Pradesh, India

The very poor, in drylands of India, survive because of vital ecosystem services from forest commons. Economic and environmental uncertainties and institutional variations governing ecosystems intensify and complicate the linkages between household poverty and dryland forest commons. These economic ties to local ecosystems not only affect the biophysical properties of a forest commons but also how people organize their livelihoods at the household and community level that further influence local ecosystems. We applied system dynamics modeling to examine forest ecosystems and livelihoods in a dryland village in Chittoor district of Andhra Pradesh, India. We do systems dynamic modeling with key stakeholders the villagers, using traditional participatory action research techniques combined with group model building. Simulation results replicate the dynamic behavior of fuelwood availability over time as perceived by the community. It also shows that new institutional arrangements regarding extraction of fuelwood work however only address the symptom and shift the pressure of resource demand to adjacent areas. Participating in National Rural Employment programs helps reduce the dependency on fuelwood for income however the domestic need for energy still drives the extraction of fuelwood. The extended non-simulating model shows the endogenous mechanism of implementation of the new institutional arrangements.

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Maintaining Disparity: Thresholds of Defection

An earlier Conference paper used a small model to illustrate oscillations in local responses to health disparities. It was noted that further work would address medium term trends and thresholds shaping public action to eliminate health disparities. This paper begins to address those issues using Heckathorns model of The Dynamics and Dilemmas of Collective Action. Among many other things the model illustrates the implications of hypotheses related to the relative fitness of voluntary action, norms of reciprocity and selective incentives or sanctions. The hypotheses can be used to explore implications of the governance variable in the causal loop diagram adopted by the WHO Commission on Social Determinants of Health. The conclusion is that the model (a) provides a framework for analysing elite responses evident in decisions made and avoided by governance groups with duties to promote public health, and (b) has the theoretical depth necessary to be recognised as a canonical situation model as defined by David Lane.

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Strengthening Links Between Anthropologists and System Dynamicists: Participatory Group Modeling & Natural Resources

In this brief communication, we argue for more systematic and self-conscious attention, within the field of system dynamics, to the process of knowledge sharing for the purposes of model construction. After explaining our rationale, we provide a number of examples showing how various groups of people---often those with central roles in the problems being modeled---are marginalized, their voices mute or silent. We recognize the valuable work of a number of SD modelers, emphasizing their work in western, often corporate, worlds. However, there are special problems that emerge when important members of the would-be client population are comparatively powerless, under-educated or even illiterate, as is the case in many international natural resource contexts---contexts likely to become more important as attempts to cope with climate change increase. We then provide some practical suggestions for addressing such communication problems. We believe that SD can be of great value in the analysis of natural resource conflicts, climate change mitigation and adaptation, the development of improved management systems, and in policy formulation and evaluation. The anthropological perspective may provide insights that will allow for better integration of the views of marginalized peoples into SD models.

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A SD-based Analysis of the Market for Hydrogen Fuel Cell Urban Buses

The paper investigates the potential of urban transit buses to provide an early market for hydrogen proton exchange membrane fuel cells (PEM FCs) in road transport. System Dynamics has already been used to explore the transition towards the large scale use of hydrogen fuel cells in road transport as a whole. Given the importance of establishing early and niche markets first, on the route to mainstream markets, this paper focuses on one early market in road transport which is considered to be particularly important: urban transit buses. A System Dynamics model has been developed in order to address this particular market in detail. The model is currently still being refined; however results generated so far suggest that the market uptake of PEM FC buses will not be rapid and will require significant public support.

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Learning How Accumulation Works

In order to understand dynamic systems, people need to understand and account for accumulation of a systems stocks. Failure to account for accumulation begets errors in prediction with respect to the behavior of the system, such as the decay rate of a stock. Recall, for example, authorities underestimating of how long it would take for the Beijing pollution to clear up before the 2008 Olympics. Even though the mechanics of accumulation are often straightforward, even highly educated people often misdiagnose behavior of simple stock-flow systems. Moreover, this effect has been shown to be rather robust across problem domains and presentations methods. Across a series of studies, we further explore the resistance of Stock-Flow failure to correction by training of various types.

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Deepening Our Understanding of Stock-Flow Failure

Accumulation has proven challenging for people to account for and diagnose. Moreover, despite many attempts to correct the misperceptions of accumulation, misdiagnosis of the behavior of a stock in a stock flow system remains robust. Misperception of the behavior of a stock is not an artifact of complex information displays, the large number of data points used in prior experimental tasks, unfamiliar contexts, and other issues unrelated to accumulation, but questions remain regarding whether people can really find the concept so difficult. In this paper we explore the robustness and origins of SF failure by testing whether people can apply the principles of accumulation in settings of extreme simplicity a system where there are only two data points (flow values for only two times), one inflow and one outflow. We find that despite the simplicity of the problem, a high percentage of people still misjudge the stock. We use these data to suggest new approaches to studying misperceptions of accumulation.

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How can Organizational Capacity help to clarify Project Performance? A system dynamics model

During a long time, studies on project management were focused on duality between temporary organization (the project) and permanent organization to explain the lack of learning form the project. If the literature review emphasizes learning process and knowledge production during life cycle of project, they both disappear once the project finishes because of a lack of knowledge management capitalization. However we think that the real causes of the success or failure of the projects find their roots elsewhere that in knowledges capitalization. From our point of view, the performance of the project could be explained starting from the concept of the organizational capacity of the project team. The organizational capacity is a collective skill. It authorizes to combine and go into action relevant resources, as teams project attitude (motivation) and teams project aptitude (innovation), organizational competences focused on good relationship at work, coordination, tasks integration, etc. In this way we have developed a dynamic model of projects performance based on organizational capacity. From this model and one of the main question results from this model is: Could organizational capacity improve the project path and behind the success or failure of the project?

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OSCAM (Operating & Support Cost Analysis Model): System Dynamics for Through-Life Costing in the US Navy

OSCAM was first developed in 1996 for estimating operating and support costs for ships and shipboard systems. Now in its sixteenth year of operation, OSCAM variants are available for ships, shipboard systems, land vehicles, and aircraft, as well as a specific version for the Joint Strike Fighter program. Procurement costs represent only part of the cost of a military platform program, with operating and support costs generally being a significantly higher proportion of the total program cost. In recent years operating and support costs have received increasing focus in the US Department of Defense and are a component of the acquisition milestone decisions process. OSCAM plays an important part in the milestone process for the US Navy, being used for most major ship acquisition programs. The paper provides an overview of OSCAM and describes the role it plays in the US Navy, with examples of its use in studies. It focuses on the use of

OSCAM from a cost analysts perspective and the impact of using system dynamics as part of a desktop tool. It concludes with an analysis of how the scope and design of the system dynamics model has changed over time in response to the needs of cost estimators.

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The Role of Behaviour Change in Eating and Physical Activity in the Battle against Childhood Obesity

Obesity results from many influences including genetic and environmental. But eating and physical activity are the two fundamental factors which influence obesity development. This work investigates how food consumption choices and the extent of physical activity have an influence on weight, BMI and the prevalence of obesity in a population of children aged 2-15 years. Around forty years ago, the weight profile of the child (or adult) population was not particularly abnormal. But with increases in energy-dense food consumption and reductions in physical activity, weight, BMI and the prevalence of obesity has increased dramatically, especially since the 1990s. Results from our model can explain these trends. If no interventions are taken to counteract them then these markers will continue to increase in the future with consequent health effects as the children become adults. In an effort to uncover the most effective interventions, this study highlights the role that a system dynamics model can play to help manage the problem in childhood, particularly through considering behavioural changes. In anticipated developments of this research it is suggested that the Theory of Planned Behaviour could be used as a framework to identify the motivational factors that influence children in their eating and physical activity habits.

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No way out? – Analysing Policy Options to Alleviate or Derail Success-to-theSuccessful in the Energy System

The purpose of this paper is to briefly discuss the presence of the archetype Success-to-the-Successful in the energy system and to analyse policy options in the presence of this archetype in the energy system. More precisely, the paper aims at finding conditions under which the path dependent allocation of investments directed to the conventional energy-technology sector can be alleviated, in order to encourage investments in alternative energies and technologies. The discussion draws on a stylized and highly aggregated model of the energy system, which is based on system dynamics. Sensitivity analyses are used as the major diagnostic tool to identify options to break away from the current dominant path of energy production and use, and the investments made in it. The value of this paper lies in the clear articulation of a complex and fuzzy topic, with the help of modelling and simulation. Implications for research comprise a further elaboration of the simulation studies within the energy field.

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A note on the bathtub analogy

The bathtub analogy has been used extensively to illustrate stock and flow relationships. Because this analogy is frequently used, System Dynamicists should be aware that the natural outflow of water from a bathtub is a nonlinear function of water volume. A questionnaire suggests that students with one year or more of System Dynamics training tend to assume a linear relationship when

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asked to model a water outflow driven by gravity. We present Torricellis law for the outflow and investigate the error caused by assuming linearity. We also construct an inverted funnel which does behave like a linear system. We conclude by pointing out that the nonlinearity is of no importance for the usefulness of bathtubs or funnels as analogies. On the other hand, simplified analogies could make modellers overconfident in linear formulations and not able to address critical remarks from physicists or other specialists.

Reducing CO2 Emissions due to a shift from Road to Cabotage Transport of Cargo in Brazil

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This work evaluates the impact of existing policies in the Brazilian National Plan for Logistics and Transport (PNLT) on CO2 emissions due to the transport of domestic cargo. We build a formal system dynamics model capturing the causal relationships influencing the modal shift from road to cabotage transport of cargo in Brazil. Scenarios are charted to understand the impact of PNLT policies on CO2 emissions(?) and the implications for the transport infrastructure. Our analysis shows that pressure to reduce CO2 emissions plays a critical role accelerating the modal shift from road to cabotage.

Causal Maps to Analyze Policy Complexity and Intergovernmental Coordination: An empirical study of floodplain recommendations

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This paper presents the findings of an empirical study on floodplain management using system dynamics to define attributes and characteristics of recommendation arguments. Relationships identified in the 97 recommendations produced a series of causal loop diagrams. The diagrams were the unit of analysis to test the association between policy implementation and floodplain management issues, solutions, and government institutions. The causal maps were also used to analyze the effect of intergovernmental relationships on recommendation outcomes. The findings show that intergovernmental coordination did not hinder the implementation of successful solutions. This paper describes a multi-method approach for analyzing policy recommendations. It is the authors hope the policy analysis strategy described in this paper increases the relative attractiveness of system dynamics research to editors of public policy and public administration journals, who may be unfamiliar with SD contributions in policy analysis.

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Capacity Adjustment in a Service Facility with Reactive Customers and Delays: Simulation and Experimental Analysis

In this paper, we apply system dynamics to model a queuing system wherein the manager of a service facility adjusts capacity based on his perception of the queue size; while potential and current customers react to the managers decisions. Current customers update their perception based on their own experience and decide whether to remain patronizing the facility, whereas potential customers estimate their expected waiting time through word of mouth and decide whether to join the facility or not. We simulate the model and analyze the evolution of the backlog of work and the available service capacity. Based on this analysis we propose two alternative decision rules to maximize the managers cumulative profits. Then, we illustrate how we have developed an experiment to collect information about the way human subjects taking on the role of a manager in a lab environment face a situation in which they must adjust the capacity of a service facility.

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The Management of Trust for Stimulating the Adoption of Improved Maize Seed in Malawi

Adoption of improved seed is the major pull factor of the seed value chain. Especially trust is an important element of the adoption decision. The aim of the study is to assess ways to manage trust. By using survey data from Malawi to elicit the role of trust in the decision making process of farmers to adopt improved seed. We use these data in a dynamic simulation model to assess the historical seed adoption pattern in Malawi and to assess branding as a policy measure to manage the trust stock. We find that branding has been contributing to seed adoption in Malawi and our analysis confirms that it can further stimulate demand in combination with strategies of pricing and new product supply.

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System Dynamics as a Method for Analyzing Human Trafficking

This paper describes a system dynamics model designed to test policies that could potentially limit, halt, or reverse the growth of human trafficking (and more broadly female exploitation for sex) in Washington, D.C and elsewhere. Human trafficking has been deemed a crime against humanity, yet despite prevention programs around the world the practice has continued to flourish. We believe these policies have had limited impact because of the variety of variables and causal structures that influence the system as a whole. Through the study of the trafficking/exploitation sex market in Washington, D.C., we have identified some key drivers and limiters in the system, as well as some of the complex interactions between them. A computerized version of our model allows policy makers to virtually test how new policies are likely to influence the system before actually implementing them in the real world. System dynamics presents a new tool in the effort to combat human trafficking/exploitation around the world, and our model is the first step towards fully comprehending and eventually eliminating this modern form of slavery.

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System Dynamics Model on Medicine Mobilization in Emergency

This paper reports the system dynamics modeling work on an unfinished project for medicine mobilization in emergencies, such as earthquake, flood, and the outburst of epidemic disease. A system dynamics model was under construction, supported by the input from experts in emergency response team, medicine producers, and logistics. In this paper, we briefly introduce the current version of the model. Even though the model has not fully completed yet, the model-building process and the simulation results of the model have identified the bottlenecks of the medicine supply in emergency and illustrated why some intuitive policies actually do not work in reality. Such insights will help to form high leverage policies to improve the medicine supply in emergency.

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The Limits of Discrete Modeling of Continuous Individual Dynamics: A Cautionary Tale from Immuno-Epidemiogical Dynamics

The gradual waning of immunity can have a substantial impact on spread of many common infections, and is important to represent in epidemiological models for those infections. Current representations of the gradual waning of immunity diverge widely, with implementations ranging from very popular dichotomous representation in classic mathematical epidemiology compartment models to detailed descriptions characterizing immune system dynamics in individual-level models. We sought to compare two simple models, one based on the traditional SIRS discrete representation, and the other based on an exponential loss of immunity. We then analytically solved these models and analyzed how much they differed. We found that these representations differed significantly, in measures such as the mathematical structures and the limits of the closed forms of the probabilities. These divergences suggest that there are major, perhaps difficult to reconcile, discrepancies between different methods of describing the same phenomenon of waning of immunity. These differences offer cautions to those who attempt to use, for example, a dichotomous model to represent a continuous phenomenon such as the loss of immunity.

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Might Continued Emphasis on Maize at the Expense of More Drought Tolerant Crops Endanger Food Security in the Horn of Africa?

Maize is widely grown in Africa including in drier areas where alternate crops will often perform better. Although maize will fail in drought years, it produces substantially higher yields than alternates, like sorghum and millet, in wet years. Although people tend to select which crops to grow based on recent experience with crop harvests and market prices, there is a widespread preference for maize even in areas where planting it is risky. This can lead to crop failures when rainfall varies from year to year. Introduction of higher yielding maize varieties might, under some conditions, cause increases in food shortages by further incentivizing the planting of maize in inappropriate situations. A preliminary model helps to investigate this and related issues.

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Resilience, Environmental Variability, and Institutions in a Multi-Species Artisanal Fishery

Social-ecological resilience is an increasingly central paradigm for understanding sustainable resource management. While previous works on resilience have observed that sudden shocks or gradual stressors may force a system over a critical threshold, natural variations may have similar results. This paper aims to better understand the effect of environmental variability on the resilience of fishery systems, and the important role that social institutions play. To explore these issues, we build a System Dynamics Model of the mollusc fishery of the indigenous Seri people in the Gulf of California, Mexico. This model includes the dynamics of the two dominant species of penn shell in the fishery (Atrina tuberculosa and Pinna rugosa), several institutional rules that the Seri use, and a number of key stochastic variables derived from empirical data. We find that modeling with multiple species, rather than the standard one-species model, uncovers more resilience in the system. However, while we expected stochasticity to be detrimental to resilience, we find that endogenous environmental variability can also increase resilience. We examine possible reasons for this finding, and discuss additional insights our study revealed about managing multiple-species artisanal fisheries.

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iSimPlus: A Multi-Method Simulation Tool for Modelling Complex Systems

Simulation provides a means to gain insight into the past behaviour and future trajectories of complex social systems. The simulation process is one of discovery: individual mental models are communicated, formalised, and simulated under a range of scenarios. There are two main approaches to social simulation: system dynamics, centred on the feedback perspective, and agent based computational modelling, which uses the individual and their interactions as the basic building block. This short paper describes a new simulation tool that can accommodate both perspectives, and where all model building is achieved using an equation-based approach. The system design is summarised and an example based on the SIR model is described.

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SD for assessing electricity market integration

Integration of electricity markets has started expanding under economic liberalization world-round. While some regions are managing better than others, lessons, both political as well as technical, highlight major challenges ahead to overcome. As in recent years, Panama, Colombia, Ecuador and Peru have decided to integrate their electricity markets; this will eventually create an enormous Latin American electricity exchange from Mexico to Chile. We developed a system dynamics model, linked to an iterative algorithm, to assess the likely effects of integration on both system expansion and security of supply. The model helps understanding the logic of the long-term system behavior under different policies, assuming Market Coupling as the dispatch mechanism. After analyzing simulations results under different scenarios, we conclude that integration of electricity markets may render great benefits regarding security of supply and efficiency; and consequently energy might be supplied at lower prices, using cleaner technologies. However, benefits largely depend on policy, regulation, and technical issues.

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Investigating an Automated Method for the Sensitivity Analysis of Functions

Automated sensitivity analysis approaches in system dynamics focus primarily on model parameters. Although table functions are often subjectively approximated, they do not form the focus of most sensitivity analyses. Recently, a promising approach that allows automation of sensitivity analysis on functions was proposed by Hearne (2010), but the applicability of this method to system dynamics table functions has not been studied, yet. In this study, the new method is applied to a simple system dynamics model. In the light of the observations a number of shortcomings are identified and a set of extensions to address these are proposed and then tested. The results of experiments with the original and the extended method demonstrate that the method can be used easily and efficiently for table functions. The extensions are shown to be valuable in creating a more comprehensive method, but they also raise the research issue of the trade-off between their added value and the cost of dealing with increased complication. Apart from our experimental results, the article also puts forth a set of directions along which the approach can be improved further. Despite the issues requiring further research, the method holds promise for routine implementation.

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System Dynamics Model for the National Guard Chemical, Biological, Nuclear, and High-Explosive Enhanced Response Force

From June through October 2008 the National Guard Bureau (NGB)J8 conducted a capability based assessment (CBA) to determine National Guard (NG) capability gaps for Defense Support to Civil Authorities (DSCA). A major DCSA mission that the NGB Capability Assessment and Development Process (CADP) focused on was Chemical, Biological, Radiological, Nuclear, and high-Explosive Consequence Management (CBRNE CM) response. As expected, the most difficult portion of the CBA was defining and quantifying the gap in NG specialized CBRNE CM capabilities (CERFPs). Initially, NGB developed a simple allocation model that captured the total number of CERFPs employed based on subject matter expertise. However, NGB-J8 developed a more objectively quantifiable model that would systemically document and consistently apply assumptions. Repeatability was essential to defining and quantifying NGB CBRNE CM capability gaps. NGB-J8 determined a System Dynamics Model would be the best approach for developing this model.

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Dynamics of Combat Aviator Training

This paper presents an application of system dynamics to understand the behavior of the AH-64 Advanced Aircraft Course at the U.S. Army Aviation Center of Excellence. This course trains Army lieutenants and warrant officers as combat aviators. In the last several years, a large bubble of students awaiting the different phases of training has developed because of organizational and process problems within the course. This paper presents a system dynamics model of the course and recommends policy changes to eliminate the backlog of students awaiting training. The model incorporates both the organizational aspects of the course, including personnel and equipment; as well as the processes within the course. Base on output from the system dynamics model, the best course of action for the

U.S. Army Aviation Center of Excellence is to add additional days to the course to account for weather and increase the number of hours available for training on a daily basis. This policy enables the center to eliminate the bubble of students and stabilize the process of training combat aviators.

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Houdini: a System Dynamics Model for Housing Market Reforms

This paper describes work in progress on Houdini: a system dynamics model of the Dutch housing market focused on explaining institutional structures leading to high price increases and obstructing new supply and on proposed reforms. The model is largely based on extensive literature on the woes of the Dutch housing market and was reviewed by a well-established expert panel, consisting of representatives of universities, ministries and national research and policy analysis institutes. The core model structure has its foundation in the diPasquale and Wheaton real estate markets model, an implicit system dynamics model. We report on the Houdini model structure, validation, base run, policy experiments and follow up activities.

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An Explanatory Framework for the Growth of SMEs A System Dynamic Approach

This study aims to develop an explanatory framework for the growth of small and medium enterprises (SMEs), which is a concept that has not been adequately developed in literature. Various models in literature were reviewed and critiqued - with a special focus on the stages model; additionally, greater understanding of the nature of the growth of SMEs has been elicited from the mental models of domain experts. A case study of a fast-growing small to medium enterprise was conducted; and a full-fledged simulation model was crafted by integrating experts mental models with the currentstateof theartin scientific theories. The model was validated against various reference modes. Finally, a future research road-map based on various case studies was proposed to further enhance and corroborate our framework.

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SD simulation for assessing biofuels incentives

Biofuels have become a good economic, social and environmental alternative to fossil fuels. Policies and incentives have been design aiming at their rapid supply and demand penetration worldwide. However, in Colombia, the proposed goals have not been met yet, and the fuel mix program initially proposed by the government has suffered changes. This article assesses, using an SD model, alternative policies and incentives and concludes that incentives such as the compulsory fuel mix and a price tariff (that covers a minimum opportunity cost) have a significant impact on biofuels production; these, contrast with VAT and income tax incentives, which have no significant impacting on production.

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Uptake of Alternative Energy Technology by Energy Poor Households in Rural Rajasthan, India

Nearly 3 billion people around the world use solid biomass, such as fuelwood and crop waste, for cooking and heating. The implementation of biogas, liquid petroleum gas, solar and other alternative energy cookstoves presents an opportunity to alleviate the burden of fuelwood collection and the health implications associated with inefficient biomass combustion while mitigating the negative ecological and climate effects of deforestation. Many governments and international development agencies have initiated programs to distribute alternative energy cookstoves, but the new technologies rarely achieve sustained use with consumers. While funds have been widely distributed to research the technical design of cookstove technologies, very little systematic research has been done to understand and improve implementation and use of the technologies in the complex markets they target. One such market is the rural poor village. This paper describes the development of a system dynamics model of the implementation of biogas cookstove technology in villages of Rajasthan. Through field visits and an iterative modeling process, our team (consisting of two Systems Engineering undergraduates and a Social Work professor) investigates the drivers of adoption and abandonment of biogas in such villages. At the current modeling stage, we find the incidence of unit failure to be a key factor in hindering the acceptance of biogas technology.

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Resource coordination and Business Model Renewal process. A System Dynamics analysis of the Aluminium Downstream Industry

The paper is focused on processes of strategic position renewal and business model redefinition. In particular it explores the effects of resource coordination mechanisms between firms and their strategic suppliers. The paper presents a System Dynamics model built on an extensive empirical set represented by the Italian window industry and it explores business model renewal of aluminium window producers coordinating their strategies with aluminium systems suppliers.

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Effects of Food Availability Policies on National Food Security: Colombian case

Food security is a problem that affects population worldwide, mainly in developing countries. Due to the multiple interactions, the process of decision making to tackle this problem is becoming increasingly complex. This research explores the food availability system of a country, as a constraint to meet the basic food needs. Through System Dynamics, it is possible to understand its structure and effects of policies to help alleviate the problem.

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Development of an Agent Based Epidemiological Model of Beef Cattle

We began to develop an agent-based epidemiological model of animal disease propagation within the beef and dairy industries. Model development was done in context of a consortium of interested parties including the New Mexico State

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University (NMSU) Extension Service, the New Mexico Livestock Board (NMLB), ranchers representing the beef industry, and farmers representing the dairy industry. The model required a thorough understanding of the life cycles for commodity livestock, especially the transportation and mixing that occurs as part-and-parcel of how production and commerce is practiced. Once this detailed network of animal movement and interaction is articulated within the model, we can simulate the introduction of disease at any given location and track its propagation. The model will serve to understand how inter-operation transfer of livestock can impact the likelihood and magnitude of infectious disease outbreaks. With this understanding, the cost-effectiveness of current and proposed prevention and monitoring strategies, as well as mitigation strategies, can be assessed. Our first focus for model application may be the propagation of bovine tuberculosis (TB) in beef cattle. In subsequent work, we would like to expand the computational model to include dairy cattle, and to consider the propagation of other diseases such as foot-and-mouth disease (FMD) and Rift Valley fever.

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A System Dynamics Approach in Water Resource Management and Government Subsidy Policy: A Case Study of Tajan Basin in Iran

After announcing the fuel rationing policy in 2008, government decided to eliminate subsidies in order to manage consumption of natural resources. Thus, a cashing subsidy policy has been applied since end of 2010. In first stage, different kinds of energy and resources like water were considered. Government's plan was to pay subsidies directly to consumers. In this paper, we focused on the consequences of removing water subsidy in Tajan, an area in the north of Iran. We modeled different ways of water supply and demand in Tajan by concepts of system dynamics. We tried to show the effects of cashing subsidies policy in municipal demand of water in Tajan and examined two kinds of implementing this policy. In the first strategy, water price is increased smoothly over modeling horizon which is considered to be 24 months. While in the second one, price is increased suddenly in the first month, exactly similar to the way the government has done. We designed third strategy in which no subsidy elimination happens and prices increase according to inflation. A water surplus indicator was considered for comparing these strategies which was calculated by decreasing water supply from its demand. First strategy was shown to be best one.

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Improving Health Care Management Through the Use of Dynamic Simulation Modeling and Health Information Systems

To better understand the performance of hospital operations in response to IT-enabled improvement, we report the results of a system dynamics model designed to improve core medical processes. Utilizing system dynamics modeling and emerging Health Information Systems (HIS) data, we demonstrate how current behavior within the hospital leads to a stove-pipe effect, in which each functional group employs policies that are rational at the group level, but that lead to inefficiencies at the hospital level. We recommend management improvements in both materials and staff utilization to address the stove-pipe effect, estimate the resultant cost-saving, and report the results of a new experiment conducted in the hospital to validate our approach. We believe that the major gains in health

information systems use will accompany new information gathering capabilities, as these capabilities result in collections of data that can be used to greatly improve patient safety, hospital operations, and medical decision support.

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Problem Structuring Methods in System Dynamics Modeling: a Cognitive Fit Perspective

The knowledge residing in the mental models of clients and stakeholders is considered as a crucial source of information by system dynamicists. Despite the importance of this knowledge, the theory of SD does not provide practical means for eliciting and recording it. Thus, several methods known as problem structuring methods (PSMs) have been developed and employed in the SD community to facilitate the problem situation conceptualization in group model building (GMB). Despite the growing body of literature on the application of the PSMs, limited work has been done on assessing and comparing the relative usefulness of PSMs in terms of their potential impact on problem-solving performance. In this paper, by invoking Cognitive Fit Theory, we develop a set of propositions for the analysis of the impact of PSMs on problem-solving performance. We then briefly look at two of widely used PSMs in GMB, through the lens of these propositions, indicating a number of improvement opportunities. Finally, we present Systemic Enterprise Architecture Method (SEAM) as a PSM that visually facilitates the problem situation conceptualization. We explore the usefulness of SEAM in terms of the theoretical findings on problem solving with cognitive fit by demonstrating a typical application example of problem situation conceptualization in a GMB effort.

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What Is a Validation Methodology? Analyzing and Synthesizing two Meanings

In the domain of system dynamics and computational modeling, the assurance of model validity is a prominent challenge. A number of contributions concerning validation tests, processes, and their epistemological foundations have been developed. Considering the existing literature on validation, little has been said about a validation methodology for system dynamics models. This paper differentiates two meanings of methodology which are referred to as methodology I and methodology II. The first meaning refers to a body of methods. This understanding has almost exclusively been adopted in the field of system dynamics. The second meaning refers to a comprehensive understanding of elicitation, description, reflection, and evaluation of issues related to validation which are currently lacking. This papers contribution is in analyzing the two meanings and synthesizing them in a conceptual model. The conceptual model is used to derive directions for future research as well as actions required bring the field forward. The paper ought to raise the attention of researchers for validation and commence a beneficial discussion.

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Measuring Dynamic Complexity: A Standardized Measure for System Dynamics Simulation Models

Dynamic complexity is an important aspect of the realm of management. It is present, i.e., when an action has one set of consequences locally and a different set of consequences in another part of a system. Dynamic complexity is best captured and analyzed by ordinary differential equation (ODE) models of the

system dynamics type. Measuring an ODE models degree of dynamic complexity approximates the dynamic complexity of a real system. However, no approach exists for measuring this concept. Here, the paper contributes with three measures. These measures yield the following benefits: First, one can inspect the degree to which a model is able to endogenously generate dynamic behavior and therefore capture the degree of dynamic complexity. Second, one can evaluate and compare the property of a quantitative model to endogenously generate its behavior. This feature enables researchers to filter out more parsimonious models. Third, these measures can be used to enhance the validity of simulation models, e.g., by reporting it in publications. And finally, they can enliven discussions about dynamic complexity. The paper develops these measures by means of a cascade of examples. The conclusion discusses limitations as well as future research.

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"10 years on average doesn't mean 10 years in any case" – an Experimental Investigation of Fixed and Continuous Delays

The purpose of the paper is to test whether people make different decisions when a task requires either a fixed delay or a continuous delay conceptualisation. With the help of a structurally simple dynamic decision making task, we test two conditions in a controlled experiment: hiring when personnel stays in an organisation for exactly ten years (fixed delay condition) or when personnel stays on average for ten years (continuous delay condition). In this preliminary study, 71 participants were tested. Findings so far show no differences in performance between the groups, indicating that they most likely use the same cognitive representation of the task. Since participants answers are substantially closer to the fixed delay condition, we assume that people have the tendency to conceptualise lags in the form of discrete delays, at least in the context of personnel hiring. Research implications comprise the repetition of the experiment to achieve a higher number of participants and to allow for a more extreme differentiation between the two conditions. Practical implications regard the formulation of decision making tasks within organisations, for instance in human resource management. The value of this paper lies in its rigorous usage of a structurally simple dynamic task to shed light on a fundamental trait of human decision making.

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Coordination Failures in Complex Environments: A Model for Primary Education Systems in Developing Countries

This article aims at improving our understanding of the processes influencing achievement in primary education systems. We do so using a dynamic simulation model that incorporates local idiosyncratic complexities such as positive feedbacks and nonlinear coordinated interactions between key variables like aggregate human capital and their effects on the efficiency and vulnerability of primary education systems in developing countries. We perform a number of experiments which offer valuable insights to understand the long-term impact of large-scale events on the systems steady-state equilibrium and suggest institutional structures and social norms that may promote a sustainable transition toward achieving universal primary education.

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Exploring the Future of Wind-Powered Energy

Although there is a trend towards more sustainable energy system, the future of renewable energy is still deeply uncertain. The future of each renewable energy technology such as wind power is even more uncertain. So what may be, in the presence of deep uncertainty, the future of wind power? This question is addressed by means of Exploratory System Dynamics Modeling and Analysis: parametric uncertainties, structural uncertainties, and model uncertainties (different System Dynamics models) related to this question are explored and resulting ensembles of plausible futures are analysed. Analysing parametric and structural uncertainties in isolation may not be thorough enough for a complete uncertainty analysis. So, model uncertainty should also be considered to be able to explore all plausible futures. The main purpose of this paper is to illustrate the exploration of model uncertainties, together with parametric and structural uncertainties.

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Privatization; Iran Power Industry As A Case Study

As it can be observed in developing countries trend, in these countries there is a huge government possessing enormous money and also cash flows in these countries are mainly within governmental organizations rather than non-governmental (private) sector. Plainly, this trend will not be favorable for those countries and will lead to economical downturn after a while, because given the weakness of private sector; the competition for market share will begin to wane, leading to good quality decline. Consequently investors will lose their motivation for investment and production drop and unemployment rise will be the inevitable consequences. As a result, putting in an effort to foster the process of privatization is one of the most important goals in these countries. Privatization should take place in many fields including electrical power supply. In this paper we will investigate the privatization trend in electrical power supply industry in Iran as a case study and we will also analyze the effect of influential parameters on this trend. At the end, some policies are suggested to accelerate the process and their results are probed.

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Economic Dynamics for Smarter Cities

The economy is studied at all scales, from micro to macro. With global trends toward rapid urbanization, one abstracted scale of the economy will become increasingly important to understand, that of a city economy. Working in close cooperation with the urban planning staff of a US city, the authors developed a system dynamics model of a city as a complex, adaptive, system of system. The economy sector of the model is distinguished by its incorporation of the citys highly porous boundaries and unification of multiple definitional approaches to the key measure of City Gross Domestic Product. The result is a system thinking tool for policy makers to explore the relationships between citywide, policy-initiated changes and the structurally determined performance of the city economy.

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Simulating an Auction Market: The Effect of the Number and Aggressiveness of Bidders

Economists have documented well their analytical approach to determining optimal pricing strategies and market efficiencies for a host of market types, including the spectrum of auction markets. While it is impressive and certainly yields optimal bidding strategies (for the given set of assumptions), the mathematics underlying these analyses does not necessarily reflect how actual participants in such markets make bidding decisions. This paper presents the results of a simulated sealed bid, first price, private value multi-round auction. Auction participants follow a relatively simple algorithm for determining their bid. The number of bidders and their determination to earn the item up for auction (their aggressiveness) is varied in order to explore the impact these parameters have on auction efficiency. The results show that both the number of bidders and their aggressiveness have dramatic impacts on both price and auction efficiency. The number of bidders is a factor in most analytical solutions. Aggressiveness, like other behavioral factors, is less common. While it informs auctioneers that having more bidders will generate higher prices and greater revenue, traditional analysis does not typically discuss bidder aggressiveness.

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A Model of Bone Loss Dynamics Due to Disuse and Overload

Bone tissue has the ability to adapt to its changing mechanical environment. Bone mass is altered by the remodeling process in response to underloading and overloading conditions. The usage history of bone is the main determinant of its health and stiffness. In this paper, the two loading conditions; disuse and pathologic overload, has been studied. A dynamic simulation model is contructed to reproduce the mechanical loading effects on bone mass. In scenario analysis, underloading accelerates bone resorption and bone mass reaches a new lower steady state. Overloading stimulates bone resorption too and decreases the bone mass to remove the damage. However, while remodeling locations increase, strain also increases, so in time damage is accumulated. This model can serve as an experimental tool to study the mechanical loading conditions as well as some therapeutic interventions to prevent bone loss in severe underloading or overloading conditions.

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A Simulation Model for Designing Effective Interventions in Early Childhood Caries

Dental caries in primary teeth of children 5 years of age or younger is one of the major health problems in the United States, especially for low-income children. This paper presents a framework for assessing the impact of various programs designed to reduce the prevalence and consequences of Early Childhood Caries. The paper describes a System Dynamics simulation model of the population of children 0-5 years old in Colorado. Results of simulations with a number of individual interventions and combined strategies are presented and program costs and savings in treatment costs are compared.

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The barrier-based system for major accident prevention: a system dynamics analysis

Only a few months apart, two offshore oilwell blowouts in different parts of the world resulted in controversy about the safety of offshore oil and gas drilling. Both led to formal enquiries. They were also eerily similar in their technical causes. The key difference between the two events, (the Montara blowout in the Timor Sea, Australia and the Deepwater Horizon incident in the US Gulf of Mexico) was one of consequence. By chance, the Australian incident had fewer immediate consequences; there was no loss of life and apparently less damage to the environment. This paper applies systems thinking and system dynamics to explore the barrier-based system of major incident management, the so-called Swiss cheese model of Reason (1997). We highlight counterintuitive features inherent to the system. We find that the number of barriers alone does not determine the effectiveness of the safety management system. Proper monitoring and understanding are vital. We also examine the impact of management and reporting focus. These insights lead us to make specific recommendations on the design and implementation of the safety management systems used by the oil and gas industry as a key pillar of their incident prevention policies.

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A Dialogue Game for Group Model Building

We present a novel approach to analysing and structuring the process of Group Model Building (GMB) in a collaborative modelling context. Collaborative modelling is the goal-driven creation and shaping of models that are based on the principles of rational description and reasoning. Our long term goal is to use communication analysis as a basis for improvement of GMB and the development of dedicated interactive support environments for GMB. In the paper we present our theoretical approach to the systematic analysis of GMB session setups and their framing as 'dialogue games'. We then present an evaluated prototype of a dialogue game for GMB: an operational on-line environment for constrained and guided GMB conversations. We pay special attention to the role of the Facilitator in the dialogue game.

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Whose Model is it Anyway?

Participation by stakeholders in developing system dynamics models holds much appeal, but what we mean by participation and model varies greatly. This can create ambiguity and confusion about what is meant by participatory modeling, especially in projects involving multiple stakeholder groups and modeling stages with different types of models. More specifically, questions can arise about whether the results were based on true participation and the degree to which model based insights and recommendations were based on the participants model or the expert modelers version of social reality. In this paper, we argue that the confusion arises from imprecision about the different types of models we use in system dynamics for theory specification, operations we apply in developing models, and relationships between different types of models. To address this imprecision, we propose a formal framework for specifying different types of models that can arise in a participatory research, and illustrate the approach through a series of case examples from previous and ongoing system dynamics

research on childhood obesity, nonprofit organizational performance, and household economic security. Implications for future research in participatory modeling and the use of system dynamics diagraming are also discussed.

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Scriptapedia: A Handbook of Scripts for Developing Structured Group Model Building Sessions

This paper describes a handbook of scriptsScriptapediafor developing structured group model building sessions. Andersen and Richardson (1997) have identified the importance of standardized protocols or scripts in group model building (GMB). GMB scripts have historically existed as undocumented structured small group exercises. Scriptapedia represents an effort to improve the practice of GMB as well the research into GMB effectiveness. We describe elements of scripts, case applications of Scriptapedia, and discuss uses, misuses, and misunderstandings of scripts. The handbook is included as an appendix to the paper.

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The Use of Financial Products and Services in Low Income African-American Communities

This poster summarizes a project designed to explore the complex social system that influences households decision to use banks and other financial institutions. The dynamic hypothesis was that the number of unbanked and under banked African-Americans in the region was due to a complex interaction of individual behaviors, banking policies and practices, and those of the payday lending industry. The project was designed to develop a grounded theory describing households experiences related to financial institutions and how financial decisions based on previous experiences impacted their household economic security. Group model building methods were used to gather insights from banks, alternative financial institutions, and community residents.

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Analyzing complicated behavior of competitive advantage

Competitive advantage doesnt sustain for a long time. The reasons are different from several viewpoints. This study uses system dynamics approach to explore the complicated behavior of competitive advantage. System thinking loops and high leverage answers are found including two balancing loops (Strategic intent establishing balancing loop-B1and Resources establishing balancing loop-B2) and one reinforcing loop (Motivation influences core competence reinforcing loop-R3). Behavior improving strategies are suggested as follows: 1.Vibration behavior of competitive advantage is the result of time delay. Shortening time delay can quickly establish new competitive advantage. 2.New competitive advantage also comes from enough strategic formation. Strategic formation must be emphasized. 3.New strategic intent must overcome the resistance of present core competence.

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Dynamics of Shared Capitalism Policies

Shared capitalism is a set of compensation practices (e.g., employee ownership, stock options, and profit sharing) through which worker pay, or wealth, depends on the performance of the firm or work group. Empirical studies on whether employee ownership improves firm performance, while predominately positive, offer mixed results. This paper addresses the question: under what conditions do shared capitalism policies improve firm performance? A system dynamics model of high performance work systems estimated using the NBER Shared Capitalism dataset and calibrated to a clean technology startup company is presented. The model posits explicit causal mechanisms to explain how various shared capitalism policies and human resource practices influence employee behaviors that drive business processes, and how those business processes interact with market conditions to generate firm performance. Simulation analyses demonstrate that employee ownership and profit sharing create and mediate the strength of multiple reinforcing feedbacks linking firm performance and employee behavior. The more wealth is shared through broad-based employee ownership, the more wealth is created, given the appropriate conditions. Policy analysis suggests how mutual gains for owners and employees can be attained through a balance of salary, stock grants and other shared capitalism policies.

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Web-based Participatory System Dynamics Modelling – Concept and Prototype Development

In this paper we present our concept and prototype of a web platform which supports participatory modelling. This platform facilitates web-based collaborative and cumulative modelling when face-to-face participatory modelling sessions cannot be organized as often as desired. Successive iteration steps of the model development can thus be displayed interactively in a standard web browser together with comments and explanations made by the modeller. The platform strengthens the support of formal model construction and documentation on the one hand and reduces the effort of model re-publishing on the other hand. This platform shall be used to support participatory modelling and decision-making processes in the field of sustainable development and in many other fields.

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A System Dynamics Approach to Examine Climate Change Impacts: The Case of the State of Guanajuato, México

Global climate change is affecting the rain-runoff process around the world since pre-climate change normal rain patterns are giving way to short periods of strong precipitation, followed by long periods without rain. In addition, temperature and evaporation are expected to increase about 20% over the next 20 years. The State of Guanajuato in Central Mexico utilizes 87% of all available water for agricultural production and is extremely concerned about the impacts of climate change on water supply and demand for its various uses in the short and medium term. To explore the future impacts of climate change in Guanajuato a two-component approach was developed: (1) an atmospheric interface that generates synthetic precipitation, temperature and evaporation time series; and simulates the characteristics of these three meteorological variables and (2) a system dynamics model that beginning with the rain-runoff process generates time related behavior for natural and man-made process for each of 13 watershed that make up the

States geography. Base Line and Climate Change scenarios have been generated from the present through 2030 to examine the impacts that this phenomenon is having on each watershed; recommendations have been drawn to assist these areas in adapting to new climate conditions.

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Documentation: Recalling the Forgotten Important

From the limited experience expected from an entering practitioner, I found myself in trouble when documenting the results of my participation in a System Dynamics consultancy. While looking for previous work related to documentation at the System Dynamics Review, I realized: (a) no single paper has been fully devoted to discuss how a proper documentation of models should be, and (b) an important fraction of the papers reviewed lacked full documentation of the model and the methodology used to build it, providing few hints into how to document an SD model. Based on existing literature and my experience as a software engineering consultant, a framework that structures a modeling process in terms of phases, workflows, activities, actors and artifacts is introduced as a vehicle to provide supporting information for adequate model documentation. Also the concept of automatic inline documentation generation is introduced to overcome the problems produced by incompatibilities among simulation packages. Four main documents are suggested as the result of the proposed documentation framework. The application of such framework can improve quality of documentation delivered to clients; help building a guide for new practitioners based on accumulated experience and ultimately promote the continued development of the field.

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Modeling Cases from Jared Diamond's "Collapse"

Throughout history some societies, including the Maya, Anazi and Easter Island, have collapsed, while others facing similar challenges, such as New Guinea and Japan, have succeeded. The Maya and New Guinea cases were taken from Jared Diamond's study, "Collapse," to create a system dynamics model capable of producing both the collapse and success behavior. The endogenous pressures described by Diamond were used to develop the feedback story. Policy interventions undertaken in by the society in the model were controlling family size, increasing farming intensity, reducing resource usage and composting. In the initial attempt the society enacted these interventions in response the cues of food shortages, perceived environmental degradation and falling crop yields (an indicator of soil quality). However, this version of the model was incapable of creating the success behavior mode, ruling out these cues as ones successful societies could have used. In version two, the society used a target land fraction occupied as its main cue and the gap between needed food production per acre and actual food production per acre as the drive to increase composting. This version was able to produce success behavior, which establishes these cues as possible cues a successful society could have used.

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Supporting decision-makers in managing stock-flow problems: The effects of oral feedback on reasoning and decision-making

This paper broadens the scope of traditional stock-flow experiments because for the first time the focus is both on product (task solutions) and process (reasoning process). By using a think aloud protocol, insight is gained in the reasoning

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processes of 8 participants in the female professors systems thinking inventory task. This knowledge is used to identify patterns and deficiencies in decision-makers ability to manage simple stock-flow problems and to propose measures to improve this. Furthermore, the effects of elaborate oral feedback on the quality of participants reasoning and ability to solve the task are assessed. The experiment shows that the most important reason for failure in managing stock-flow problems is decision-makers lack of familiarity with the concept of average delay time for determining the outflow of a stock. Furthermore, the oral feedback is found to be effective for creating insight in simple stock-flow problems, although use of supporting tools like a spreadsheet is essential for gaining full insight and for successful management of the stock-flow problem.

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A Framework for Analysis of Energy-Water Interdependency Problems

The overall objective of this work is to improve the holistic value of energy development strategies by integrating management criteria for water availability, water quality, and ecosystem health into the energy system planning process. The Snake River Basin (SRB) in southern Idaho is used as a case study to show options for improving full economic utilization of aquatic resources given multiple scenarios such as changing climate, additional regulations, and increasing population. Through the incorporation of multiple management criteria, potential crosscutting solutions to energy and water issues in the SRB can be developed. The final result of this work will be a multi-criteria decision support tool usable by policy makers and researchers alike that will give insight into the behavior of the management criteria over time and will allow the user to experiment with a range of potential solutions. Because several basins in the arid west are dealing with similar water, energy, and ecosystem issues, the tool and conclusions will be transferrable to a wide range of locations and applications. This is a very large project to be completed in phases. This paper deals with interactions between the hydrologic system and water use at a basin level. Future work will include the interdependency between energy use and water use in these systems.

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Coca Farming Dynamics: The Colombian Case

During the last 20 years, Colombia has had a reputation for being one of the largest producers of coca in the world. However, even when the Colombian cartels ruled the market and were the most innovative and aggressive suppliers, they were not always the largest producers. This work describes the rise and fall of the Colombia coca farming industry, understanding the dynamic of the illegal markets, and the role of the law enforcement. Using a system dynamics approach, and the elements of the economic theory of the criminal firm, our work finds that one of the main causes of the coca farming rise might be attributable to a counterintuitive policy against the dominant cartels monopoly. As well as the legal markets, in the illegal ones, an increase in competence means an increase in production resulting in decreased prices.

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A System Dynamics Approach to Macroeconomic Policy Evaluation - The Case of the German Debt Brake

In the aftermath of the expansive fiscal policy stimuli dealing with the consequences of the world financial crisis of 2007/2008 the public indebtedness

around the world has increased dramatically. As a consequence the world-wide interest in policy measures to limit and reduce public debt has increased drastically. In Germany the parliament has altered the constitution which encompasses now a new article regarding a seemingly tight debt rule. In many member states of the EU and around a political discussion has started whether the German debt rule could serve as a guideline. This article explains the German rule and analyses its effects by employing system dynamics methods. The mainly qualitative analysis demonstrates that the German debt rule has important shortcomings and that there are severe side effects which have to be addressed by public policy.

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Dynamic Model for Estimating the Added Value of Maintenance Services

A dynamic model of maintenance services is presented in this paper. The focus is on the service (i.e. value co-creation) perspective and the main purpose of the model is to facilitate the understanding of the added value of services. Determining the monetary value of services is important since the pricing of services is based on the value rather than on the cost. The modeled services vary by their complexity and their effects on the system. The model was built to be a communication tool for customer and the service provider to enable shared understanding of the system and the effects of different collaborative services.

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A generalized growth model for strategic analysis

This paper presents an adoption model where the rate of adoption is disaggregated into three components, and feedback paths to each component from three stock variables. The strength and sense of the feedback loops are expressed as elements of a 3x3 matrix easily varied. The model is a generalization of an analysis of growth in a local photovoltaic market (Jones 2008). Informants in that study had a variety of opinions on the net strength and valence of feedback paths incorporating multiple effects. A strategy that depends upon reinforcing feedback (returns to scale, learning curve, get big quick) can be adopted when the mechanism is poorly articulated or poorly understood. This model acts as a framework for analysis of such situations.

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Assessment of the job creation potential of South Africa's Automotive Investment Allowance using a system dynamics model

Job creation has been a key motivation for the continued offer of incentives to South Africas automotive industry. After more than a decade of incentives offer under which jobs were largely sustained, government has come up with a new programme named Automotive Production Development Programme. Automotive Investment Allowance (AIA) is one of the incentives under the new programme. Against the background of concerns that previous benefits received by the industry were not commensurate with jobs created, an assessment of job creation potential of AIA is done using a system dynamics model. Preliminary findings indicate that at best the AIA can only sustain, but not create jobs. The incentive reduces the cost of machinery and equipment relative to cost of labour,

leading to firm substitution of labour for capital equipments. The AIA in isolation is a weak policy intervention to support job creation South Africas automotive industry.

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A Multi-scale Paradigm to Design Obesity Policy: Exploring the Integration of Individual- Based Modeling and System Dynamics

Complex adaptive systems-of-systems are inherently multi-scale across several dimensions, including temporal, geographical, and organizational. We present a multi-model paradigm integrating a localized community-scale individual-based model (IBM) with a population scale system dynamics (SD) model to analyze long term results of potential policy interventions for obesity prevention. The IBM uses virtual agents embedded in a social network to simulate the spread of opinions relating to nutrition and physical activity (N&PA) behaviors such as dieting and exercise, and the effects of these opinions on individual behaviors. The network structure uses a mixture of scale-free and uniformly random connections to represent a social network of relationships and interactions within a local community. The N&PA related health behaviors of individuals change dynamically relative to endogenous influences within their social network and exogenous influences from industry-based advertising and public health-related educational policies. The outputs of the IBM, seen as changes in obesogenic (N&PA unhealthy) behavior prevalences, can be used as inputs to a SD model to calculate the resulting changes in mortality and morbidity over the ensuing decades. We analyze and compare effects of possible policy interventions, and illustrate a policy cocktail that addresses multiple aspects of the obesity problem, resulting in amplification of desirable results and a strong uncertainty reduction.

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Understanding Innovation Diffusion in the Presence of Supply Constraints and Price Feedback: The Case of the Toyota Prius

Despite the extensive literature examining the diffusion of innovations, few have considered the effect of supply constraints on the diffusion process. Here we extend existing theories of diffusion under supply constraint to capture price dynamics, accounting for both waiting lists in the presence of excess demand, and discounting in the presence of excess supply. The model is tested against the case of the diffusion of the Toyota Prius hybrid-electric vehicle in the United States, quantifying the relative contribution of marketing and word-of-mouth to the development of familiarity with the Prius, and explaining both persistent waiting lists over many years and discounting against the Manufacturers Suggested Retail Price (MSRP) in recent times. We find that inclusion of endogenous wait lists and discounting significantly improves model explanatory power and alters the contribution of marketing and word-of-mouth to the diffusion process.

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A Taxonomy of System Dynamics Models of Educational Policy Issues

A number of papers have been published describing various System Dynamics (SD) models of various Education institutions and issues, on topics including the role of SD in Corporate Governance, Planning, Resourcing & Budgeting, Teaching Quality, Teaching Practice, Microworlds and Enrolment Demand. This

paper builds on previous papers by this author that provided a catalogue and classification of this work in order to highlight potential areas of research in this field of study and to identify system archetypes at different hierarchical levels and discover new ones. The findings from these investigations are briefly described.

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A Taxonomy of System Dynamics Models of Educational Pedagogic Issues

A number of papers have been published describing various pedagogic techniques for the dissemination of the System Dynamics (SD) approach at various Education institutions and academic levels ranging from schools (K-12 in the US) to higher education. This paper builds on previous papers by this author that provided a catalogue and classification of this work in order to highlight potential areas of research in this field of study and to identify system archetypes at different hierarchical levels and discover new ones. The findings from these investigations are briefly described.

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"Counterintuitive Ways Of Doing More With Less" – An SD Contribution To The Urban Water Crisis in the Global South

In urban areas across the developing world, access to water, particularly for drinking and other domestic uses, has now become a critical issue. Indian cities, perhaps as well as any, exemplify the social, environmental, economic and political problems that arise when this essential, life-supporting resource becomes scarce or unaffordable. The most common way of rationing water demand in India is to limit the hours of supply to a few a day; during the remaining time no water flows through the distribution system. This model will attempt to show that the existing "intermittent" system does more harm than good, whereas a continuously pressurized 24x7 water system, with proper metering and pricing, ensures equitable and reliable distribution, without the need of additional supply and has positive socio-economic impacts that are system wide.

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Mapping Standard HIV Disease Surrogate Markers to Alternatives ones: A System Dynamics Approach

Use of system dynamics (SD) methodology in modeling HIV/AIDS disease progression is not very new, however use of a triangulation of methodologies in form of the Dynamic Synthesis Methodology (DSM) to model the relationship between surrogate markers for monitoring HIV/AIDS disease progression for an individual patient is entirely new. This paper seeks to demonstrate the practicality of the use of a triangulation of methodologies called DSM combining SD and Case study methodologies to establish the relationships between HIV/AIDS surrogate markers so as to arrive at an appropriate model for monitoring the HIV/AIDS disease progression for a resource limited setting. The authors present an understanding of DSM and then describe the model development process, validation and analysis of the model to identify the dominant loops. The paper makes useful contribution in suggesting how DSM can be used in a clinical setting to enhance technology use in decision making for healthcare in a resource limited settings.

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Designing and Managing the Virtual Enterprise - A Breakthrough Application for System Dynamics Using SimBLOX and scmBLOX

Almost everything we use today is manufactured by a virtual enterprise composed of hundreds of companies. These large distributed systems have led to numerous problems and challenges across multiple industries. The need is great for an analytical technique to examine the performance of a large-scale virtual enterprise. System Dynamics has been successfully used to model these large enterprises and assess the impacts on system behavior of changes in demand and various parameters. These large-scale enterprise models, however, are complex and time consuming to build and are difficult to restructure. For enterprise management, the ability to reconfigure the network of companies in response to external forces is critical, and models of the enterprise must have similar flexibility and rapid re-configurability. Using System Dynamics agent models of factories, distribution centers and customers, scmBLOX uses drag and drop features that enable fast construction of enterprise models and rapid assessments of alternative enterprise structures. Replacement of a make-to-stock factory for a make-to-order factory or the addition or elimination of distribution centers can be quickly evaluated. On-going research is focusing on the interplay between enterprise structure and performance, the development of additional agent models and new features for current agent models, and the assessment of optimization strategies such as push-pull boundaries within the global virtual enterprise.

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Sociopolitical Factors Influencing Water Shortages in Maharashtra Nagar: A Qualitative Model from the 2011 Winter Institute

The Winter Institute is a two-week intensive experience hosted by the Tata Institute of Social Sciences (TISS) in partnership with Washington University in St. Louis. Through the Winter Institute, students use community driven system dynamics to engage community members in investigating social problems that affect their livelihoods. In January 2011, the second Winter Institute was held in Mumbai, India. A core modeling team consisting of students, CORO Fellows, and professionals from the non-profit, non-governmental agency Prayas worked with four slum communities to look at issues pertaining to water, solid waste, financial inclusion, and housing. This paper presents the qualitative model developed by the water team. The model emphasizes the sociopolitical factors driving water shortages and identifies community coordination, increased maintenance and repair of water infrastructure, and policies to redefine legal residency in slums as potential places for future interventions.

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Regional Economic Growth and Municipal Financial Planning: An Application of A System Dynamics Model to Calgary

Over the past two decades, Calgary a midwestern Canadian City of approximately 1 million inhabitants has experienced periods of rapid resource-driven economic growth and attendant municipal growing pains interspersed with periods of relative stasis. Effective municipal financial planning in this

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environment imposes profound challenges, particularly due to the presence of feedbacks, delays, non-linearities. To facilitate improved municipal financial planning, the City of Calgary has constructed the detailed multi-sectoral Calgary Impact Assessment Model (CIAM). CIAM whose structure draws inspiration from previous peer reviewed models includes an articulated representation of population demographics, migration, the labor market, the domestic and commercial property market and taxes thereon, infrastructure, finances, and the budget, recreational land, service levels, and quality of life. CIAM was parameterized using data from City databases and reports. Model construction incorporated a variety of best practices, and underwent a through a rigorous peer review. CIAM was subsequently calibrated to dozens of time series, leading to further model structural refinement and parameter estimation; the resulting model reproduces quite well a wide variety of historical municipal dynamics. CIAM has been used to investigate several scenarios important for municipal financial planning, and offers the potential to serve as an important decision-making tool for future city financial planning.

Providing structural transparency when exploring a model's behavior: Effects on performance and knowledge acquisition

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Prior exploration is an instructional strategy which has improved performance and knowledge acquisition in system-dynamics based learning environments, but only to a limited degree. This study investigates whether model transparency, showing users the internal structure of models, can extend the prior exploration strategy and improve learning even more. In an experimental study, participants in a web-based simulation learned about and managed a small developing nation. All participants were provided the prior exploration strategy but only half received prior exploration embedded in a structure-behavior diagram intended to make the underlying models structure more transparent. Participants provided with the more transparent strategy demonstrated better knowledge acquisition of the underlying model on an objective measure (multiple-choice posttest) but no difference on a subjective measure (open-ended verbal protocols based on short essay questions). Furthermore, their performance (managing the nation) was the equivalent to those in the less transparent condition. Combined with our previous studies, the results suggest that while prior exploration is a beneficial strategy for both performance and knowledge acquisition, making the model structure transparent in this way (with structure-behavior diagrams) is more limited in its effect and may depend on the participants level of expertise.

Measuring knowledge acquisition in dynamic decision making tasks

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When evaluating the effectiveness of interactive learning environments it is important to include measures of knowledge acquisition that complement measures of performance. In this paper we report on participants knowledge acquisition in a dynamic decision making task where participants learned about and managed a small developing nation. In the course of the experiment participants not only had to make decisions but also answer multiple-choice questions and short essay questions. The results suggest that participants had a fairly good understanding of the reinforcing nature of national development processes and of processes that are in close causal proximity to their decisions. On the other hand, participants largely failed to recognize nonlinearities, the

existence of the outflows to stocks and the proper treatment of delays with different durations. Knowledge acquisition was facilitated by the intensity of participants exploration activities during a simulation-based, guided exploration phase between reading textual instructions and making actual, simulation-based decisions.

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Dynamic model in understanding dynamics of competitiveness: system dynamics approach in mobile handset vendor business

Understanding firms competitiveness is the central goal in strategic management. The resource based view has emerged as the main theory explaining performance differences between firms. However, a significant amount of criticism has been raised against the theory, and the validity of the theoretical framework has been questioned. These questions have become stronger as there is a lack of credible empirical validation due to the problematic concepts and measures used in the theory. Dynamic RBV theory has emerged to overcome challenges in the traditional RBV theory but the new theory has proven to be challenging to implement as it sets new challenges for the used research methodology. In this study, system dynamic simulation was used to overcome these challenges in an empirical case study on the competitiveness in the mobile handset vendor business. The results from simulation give support for both the created dynamic RBV framework, but also to the suitability of system dynamic simulation as a tool in strategic management research.

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In Search of Explanations for Stock-Flow Performance

Research repeatedly shows that people have difficulties performing stock-flow tasks. People do not understand the principle of accumulation and seem to use wrong heuristics while doing these tasks (Cronin et al., 200; Sterman, 2010). In this study we explore two possible sources of explanations for stock-flow performance: reasoning patterns as verbalized by participants while performing stock-flow tasks and individual decision making characteristics. This paper reports an experiment in which participants are randomly assigned to a task, department store or bank, and a condition, verbal (using a think aloud protocol) or written. The different tasks do not reveal differences in performance. The combined task results are comparable with previous research. An analysis of think aloud protocols reveals a set of reasoning patterns giving rise to particular stock-flow performance. In line with the literature many stock-flow failures in this study also seem to be a result of the correlation heuristic, more specifically as a stock-net flow correlation. However, we also find additional incorrect reasoning types and other sources of problems. As a second source of explanations we relate individual decision making characteristics to stock-flow performance. We find that need for cognition and need for deliberation correlate positively with participants stock-flow performance.

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The Validity Tests Used by Social Scientists and Decision Makers

How can simulation be sold to policy decision makers? How can simulation be sold to other social scientists that do not accept simulation as a complement to accepted techniques (Repenning, 2003)? Decision makers and social scientists use

validation tests to determine how much confidence they should vest in a model (Forrester and Senge, 1980). And because these communities have different uses for models, they will employ different validation tests. If validation tests are not sufficiently clear, several problems could occur. A decision-maker may dismiss a simulation model using a particular validation test, unbeknownst to the modeler. This paper collects the validation tests in the various simulation and statistical / psychometric literatures into a comprehensive framework. Decision-makers are keenly interested in use as well as how scientifically valid that model is. Therefore, there are analytic, consequential, and pragmatic validity tests. Decision-makers may rely on heuristics (Kahneman, Slovic and Tversky, 1982) as validity tests because they have difficulty understanding simulation (Cronin, Gonzalez, & Sterman, 2009). Decision-makers can teach modelers too humans have used heuristics to become the dominant species in complex ecosystems. The long-term research objective is to use experiments (Sterman, 1987) to understand how decision-makers use both adaptive and dysfunctional heuristics.

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What's Wrong with This Picture? — Group Knowledge Elicitation with Progressive Concept Models

The Health Systems Design Laboratory applied progressively more complex concept models to help elicit expert knowledge from medical professionals leadership at a population health agency (PHA) as part of a study of medical professional capacity planning over a 20-year horizon. In this paper we document the knowledge elicitation process employed with PHA managers and medical professionals in two half-day sessions in which we introduced first principles of System Dynamics methodology and applied those in progressively more complex concept models. We observe that our working group, made up of persons with widely divergent levels of experience with complicated models and systems thinking consultations, quickly learned iconography and terminology of system dynamics and contributed to the development of dynamic hypotheses.

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Understanding and Alleviating Future Skilled Labor Shortage in Norway

The objective of the study is to conduct an exploratory study of the causes that constitute to skilled labor shortage in Norway. Subsequently, we formulate policy to increase skilled labor supply. We apply system dynamics methodology to model the causal relationship between individuals motivation to tertiary education participation, from wages and job opportunity perspective. From the simulation, we find that if tertiary education participation persists as it is, skilled labor shortage will increase from 40,000 in 1994 to 190,000 skilled laborers in 2050, which accounts for 11% of the total skilled labor force. With the introduction of voluntary-based internship program into current tertiary curriculum, promotion of online tertiary education, and encouragement of more foreign tertiary students to study in the country, total university students in 2050 will be 1.30% higher, domestic skilled labor force will be lifted 2.5%, and skilled labor shortage will be reduced by 35%.

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System Dynamics Modeling for the Future IT Development: Applied to Education, Health Care, and Smart Work System in Korea

This paper provides the CSI (cloud computing, smart devices, and the Internet of things) system dynamics model to simulate the future trend in the fields of education, health care, and smart work system. The simulations focus on the policy strategies for success in each field. In addition, this study has a unique meaning in terms of system dynamics modeling approach. A new attempt to build an archetype model for applying to different policy fields was adopted as a new trial.

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Social Dynamics of Traffic-Related Pardons in Korea

In Korea, presidential pardons for traffic violations have been carried out almost every three years, starting from 1995. Whenever Presidents announced pardons for traffic violators, they repeatedly emphasized justifiable reasons that drivers under administrative ruling should be given another chance to make a living by driving. Nonetheless, whenever Presidents issued pardons towards violators of traffic offenses, they were not free from a series of criticism or blame. In fact, the pardons were controversial from the outset. Findings from this research imply that the traffic-related pardons have led to unexpected results: notably, an increase in the number of traffic accidents between 6 and 18 months after the pardon, and raising the moral question of bad drivers. In addition, the findings stress that President-initiated pardons acted as an essential factor in destructing the balancing mechanism, which would rather significantly contribute to minimizing traffic accidents per se. Even though Korean society as a whole has to endure additional social costs originating from the increase in traffic accidents, why have traffic-related pardons been consecutively adopted by Presidents? Simply speaking, political gains have been Presidents primary concerns, even transferring socio-economic costs to ordinary citizens. Therefore, we propose a series of policy alternatives which would contribute in reorienting policy designs of traffic-related pardons in Korea.

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Open Source System Dynamics with Simantics and OpenModelica

We will introduce a new system dynamic modelling and simulation environment based on open source components. The development was initiated by a group of active system dynamics modellers who had needs and ideas for an open toolset. The new needs for features like hierarchical modules, module libraries, collaborative model development and efficient model communication in system dynamics together with the development of open source modelling framework Simantics and simulation environment OpenModelica have driven us to start developing an open source modelling and simulation software for system dynamics. In this paper we discuss how current open source components can be used to build a comprehensive tool for system dynamics modelling and what impact open source could have on system dynamics modelling. Even though the development is still on its early stages, the open source components have enabled us to rapidly develop a tool capable of hierarchical modelling, simulation and some basic result and model analysis. When using open source, the modelling

software becomes more affordable and distribution of models becomes easier, modelling software can be adapted to individual needs and models can be used and validated by all stakeholders.

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Interaction of Product and Service Innovations - An Anaylsis of the Dynamics in Industrial Companies

Industrial companies increasingly rely on services to stand out from the crowd. Alongside direct strategic and economic advantages, these industrial services can also provide impulses for the further development of the producers good. Likewise, modifications of the material product may lead to new or advanced service offers. Hence, product modifications may lead to service adaptations, which again lead to product enhancements. Consequently, product and service innovations seem to interact, driving a dynamic loop and accelerating the innovation activities of a company. This article analyzes the causes by means of a literature review. Afterwards a system dynamics model is constructed to describe the assumed interaction system of product and service innovations in industrial companies and show first consequences resulting from this dynamic loop. Finally, the impacts of some drivers are tested, to give some insights into the behavior of this system.

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Towards An Early Warning System Of Sovereign Debt And Financial Sector Crises: The Case of Jamaica

This paper examines the relationship between sovereign debt dynamics and the stability of financial institutions using a system dynamics framework. The model, which builds upon the seminal work of Saeed and Parayno (1993), incorporates three heterogeneous banks, a central government and a rating agency. Further, the banks and the central government are assumed to be boundedly rational and backward looking interacting via both the local and international capital markets. The model is calibrated to conform to time-series data of Jamaicas debt-deficit dynamics and banking system performance between FY 1997/8 and FY 2003/4 and then used to perform a set of counterfactual exercises based on the impact of exogenous hypothetical shocks to the Jamaican economy four years prior to the onset of recent the global financial crisis. Accordingly, the paper proposes an early warning system for the vulnerability of banking institutions to a default on public debt. Scenario analyses, conducted using the framework, suggests that significant shocks to net international reserves and exports in 2004 would catalyze a significant fall-out of the banking sector in the near to medium term, with the country being more vulnerable to shocks to net international reserves. We close with some implications for prudential regulation.

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A Supply Chain Paradox

Supply Chain Management is a critical paradigm for success in todays capitalistic business environment. Among the numerous supply chain theories, however, a major theme of collaboration emerges. Should individual businesses in supply chains operate in a winner-takes-all mode of capitalistic local optimisation, or should they collaborate, cooperate, and co-exist as a communal and symbiotic organisation where individual partners are willing to compromise and even sacrifice in order to globally optimise for the whole supply chain? Is there some kind of stance between such extremes that makes better sense? This study explores the relationships among supply chain partners through multiple

perspectives, including systems theory, systems analogies, and mini case studies. Models and frameworks developed in this paper propose a new research interest area in the dynamics of supply chain collaboration.

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Dynamic Decision-Making, Learning, and Mental Models

Bounded by limited cognitive capabilities, decision-makers resort to using mental models (reduced versions of real world dynamics) for decision-making and interventions in complex tasks. Such mental models are constantly updated with new experience and knowledge acquired, facilitating a learning process. Through this learning process, mental models can be refined to better represent real world dynamics. Systems theory suggests that updates of mental models happen in continuous cycles involving conceptualisation, experimentation, and reflection (C-E-R), which closely resembles a dynamic decision-making process (DDM). This study investigates the learning process of decision-makers in DDM tasks. Participants involved in simulated environments (Management Flight Simulators and Microworlds) are observed, with proceedings of their DDM tasks recorded and analysed to trace and identify any patterns of learning. Updates of mental models are recognized in changes of their performance, and their perceptions towards performance indicators and systems behaviour, before and after the decision tasks. Findings of this study show significant changes in mental models after participation in DDM tasks. However, the level of learning is questionable.

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Impacts of Project Controls on Tipping Point Dynamics in Construction Projects

Large, complex construction projects subject to unique types of risks. One such unique risk is the combination of rework and increased project scope that can push a project from a behaviour mode of progress toward completion, past a tipping point, and into a behaviour mode of falling farther and farther behind. Previous research has demonstrated the potential of rework-induced tipping point dynamics to cause poor cost and schedule performance on large, complex construction projects and the effectiveness of project design strategies in mitigating tipping point risk. Previous research has also examined three project labor control policies (overtime, workforce, and work intensity) and their impact on project performance. However, the impacts of project labor controls on tipping point dynamics have not been fully investigated. The current work uses a simulation model of a construction project to investigate the ability of project labor control actions to respond to tipping point dynamics. The model demonstrates that some well intended and reasonable project labor control actions, such as the extended use of overtime, can push a project over the tipping point to failure.

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Exploring the Long-Term Development of Festival Tourism and Culture Policies- a Case of the Hakka Tung Blossom Festival

The Hakka Tung Blossom Festival is one of the most famous culture-led festivals in Taiwan. With a ten-year history, this festival was initiated by government policies and then extended to the private sector. While this festival is recognized

as a success in branding an event and also expanding in regions and scale, the expansion in scale and scope of the festival activities seems to deviate from its original image. Building a successful festival requires a long-term accumulation of event images, infrastructural resources, community involvements, and the interactions of various social-political-economical factors, and it is even more difficult making event tourism sustainable. This study uses system dynamics to analyze the development process of this festival, and identified the structural changes through out the developmental stages. Results and implications from the derived model are also discussed.

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The Impact of Design Rework on Construction Project Performance

Rework in construction development projects can significantly degrade project cost and schedule performance. In a typical construction development project which involves design and construction, rework in the construction phase could increase construction cost by 10%-15% of the contract price (Burati. 1992, Josephson & Hammerlund 1999, Love & Li 2000). The proportion of money and time spent on rework in the design phase is usually higher (Smith & Eppinger 1997). In large, complex projects, undiscovered rework in the design phase can induce rework in the construction phase. The time when rework is discovered during the project development process affects the impact of rework on overall project performance. However, available knowledge is not always successful in improving project managers understanding of the feedback mechanisms which drive undiscovered rework impacts on project performance, specifically the interaction between different phases during the developing process. The current work uses a system dynamics model of a two phase project development cycle to identify high leverage points for minimizing the impacts of rework on development project performance. Model analysis suggests that failing to discover rework near its creation in the project development process can magnify the impact of rework on project performance.

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Addressing Retail Out-of-Stock Issues Using System Dynamics

Out of Stock (OOS) has long been a plaguing problem in the consumer packaged goods (CPG) industry for both manufacturers and retailers. It refers to a situation in which an item is unavailable for sale as intended at a store. One study estimated that OOS items on average cost retailers 4 percent of their annual sales, and manufacturers $23 million for every $1 billion in sales. OOS could be caused by many factors, such as manufacturer production shortage, distribution center delay, consumer demand surge, and sub-optimal store operations, etc. There have been many previous attempts to model and fix OOS. To the authors knowledge, this is the first study to address the full production-distribution system using system dynamics (SD) and help all players understand the structure of the CPG distribution system that contributes to the system behavior that causes OOS, and interventions or improvements that can be made to the system to improve its performance related to OOS events. This paper will describe the OOS model we developed, the insights we gained, and the process we used to translate the initial SD model into a business application that can be employed on a wide range of product and retailer scenarios.

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Simulations for Comprehensive Operations

Simulations seem a natural way to deal with the complexities of international interventions. While many social system simulations have been created, comparatively few have informed actual operations. This paper discusses the gaps in present models and the postulates requirements for simulations that might better inform operations.

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Nuclear Waste Management: Strategic Framework for Large-Scale Government Programs: Addressing Legacy Waste from the Cold War

We present a framework for the use of an influence diagram, or causal loop diagram, to develop system insight into the U.S. Department of Energys (DOE) responsibility for environmental cleanup of legacy nuclear waste. We use this framework for exploring policy options, analyzing plans, addressing management challenges and developing mitigation strategies for DOE Office of Environmental Management (EM). The sociotechnical complexity of EMs mission compels the use of a qualitative approach to analysis to complement a more a quantitative discrete event modeling effort. We use this analysis to drive scenarios for the model, pinpoint pressure and leverage points and develop a shared conceptual understanding of the problem space among stakeholders. This approach affords the opportunity to discuss problems using a unified conceptual perspective and is also general enough that it applies to a broad range of capital investment/production operations problems.

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A System Dynamics and Agent-Based Simulation Approach to Test Group-Level Theories of Political Violence

In the political violence scholarship, there is a gap in explaining how group-level dynamics cause mass political violence. There are several theories of why political groups become violent. Because of the qualitative nature of these theories and the feedback complexity of political violence, it is hard to test these theories against each other and against data. This paper describes an attempt to use a combination of system dynamics and agent-based modeling to create a simulation pitting rival theories of political violence against each other and against empirical data. The purpose of the research is theory testing: to see what theory or combination of theories best explains political violence. The paper provides an overview of the relevant theory and data. The paper then develops a dynamic hypothesis and a prototype hybrid Netlogo simulation of two theories, political opportunity and collective action.

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A Resource-Based View of Local Digital Government: Core Capabilities for Success from the Case of Mexico

Digital Government has been an important component in administrative reform efforts and strategies. However, benefits from such strategies remain mainly as a promise. In order to better understand the reasons of success and failure, many researchers have explored the problem following one of two approaches: (1)

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identifying a list of success factors or (2) better understanding the problem through process models. In this paper, following the process tradition from a strategic point of view, we propose to use the resource-based view of the organization and system dynamics as a modeling tool to explore core capabilities of local governments to exploit the benefits of digital government, promoting more competitive localities that create value for inhabitants. On the basis of three case studies of digital government strategies in municipalities in Mexico, we introduce a preliminary conceptualization of the core capabilities and resources for a successful digital government strategy.

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Modeling of Social Sphere Based on Methods of System Dynamics

Article describes the complex of imitation models of social sphere. The model complex is intended for support of decision-making in social sphere, focusing on problems of reforming of housing, public health services and social security. The complex is realized on the basis of system dynamics methods and modern technologies of simulation modeling.

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Learning Lab for Sustainability -Theory and Case Study

Sustainability is a complex, multi-actor and multi-scale phenomenon embodying characterises of complex adaptive systems (emergence, bifurcation, self organisation) as well as system dynamics (delay, feed-back loops, nonlinearity). Such phenomena cannot be approached and solved by conventional, reductionist and expert oriented methods. This paper introduces a novel systems thinking based methodology, called the Learning Lab, for complex and wicked problems and will demonstrate its application through a real case study. The Learning Lab engages diverse stakeholders in a scientific and unifying process of decision making, planning and cross agency collaboration leading to shared purpose and aligned goals and objectives. The Learning Lab has been adopted by UNESCO MAB Program as core methodology for sustainability for its Biosphere Reserves.

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Towards a shared systems model of stakeholders in tourism development in the Cat Ba biosphere reserve of Vietnam

Tourism is a dynamic and complex system, which involves numerous stakeholders, each with different understandings of the system and holding different management objectives. These different expectations result in unforeseen conflicts among stakeholders that could negatively affect the development of tourism. This paper describes a participatory systems approach to develop a shared understanding amongst stakeholders of the tourism system in the UNESCO designated Cat Ba Biosphere Reserve in Vietnam. The process includes the development of a systems model that represents a holistic understanding of the interconnectedness and relationships between the various tourism system components that impact on the sustainable development of tourism in the biosphere reserve. The model is intended for use as a framework for decision making and capacity development by government and private stakeholders who share the responsibility of developing, managing and sustaining the system.

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The Strategic Impact of Balancing Capabilities: A Resource-Based Approach

This paper proposes the concept of dynamic balancing capability (DBC) as a meta-capability, which managers use to adjust the performance of a firm in response to incremental changes in the environment. It argues that differences in DBC can alter intended strategic position and performance through differential accumulation in strategic resource-stocks, even though these differences might be very subtle. It uses a series of simulation experiments based on events in the British life insurance industry to show how heterogeneity in DBC leads to differential performance among otherwise identical business units within firms.

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Using System Dynamics to Assess a Web 2.0 Governance Model for Public Service Delivery

In the last decade Public Administrations (PA) have introduced new governance models to design, implement and deliver public services to citizens. Such models have been also driven by the New Public Management (NPM) movement, which contributed to increase the pressure on PA, of both central governments and communities, to design more citizen-centric oriented services aimed to improve PA outcomes, efficiency and accountability. A key-lever on which PA can act on to reach the above goals is the use of WEB 2.0 technologies, which can enhance a fruitful collaboration between citizens and PA, not only in an ex-post analysis, but also, and in particular, in an ex-ante phase, letting the final users to contribute in the design and implementation strategies of the services to be delivered. In order to assess a Web 2.0 governance model for public service delivery, a Group Model Building session has been conducted with a small group of stakeholders representative. A preliminary findings of the GMB session results in a feedback model which can be used as a vehicle to support public decision makers in the design and implementation of new public services.

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A System Dynamics Model For Replacement and Overhaul Policy For Capital Asset Subject To Technological Change

Capital asset replacement has a significant effect on company cash flow, since the investment on new asset is expensive. Overhaul policy can extend the optimal service life of an asset, and results in lower total life cycle cost of an asset. Technological change also affects the life cycle cost and optimal service life of an asset. In this paper we examine the replacement/renewal and overhaul/refurbish policies in a combination under technological change. We used System Dynamics model and simulate hypothetical data for 4 cases, and the output is in line with some previous studies using analytical models.

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Communication in Agile Software Projects: Qualitative Analysis using Grounded Theory in System Dynamics

Finding the difficulties and concerns of the client, understanding the variables involved in creating the difficulties, exploring the casualty amongst the identified variables and framing the dynamic hypothesis is the most critical and difficult

phase of system dynamics modeling process. Although, there are many ideas in literature to carry out this phase, lack of a comprehensive qualitative method is noticeable. Hence, the authors of current paper, by reviewing the literature, introduce an inclusive and customized grounded theory method, specific to requirements of qualitative system dynamics modeling. Additionally, this paper argues that the methodology described in the paper could contribute to integrating of existing methodologies, facilitating the iterative process of modeling and set up a systematic framework in order to maintain and relate findings of qualitative phase to quantitative phase in system dynamics modeling process.

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Stock-and-Flow Failure: Visual Saliency

The Stock-and-Flow failure (SF) is a robust difficulty in people's understanding of accumulation. There is a growing body of literature that tries to understand the nature of the failure and ways to overcome it. Several strategies have been tested with mixed results including modifications to the representation of the problem (e.g. bar graphs, text, numbers, etc.). Exploring elements relevant to overcome this failure, we explore the difficulties that individuals experience in identifying the relevant elements of stock-and-flow problems to then solve these problems (e.g. the classical People in the Store problem, PinS). We test the effect that visual saliency has on performance and found that changing the visual saliency of relevant elements of the problem results in statistically significant improvements in performance. The experimental design and results are presented and discussed.

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Illegality and Instability as a Continuum: The US-Mexico Border Case

The escalation of violence in Mexico and along the border with the United States has triggered a number of social responses that attempt both to control and to live with current levels of uncertainty in both countries. Additionally, several other social problems have contributed to the messiness of the current situation making it difficult for individuals and governments to identify leverage points of intervention. This work explores dynamic drivers of the emergence of violence in Mexico and along the border with the United States as a specific manifestation of the social processes that turn illegality into instability. A system dynamics approach is used to explore these issues in an effort to identify high-leverage points of intervention.

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Mexico's Cartel Problem: A Systems Thinking Perspective

The unprecedented increase in recent years of cartel-related violence has presented growing challenges both to Mexicos socio-political stability and to the United States (US) National interests. Current efforts to address Mexican cartels treat these organizations as only drug-trafficking networks and focus on law enforcement measures to interdict their operations. In this paper, we approach the cartel problem from a systems thinking perspective and present a holistic assessment of these complex criminal networks operating in multiple domains. By highlighting the dynamic relationships and complex feedbacks between critical variables involved in different domains of cartel operations, we identify the inherently systemic causal factors contributing to the problem situation. We argue that the efforts that rely on law enforcement measures and technological

assistance alone will fail to produce lasting change. Instead they need to be coupled with high leverage strategies that address the socio-economic root causes that foster weak public institutions perpetuating illicit activities in Mexico.

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Using System Dynamics to Plan Investment in Alcohol Services

The authors developed a Dynamic Whole System Model of Alcohol Harm Reduction for the England Department of Health, to support local commissioning of alcohol related services. The project used group model building, based on the best evidence available. It is intended to help local primary care commissioners reduce hospital admissions attributable to alcohol. The main high impact interventions incorporated are brief advice in Primary Care, the employment of Alcohol Health Workers in hospital, and Specialised Treatment. The key output measures are hospital admissions and costs. The model uses four consumption groups (Abstainers; Lower Risk; Increasing Risk; Higher Risk) including binge and dependent drinkers in more than one state. Each state has a differing propensity for hospital admissions. The model provides a dynamic cost analysis; as interventions move people between states hence changing their risk of admission to hospital. The model contains a set of policies parameterised by the Department of Health, but also allows for local settings. The work relates to the search for consistent and cohesive policies by which central government can guide local actions. The approach of using dynamic models goes beyond action lists for guidance and allows localities to learn what will work for them.

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Modeling the Dynamics of Dental Health in Older Adults

As the population of older adults in the United States expands with the aging of the Baby Boom generation, the advantages of developing coordinated and cost effective health policies have become clearer. Co-morbidities between medical and dental health conditions become more prevalent with age. For example, periodontal disease is a risk factor for other chronic illnesses, notably diabetes and cardiovascular disease. Despite this link, medical and dental disorders are rarely screened for and treated as related conditions. Additionally, access to dental care for older adults may be adversely affected by lack of insurance coverage and complex social, cognitive, and physical factors that result in missed opportunities for intervention and prevention of more serious conditions. Developing interventions to improve dental health among older adults is a particular challenge, given the complex set of causal pathways and time delays over the life course that are involved. In this paper, we draw upon the experience of Columbia Universitys ElderSmile outreach program to inform construction of a dynamic model as part of a larger research endeavor that explores the intra- and inter-personal relationships relevant to oral health in older adults.

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Moscow Case: When Violence and Nationalism-like identity are Dancing Together

The problem of violence is one of the ever-existing ones. The paper is studying a particular case with a use of system-dynamics approach, which is not typical for

Russian policy analysis. In particular: there is rising number of violence victims from 2004 till recent times in Moscow. There were key leverage points indicated and proposed 3 policies with a way of its implementation on Moscow city level.

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How do system dynamic models (SD) capture path dependent and complex evolutionary behaviour in social science analysis?

The aim of social scientists is to capture the causal mechanisms that explain behavior of people and groups of people, such as communities, societies or firms. Such an endeavor becomes increasingly difficult as theorizing concerns patterns of behavior. A theory of behavior explains how the cause-effect structure of interaction among specific variables leads to emergent paths of behavior of these variables. Thus, building theories of behavior implies creating a narrative that connects a deep theoretical structure to a repertoire of plausible behaviors that encompass the observed critical events and behaviors. A problem challenging discursive theories of behavior is the quality and robustness of inferred connections between causal structure and emerging behaviors. Equally difficult is to understand how modifications of theoretical assumptions, crystallized into a model, lead to modifications of the phenomenon under study. To make the described endeavor even more challenging, observed patterns of behavior are often produced by path-dependent processes that amplify non-systematic and stochastic disturbances. In this essay, we suggest that the interaction between field research, computer simulation and System Dynamics allows to elicit causal models from the rich texture of everyday life.

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Extending Opinion Dynamics to Model Public Health Problems and the Evaluation of Policy Interventions

The public health community is recognizing the importance of social network dynamics in analyzing chronic diseases correlated with behaviors including tobacco and alcohol use, substance abuse, and obesity. These behaviors are driven in part by opinions that individuals hold regarding products, behaviors, and lifestyles. The opinions and behaviors of individuals are influenced by their personal social networks, as well as exogenous components, such as advertisements. We extend the basic opinion dynamics model to include two processes important for analysis of behaviors correlated with chronic diseases. The first is an antagonistic reaction that drives individuals further apart in opinion space; the second is the addition of hysteresis representing the constraint addiction places on an individuals behaviors. We apply this extended model to consider smoking within a community and various approaches to influence its prevalence, including advertisements and health-related educational campaigns. We examine the roles of advertising strength, the strategic importance of tolerance, and how hysteresis in the behavioral function influences smoking within a community. Finally, we show how spatially and temporally local results can act as inputs to a population-wide, long term system dynamics model. This allows for the examination of the impact of interventions on future mortality.

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A System Dynamics Investigation of Employment and Production in the Fars Province Agricultural Sector

This research analyzes agricultural employment and production in Fars Province while rural areas are taken into consideration. The researcher will face with some employment problems in rural areas as a separate problem from static viewpoint. On one hand, employment in rural areas may relate to labour supply and demand and on the other hand to the social challenges such as population growth rate and emigration in a systematic model. This study aims at considering the most measurable issues related to the agricultural employment and production along with econometrics estimations in the form of a formulated System Dynamics (SD) model. The overall results indicates that the unemployment problems rooted in rural areas will be aroused in the urban areas in near future and agricultural production, per capita income, labour demand and finally employment can be affected by increasing investment in the agricultural sector. Also, the effective policy in increasing employment is cultivated lands which are increased by development modern irrigation systems and improvement in agricultural production technology. Keywords: System Dynamics, Rural Employment, Agricultural Production, Unemployment Problems, Agricultural Sector, Rural Emigration, Fars Province, JEL Classification: J08, J21, J23, J64, Q13, Q18.

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Water Resources Management in the Agricultural Sector of Saadatabad Basin by Using System Dynamics Approach

Nowadays, it is necessary to manage and control the water resources, especially in arid and semi arid areas. For this purpose, using managerial tools could assist executive managers and policy makers simultaneously. The System Dynamics approach is selected to simulate the real world and consequences of diverse decisions. In this study, the Saadatabad basin which is located in semi arid area has been simulated for the evaluation the trends of factors affecting on the water resources. Hence, the simulated model is conducted in four sub-model; supply, demand, water balance and population. The overall results by different scenarios suggested that the optimal management polices related to water supply/demand have positive effects on the underground water resources. The specific results show that the more expenditure on the irrigation systems can reduce the agricultural demand. Keywords: System Dynamics, Water resource management, Demand management, Simulation, water demand, Pasargad twon JEL Classification: Q21, Q25, Q28, C61.

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Considering Combining: Designs for the Complementary Use of System Dynamics and Discrete Event Simulation

System Dynamics (SD) and Discrete-event simulation (DES) can be viewed as complementary approaches to modeling. Both are popular approaches and have been applied in a wide range of situations for various purposes. Reviewing the literature from the multimethodology field allows us to develop a modeling framework that considers the differing designs for the combination of SD and DES. The aim of the work described here is to test, reflect on and further develop this framework through an intervention, and to examine how the modeling approaches can be combined in practice. The paper discusses models under development with a radiotherapy center to explore the impact of altering

treatment regimes for patients in response to the adoption of new, more complex, technology. The questions posed within this project lend themselves to exploration using both SD and DES and the work explores the potential to combine their use in a way which is both complementary and synergistic. The SD model developed in conjunction with the radiotherapy center is discussed along with the proposed development of a DES to provide further insight. The paper concludes with reflections on the experience to date and learning with regard to the proposed methodology.

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Emergency Department Crowding: Vicious Cycles in the ED

Over the past several decades, demands on the United States emergency and trauma care system have grown dramatically, but the capacity of the system has not kept pace. The result is a widespread phenomenon of crowded emergency rooms, especially in urban hospitals, which has become a major barrier to receiving timely care and has been implicated in adverse medical outcomes. This paper develops a stylized system dynamics model to examine the dynamics of patient flow in emergency departments. Simulation results show that increased ED resilience can come from relaxing bed constraints or from more human capability to cope with increasing workloads. The vulnerability of this system is rooted in the critical interaction between physical constraints imposed by the environment and the human capability of the staff to work at high performance levels under conditions of worsening workload pressure.

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Approaching the Tipping Point: Critical Transitions in Systems

For complex dynamic systems there are a limited number of transition paths to shift from their normal system state into a catastrophic system state. In the present paper, the time development for five generic types of paths have been identified and analyzed. Here, concepts of systems science are linked to observations in human-environment-systems and ecosystems. These generic paths allow analyzing systems from a systemic perspective of how their critical threshold is reached.

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Likely Causes of the US Housing Market Crisis: A System Dynamics Investigation

This paper investigates the causes of the US housing market crisis that have been cited in the literature. The loosening of bank capital requirements, cheap money availability through the governments push to increase home ownership and household equity rise due to the housing market boom, and the impact on available money for debt service due to changes in mortgage rules, are all investigated. The system dynamics approach allows for studying each in isolation as well in connection with each other. This helps to assess whether the claims in the literature regarding the various reasons cited for the crisis are justified and what specific conditions lead to a stronger or weaker effect of each.

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A Feedback Perspective on the Diffusion of Energy-Efficient Renovations

The diffusion of energy-efficient renovations in Switzerland's stock of buildings is a crucial policy objective, which is seen to alleviate climate and energy policy problems. In this chapter of my forthcoming dissertation thesis, I describe the main feedback loops driving the diffusion of energy-efficient renovations in Switzerland. Specifically, I show how building owners and tenants interact on the housing market. And I show how they interact with technology and public policy interventions. Based on this perspective, I develop preliminary conclusions for the development of thelarger simulation model and I discuss the potential value of my Causal Loop Diagram as a general framework.

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A System Dynamics Approach for Urban Water Reclamation-Reuse Planning

More and more water utilities are employing water reclamation-reuse to supply reclaimed water for potable and non-potable uses, due to worldwide aggravating water shortages caused by growing urban community and climate change, more stringent wastewater effluent standards in prospect, as well as increasing availability of high-performing and cost-effective water reclamation. However, revenue recovery related with water reclamation-reuse remains an obstacle for many water utilities in the United States. A system dynamics model was created to simulate and optimize economic costs of urban water system as a whole (including drinking water treatment, wastewater treatment, and wastewater reclamation-reuse), accounting for future scenarios of population growth, economic development, and climate change. The model was applied to two U.S. municipal water systems located at water-abundant and water-scarce regions: Kalamazoo-Michigan and Tucson-Arizona. Simulation results indicate significant levels of water reuse, due to potential increases of water demand and delays of water/wastewater infrastructure building. The model also suggests that a decision to implement water reclamation-reuse can yield remarkably lower water withdrawals and lower system costs by reducing extra costs that would otherwise be caused by water scarcity and more stringent discharge requirements for wastewater effluents. In this sense, water reclamation-reuse is both environmentally and economically sustainable.

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Modeling the Spread of Infectious Diseases after Flood in the Rainy Season in South Bandung, Indonesia

Flood is the most frequent natural disaster in Indonesia. However mitigation program is still not effective, especially the indirect impact related to human health. The limitation on clean water, sanitation facilities, cold temperature and the quality of health surveillance might trigger the outbreak of infectious disease and also ineffective the mitigation policy. Therefore in this paper we use System Dynamic that modeled the the two diseases that mostly emerge during rainy season, diarrhea and acute-respiratory-infections (ARI)to give insight and feasible policy to mitigate and control the potential outbreak of infectious diseases.

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Modeling the Dynamics of Academic Publications and Citations

In promotion, tenure or funding decisions, publication performances of researchers in scientific institutions are evaluated using some performance measures. However, there is a concern that measuring research performance, if not properly done, may damage science. Researchers tend to change their research practices when they are asked to be good at some particular measure. In this study, a dynamic model is developed for analyzing the changes in publication practices of researchers towards improving the performance measures used. Reputation, skill level, total time devoted to research activities, fraction of papers accepted by the journals, publication and citation pressures on researchers are the basic variables in the model. The model is constructed and calibrated using Boğazii University Engineering Faculty data. Validation of the model is established by standard structure and behavior tests. Scenario and policy analysis are performed with the simulation model. Pushing researchers to publish in high numbers causes spurious publications with low citations. Allowing researchers to spend more time on research activities is found to be an effective policy. Encouraging mostly the high quality research results in more high-quality publications compared to low-quality ones, hence increased citations. The model provides a platform on which many other policies can be tested.

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Analysis of the Effects of Different Complexity Factors on the Complexity of a Simulation Game

As a part of a larger ongoing research, this paper presents an experimental study in which the effects of delay, nonlinearity and feedback on game complexity are analyzed. A simple growth management game is designed and the game structure is modified to accommodate complexity factors. Factors are tested in independent Latin square experimental designs, with 4 or 8 levels. As performance measures, subjective difficulty ratings of players are also tested, in addition to the usual game score measure. Results show that individual complexity factors do not necessarily make the game more complex. Only the delay factor yielded a significantly worse game score with respect to the base game. Moreover, increasing delay time and feedback strength even causes improvement in game scores. The effect of repeated trials is only observed in players who played nonlinear games, which happen to be easier than other versions. Players' subjective complexity ratings and game scores show a correlation of -0.6, which indicates that people tend to rate a game easy if they perform well. As further research, this experimental design will be applied to a stock management game. Next, the interactions of the complexity factors will be tested in a new set of experiments.

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Perception is more than time delays

Many system dynamics models include perception as a factor translating actual into observed conditions. It is assumed that true conditions are not available to decision makers and thus, should not be used directly in decision policies in the model. Instead, perceived conditions are used. Typically, perception is modeled by delaying changes in underlying variables. That is, provided that the underlying variable does not change anymore, the perceived value may eventually reach the true condition. In decision sciences and psychology, however, errors in perception

are described that lead to systematic differences between actual and perceived conditions. Some of these biases and heuristics prevent a decision maker from ever arriving at the true condition, even if the latter remains constant over time. In this paper, we attempt to broaden the definition and use of perception in system dynamics models. To this end, we present a general model on perception and compare this to a belief updating model formulated in cognitive psychology. We give examples of particular biases and heuristics and how these may be captured in model structures. These model structures may be used in addition to information delays to capture a broader range of perception errors in human decision making.

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A Construct for Testing Effective Cooperation in Large-Scale Resource Social Dilemmas

Social dilemmas are conflicts between individual rationality and general welfare. The Literature explains how to evaluate effectiveness of cooperation based on trust mechanism in small-scale social dilemmas, but how to evaluate effectiveness of cooperation mechanisms in large-scale situations remain unknown until this paper. We designed a construct to test cooperation mechanisms used to promote cooperation in large-scale social dilemmas that involve resource depletion. The proposed construct integrates cooperation mechanisms like trust, perception of damage and cooperation as norm. Results suggest that the designed artifact explains how mechanisms promote cooperative behavior in large-scale social dilemmas that involve resource depletion. In these cases dynamic complexity affects cooperation. The research finally indicates how cooperation mechanisms can be effective to promote cooperation in the context of dynamic complexity in large-scale social resource situations.

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Analysis of malaria trends and policy options for sub Saharan Africa through the Malaria Management Model

The use of DDT for Indoor Residual Spraying (IRS) in recent years has proven to be a cost effective way of combating malaria in sub Saharan Africa. A variety of alternatives to DDT for IRS exist. However, their costs and benefits are insufficiently understood. This is particularly true when it comes to evaluating vector control strategies in an integrated way, i.e., also in terms of their broader socio-economic development impacts. The Malaria Management Model project estimated the costs associated with the eradication of malaria for different combinations of vector control interventions and for different time horizons. For this purpose it developed a computer based simulation model that is based on an extensive database and calibrated for the aggregated sub Saharan African region. It studies long-term (1970-2050) trends of malaria diffusion and the implications for socio-economic development. Model simulations showed that for all policy-scenario combinations, the average yearly expenditures for malaria prevention were much lower than the possible average yearly gain in GDP from eradicating malaria. Model simulations also revealed that the additional costs of substituting DDT for IRS create a series of benefits as well as avoided risks that overall more than offset the costs.

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Convenience Stores in Bogotá at 2030

The objective of this research is to identify the key factors that impact the system of product commercialization in the Bogotas market to allow a better

comprehension of the growth behavior of the convenience stores in this city. Its purpose is to develop an understanding of how the process of sales, consumer reaction through years of exposure to the commercialization format and the presence of informal commerce, among other factors enable the growth of convenience stores in the city of Bogot to ultimately generate scenarios that allow the appreciation of relevant risks to investors interested in entering the market. For research purposes, emphasis will be made on the system of competition of convenience stores as a whole, without differentiation among diverse chains that compete or will compete in the segment, attempting relate the factors that impact its growth. Key words: Bogot, neighborhood stores, system dynamics, modeling, and convenience stores.

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Cyclical Dynamics of Airline Industry Profits

Aggregate airline industry profits have displayed prominent cyclicality since deregulation in 1978. In order to better understand the causes of these profit cycles I build a large-scale model of the airline industry that includes more endogenous feedbacks than previous models, as well as formulations for several strategies that have been employed by airlines to mitigate the cycle. While I find that, consistent with earlier research, the delay in acquiring capacity can be an important determinant of the time-series behavior of earnings, I also show that multiple negative feedback loops are involved in the size and periodicity of the profit cycle in the airline industry. Specifically my modeling work suggests that the feedback loops governing the setting of price dominate the severity of the profit dynamics.

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An Object-Oriented Type System for System Dynamics

Modules (as implemented in iSee software) are nestable containers designed to support the development of hierarchical model structure. They are a valuable tool for increasing the readability and transparency of a model by allowing the model author or reviewer to work at different levels of complexity, as well as making feedback between different components more explicit. However, because modules lack the concept of inheritance, you cannot answer the question 'how is this module of structure related to that module of structure' except by manual comparison. Jim Hines' Molecules provides a hierarchy of common, ready to use pieces of structure. By not forcing modelers to implement common idioms over and over again, Molecules can make new-model creation easier. At the same time, the idea of construction by replacement and relabeling makes it quite hard for software to keep track of the evolving complexity of model structure in a way similar to iSee modules. The paper describes how inheritance and classes can be applied to system dynamics models, primarily through a type system supporting classical inheritance along with a standard library of molecules, with the goal of enabling the rapid creation of exceptionally readable models.

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Sustainable Growth Strategies for Indian Shrimp Industry: A Multiple Perspective

System dynamics modeling as an approach to designing industrial growth strategies has the strength of testing the effectiveness of a strategy. But generating alternative candidate strategies remains the most elusive task. The literature on

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strategic management provides many ways and means to generate such candidate strategies. Making use of these ways and means, the current paper presents a multiple perspective approach to designing growth strategies for Indian Shrimp Industry. Indian Shrimp Industry has displayed cyclic growth behavior in the past that can be characterized by fast growth (19901994), slow decline (19951997), recovery (19982004), and sharp decline (20052009) in terms of production, area under cultivation, and yield. High profitability, generated pollution, and associated government controls on expansion are the primary factors that interact in complex ways to generate the cyclic industry behaviour. In order to formulate appropriate strategies for a sustainable growth of the Industry, a multiple perspective approach based on Industry analysis using Porters Five Forces Model, Delphi survey administered among the Industry stakeholders, qualitative analysis of the system archetypical framework of the Industry, and a system dynamics simulation study has been adopted that have generated meta-strategies for sustainable growth of the Industry.

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Mind Meets Heart: Smart Transition Management to Smarten Energy Systems in a Deeply Uncertain World

Enormous future investments are needed to replace and expand energy systems, and prepare them for future needs. Moreover, smarter technologies/systems are needed. And in this ever more complex, interconnected, and uncertain world, smarter policymaking in the energy field is certainly needed too. After all, current energy policymaking still mainly ignores (dynamic) complexity and (deep) uncertainty. This paper illustrates two SD-based approaches for supporting policymaking for complex and uncertain issues as well as their combination. First, Exploratory SD Modeling and Analysis allows exploring and analyzing millions of plausible (uncertain) dynamic system behaviors and testing the robustness of policies. This approach is illustrated by means of a SD model related to energy grid investments. Second, SD-based Experiential Serious Gaming allows policymakers to experience dynamic complexity and deep uncertainty, and helps them feel the need to embrace both method(ologie)s in policymaking. Before having experienced different plausible futures, players of such experiential games applied inappropriate strategies in almost all plausible futures played, and hence failed in the face of uncertainty. Repeatedly failing actually prepared them for thinking outside their old/reactive/predictive modes in subsequent bounce-casting sessions. Both approaches may also be mutually beneficial: most subjects only acknowledge the need to take uncertainty and dynamic complexity seriously into account after having participated in experience-oriented gaming sessions.

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The Leadership Game: Experiencing Dynamic Complexity under Deep Uncertainty

In this ever more complex, interconnected, and uncertain world, leadership is needed more than ever. But the literature and most leaders largely ignore dynamic complexity and deep uncertainty: only futures characterized by ever faster change, ever more (required) flexibility, and ever more scarcity (especially in terms of highly qualified human resources) are considered. Plausible consequences of dynamic complexities and deep uncertainties are ignored and robustness of strategies for dealing with many different futures is hardly ever considered. But what if the predicted future does not materialize? This paper describes a System Dynamics-based leadership flight simulator and the experiential serious gaming workshop it was tailor-made for. During the first part

of the workshop, participants play the part of the leader of an organization but in rather different virtual worlds (scenarios) in order to experience the impact of long-term dynamic complexity and deep uncertainty on leadership, as well as the influence of leadership on the success of their virtual organization. After having experienced the role and effect of different leadership styles/strategies in different virtual worlds, participants dialogue/brainstorm in a bounce-casting session about strategies and actions to build robust leadership capabilities for an uncertain complex world.

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Exploring Demographic Shifts: Ageing and Migration in a Deeply Uncertain Dynamically Complex World

Plausible dynamics of a major demographic shift --(societal) ageing-- is studied in this paper, both from a global perspective and from a national perspective. Several economic, political and social implications of ageing and ageing-related demographic shifts are explored using System Dynamics models as scenario generators for Exploratory System Dynamics Modeling and Analysis. In Exploratory System Dynamics Modeling and Analysis, a plethora of uncertainties (pertaining to model structures, functions, scenarios, parameters) are used to generate thousands of plausible future scenarios. The dynamic complexity of the resulting `ensemble of future worlds' is analyzed to find leverage points for adaptive policies. The effectiveness of these policies is then tested over the entire ensemble in order to test their robustness. Using this method, the world model is used to explore dynamic and cumulative effects of (societal) ageing, pressures on population structures (e.g. larger shares of aged individuals and large groups of (unemployed) young individuals), migratory flows, labor force expansion/reduction, decreasing societal homogeneity, etc. The national model is used to explore plausible effects on the sustainability of (Dutch) national health and social security systems, the economy, housing sector, et cetera.

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Making System Dynamics Cool III: New Hot Teaching & Testing Cases

This follow-up paper presents seven actual cases for testing and teaching System Dynamics developed and used between January 2010 and January 2011 for the Introductory System Dynamics courses at Delft University of Technology (250+ students per year). The cases presented in this paper range from short to long and can be used for teaching and testing introductory/intermediate System Dynamics courses at university level as well as for self study. Additionally, the use of traditional and new Multiple Choice questions for testing System Dynamics is presented and discussed.

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Energy Transitions towards Sustainability: A Staged Exploration of Complexity and Deep Uncertainty

This paper illustrates the use of Exploratory System Dynamics Modeling and Analysis -- a multi-method combining System Dynamics and Exploratory Modeling and Analysis to explore and analyze uncertain dynamic issues and test deep policy robustness, i.e. policy effectiveness over thousands of plausible futures. This paper gives an overview of the current state of this multi-method by means of illustration. The multi-method is applied to the transition of the electricity generation system, more specifically the battle between old and new

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electricity generation technologies. Starting from a small System Dynamics model about the battle, uncertainties are added to turn it into an exploratory variant which is used as a scenario generator in the multi-method. Later, model and method uncertainties are added and explored by joint consideration of multiple models (the exploratory SD model, another (large) System Dynamics model,...). As such, the reader is taken step by step from the identification of uncertainties, development of SD models, transformation of these SD models into exploratory models by adding uncertainty-related structures and formulations, to the stage-wise exploration of different types of uncertainties -- starting with parameter uncertainties, subsequently adding uncertainties related to functions, structures, models, and methods.

To Radicalize or to Deradicalize? Is that the Question?

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Radicalization and deradicalization are deeply uncertain dynamic processes. Exploring and analyzing many plausible futures and assessing the robustness of policies to reinforce desirable evolutions seem more useful for such processes than trying to predict their precise development over time and optimize the associated policy response. This paper illustrates how the combination of System Dynamics Modeling and Exploratory Modeling and Analysis could be helpful in that respect for deeply uncertain dynamic issues as de/radicalization processes. The generic SD model about radical and non-radical activism used first is methodologically relevant because it generates clear bifurcations. This generic model could be seen as a plausible dynamic theory about how activism may become more/less radical. Specific instances of this generic model are subsequently used to shed light on particular de/radicalization processes - such as animal rights activism - and successful actions to fight radicalization. Finally, SD teaching and testing cases based on these models are provided in the appendix.

Using model to identify and meet potential challenges in regional development: The ECOWAS T21 case

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The ECOWAS region (Economic Community of West African States) has big potential, but it faces major challenges in its development. To help support the decision making of regional and national leaders and bring a wide variety of stakeholders from all member states into policy debates, the ECOWAS T21 model was developed. The initial focus of the model was to test the consequences of regional integration of 1) free movement of people and commodities; 2) integrated energy, transport, and telecommunication infrastructures; and 3) creating a monetary union. When building and calibrating the model, another challenge was identified: fast population growth would make it difficult to improve the well being of the people in the region, even with successful implementation of regional integration. As a result, a family planning scenario was added. Results from the model show that a combination of regional integration and family planning policies generates the best results: smaller population, longer life expectancy, higher GDP, much higher per capita GDP, higher total government revenues, a lower poverty rate, a lower unemployment rate, more forest land, and higher per capita cereal production. However, any good policy could have its costs, such as higher oil demand and lower oil exports in this case.

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Modeling Polarization Dynamics in Online Communities

The advent of Internet and other communication technologies has drastically increased the volume of communication in human societies. One might hope that increased communication will lead to a higher degree of mutual understanding and resolution of conflicts. An opposing, and somewhat counter-intuitive, point of view is that the reduction in the cost of communication would make it easier for people to interact with other like-minded individuals despite geographic distance, thereby polarizing the society. In this paper, we study some of the basic dynamics underlying this problem. We develop an agent-based model to capture the dynamics of an online community where agents post stories and read and vote on others stories. We show that different combinations of parameters can lead to different macro-level behavioral modes in this model, and give anecdotal evidence from a large online community to support the predictions of the model. In particular, we identify four types of communities based on their dynamics: majority dominated, competitively polarized, converged, and diversified. We discuss the implications of each of these forms on the social welfare and the stability of the community.

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Under the Golden Arches: Disruptive and Conventional Product and Firm Dynamics under Consumer Heterogeneity and Network Effects

This paper examines dynamics following introduction of nutritious food by a company well known for high-motivational and low-nutritious products. Employing a system dynamics model, we investigate how consumer dynamics affect uptake of the disruptive product. Our example is the burger chain McDonalds, which introduced salads, fruit and other healthier options in the early 2000s. Focusing on consumer choice, we analyze the process of newcomers trying McDonalds and either becoming core customers, or not. It is important to distinguish overall post-introduction commercial success, from sales of the new product per se. We examine conditions that separate commercial success (by drawing in new types of customers, whether these are the profitable ones or whether they simply accompany more burger-eaters), neutrality (in which existing customers simply change over), or failure (by alienating existing customers so that they abandon the company). We focus on the role of heterogeneity in products and consumers, and on interactions with network effects. We consider in detail the large and inertial installed base of pre-existing burger eaters, and the degree to which its dominance is hard to unseat, drawing parallels with reactions to other disruptive and 'progressive' products in industries ranging from consumer products to electric vehicles to utilities.

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Applications of a Telecom Sector Model for Establishing and Validating Telecom Policies and Strategies

This article describes several applications of a system dynamics model of the telecom sector to the definition and validation of telecom policies and strategies in developing countries. This describes real cases where this model has been used to solve problematic and complex behavior found in the telecom sector, such as

saving telecom operators from bankruptcy, validating a new structure for telecom operators, defining and validating universal service policies, and validating tax policies for the telecom sector.

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A Non Smooth Model of National Energy Market for the Regional Energy Integration

In this paper a novel non-smooth model for a national energy market and its extension to n-countries is proposed, showing several differences from the traditional smooth models. The study begins with the classical treatment of system dynamics theory and jumps to non linear dynamical systems theory finding mathematical results about its complexity. Such results are important in creating processes of integration energy policy between countries, as for example in the latinamerican region, because trough of bifurcations diagrams (from dynamical systems theory) is possible to know what are the all possible scenarios of the system giving robustness to the decision making.

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Model Based Theory in Health Innovations

While there are many models of what would constitute effective health practice, the theories that people use to implement them are less well articulated. However, those charged with designing the implementation programmes for these models of health practice have internal mental models that comprise their theories of change and which guide their actions. This study uses in-depth interviews with seven clinical, management and policy leaders within the New Zealand health sector to develop a theory of change which is then described using system dynamics. The study uses cognitive mapping to elicit the key components of the expert theories by analysing both the individual maps and a composite map developed by combining data from all seven interviews. A thematic analysis is conducted of this composite map and the resulting themes are used to inform the development of a system dynamics model. The system dynamics model highlights the key causal connections within the map, projections of how they evolve over time and the key modifiable variables that affect the future pathway.

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Improving Service Levels at a Major Brazilian Consumer Goods Company

The clients demand for better service is getting higher which forces the companies change some policies to satisfied their clients, otherwise they can lose sales because of low service level. This paper proposes for a Brazilian consumer goods Company a detailed production system model aimed at achieving superior customer service levels, by increasing the Order Fulfillment Rate (OFR) through improved operations management.

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Using System Dynamics Methodology to Generate Insights: An Example from Singaporean Population Health

Singapore is one of the worlds most rapidly ageing nations, and the country is facing a number of health care policy issues, particularly including the care and treatment of ageing-related dementia. To help inform policymakers about dementia treatment and care, we constructed a System Dynamics model that addresses changing population characteristics, incidence and prevalence of dementia, and a population-level natural history of this pernicious condition. This article (a) describes how a discrepancy between measured census data (reference modes) and simulated population led to improved estimates of the population, (b) introduces a novel and generalizable means to simulate how the prevalence of mild, moderate, and severe dementia is likely to change over the next 20 years, and (c) provides comparisons between two means of prevalence estimation.

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Public Policies Assessment to Improve the Small Agricultural Producer Profit

Traditional agriculture is the main source of national food competes with imported products and mostly made by small producers. In recent decades, various policies have been implemented to support this type of farming, such as improving yields through new seed varieties. After trade opening in 1990, this was affected by import products, therefore was adopted mechanisms for protection and price stabilization. On the other hand, in this decade, public spending in infrastructure increased substantially vial. However, several studies show that the situation of small farmers in this agriculture has improved just slightly despite the fact that for example the policy of improving varieties has been successful in increasing yield improvement. The purpose of this research is to analyze the dynamic effects of the principal policies in support of traditional agriculture on the profit of peasant as formal farmers. The politics of agricultural support to be used for the study are mentioned in the previous paragraph; these are within the tariff and tax policy. The application presented here is a computer simulation which will help to measure the impact over the many political options applied and determine the better choice upgrading and protecting the peasants profit.

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Estimating future scenarios for farm-watershed nutrient fluxes – Can on-farm BMPs really do the job at the watershed scale?

A dynamic model of Phosphorus (P) movement through the Peel-Harvey Watershed in South Western Australia was developed using STELLA dynamic modelling software. The model was developed to illustrate watershed P flux and to predict future P loss rates under a range of management scenarios. Input parameters were sourced from surveys of local agricultural practices and regional soil testing data. Model P-routing routines were developed from the known interactions between the various watershed P compartments and fluxes between various P stores. P-retention characteristics of a variety of management practices were determined from field trials where available and published values where not.

The model simulated a 200 year time frame to reflect 100 years to the present day since initial land development, and forecast 100 years into the future. Although the watershed has an annual P loss target of 70 tonnes per annum (tpa), the measured present day loss is double this amount (140 tpa) and this is projected to rise to 1300 tpa if current land management practices continue. Even if broad-scale BMP implementation occurs, P losses are likely to increase to approximately 200 tpa. This has significant implications for both future land use and subsequent water quality in the watershed.

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Dynamics of Operational Procurement: Systems Modelling for Performance Tracking and Auditing

Traditional independent project performance evaluations take time, disrupt business-as-usual, and report one-off performance based on the best data available at the time. The alternative approach for measuring project, programme or enterprise success performance tracking risks moving the focus of work from the technical end goal to the satisfaction of performance measures. In this research, we create and begin testing a method aimed at creating a synergy of these two approaches. We employ qualitative system dynamics models, built from a text-based analysis of an existing audit of defence procurement in the UK within a group model building context. We set out to prove that it possible to create recommendations commensurate with an independent audit from an interrogation of causal loop models. Considering the inherent dynamic properties of qualitative system dynamics and the relative ease of keeping models up-to-date (compared with performance audit reports), by proving it possible to create adequate performance recommendations from qualitative system dynamics models, we now have a firm basis for producing a framework of dynamic organisational system performance evaluation.

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Simulation of a Distributed Design Project

Dissemination of system dynamics to project management practitioners is not as widespread as its use for project management theory building within the system dynamics community. This article presents a decision support and training project model built for a global consulting and engineering company. The simulation model comprises the most important work phases within the detail engineering phase of a large investment project in three offices. The model was validated using data from several past projects and in workshops with the company. A user interface was built to aid dissemination and use of the model. The purpose of the model is the bottleneck analysis and simulation of an ongoing engineering project, as well as the simulation of quality, scheduling, and profitability issues when outsourcing parts of the detail plant engineering.

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Tension in a Local High School from a Systems Perspective

This poster is describing a project that was looking at the issue of tension in a local high school. The project was composed of three sessions with 15 high school students and used various scripts to create an experience where students were able to share their perspectives of issues related to tension in their school as well as learn about systems thinking and system dynamics. Students identified

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key variables within the structure that was created and generated potential intervention strategies that might influence the issues they are facing on a daily basis. Students involved in the project felt that they were able to see the connections between certain behaviors and the resulting consequences, as well as identify linkages between the variables.

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Building and estimating a dynamic model of weight gain and loss for individuals and populations

The obesity trends in the U.S. and many other countries are alarming. Models that can assess the potential impact of alternative interventions are much needed in turning the obesity trend. The purpose of this research is to study the dynamics of obesity in the United States over time to build a generic system dynamics model that can be used for obesity policy analysis at multiple levels. The model is multi-level in the sense that it builds on individual level models for both childhood and adulthood to capture the energy balance and weight change throughout the life of individuals, and aggregates individual level models to population level trends. We discuss the application of simulated method of moments to the calibration of this model. This approach enables community, state, or national policy analysis building on a calibrated model and offers promising methodological advances in model calibration in the field of system dynamics.

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Fuzzy Modeling of Linguistic Variables in a System Dynamics Context

This paper builds on a previously proposed approach where fuzzy logic is used to incorporate linguistic variables in system dynamics modeling. The motivation for this approach is to include vague yet dynamic variables that are combined in a meaningful way. The essence of our approach requires the definition of membership functions as representations of the degree to which specific variable attributes hold, the application of a max-min direct inference approach as a way to combine two or more fuzzy variables, and the use of a defuzzification method that captures (summarizes) the joint effect of the linguistic variables. The objective of this paper is to study the implications of using two alternative defuzzification methods (largest of maximum and center of area) and to highlight various interpretation and modeling challenges associated with each defuzzification method. For illustrative purposes we use a variant of a sales and service model that is based on the concepts of product diffusion, backlog accumulation and personnel adjustments and their respective existing modeling representations in the literature. In summary, based on our findings, by substituting the Max-Min operator and eliminating inconsistencies among the fuzzy rules, the defuzzified values behave reasonably for both defuzzfication methods.

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Farmers, Bandits, Soldiers: A model for addressing peace agendas

This paper models an economy of farmers, bandits and soldiers. In addition to the economic factors affecting the economy studied by Saeed and Pavlov (2008), we examine also the effects of two psychological factors broadly categorized as exposure to violence and group identity. Within this environment, we conduct

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simulation experiments (1) infusing the economy with additional agents of each type under different assumptions about rational economic behavior, psychological influences and the writ of government, (2) changing the parameters representing the productivities and behavioral scaling factors in the economy, and (3) adding external flows to the incomes of each type of agent. Our experiments indicate that the optimal policy for promoting peace involves increasing farmer productivity, strengthening the writ of government, downplaying the prestige of soldiers and reforming institutions so corruption and the extraction of ransom from the public are reduced. Key words: peace economics, political economy, conflict resolution, behavioral economics, psychology, public policy, system dynamics, computer simulation.

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A system dynamics model of post-installation use of enterprise information systems

An enterprise information system, e.g. a system for Enterprise Resource Planning or Customer Relationship Management, is important for any organization to carry out its business activities. Even when the upstream activities of selection or development of such a system, its installation and appropriate user training are carried out effectively, the subsequent use of the system does not always result in meeting the expectations to carry out the work of the enterprise. Published literature is rich in covering the initial acceptance and adoption of such information systems, but is rather sparse in covering the dynamics of post-installation use of the systems. This is particularly so for the critical time period immediately after the system is installed when enterprises have the opportunity to take corrective actions, if needed. Our system dynamics model is an initial attempt to capture the complex dynamic interactions among the characteristics of the organization, business processes, users, the enterprise information system, and interventions by the organization. Our results show that the model can be used to understand the impact of organizational characteristics and interventions on profiles of system use and work done via the system after an enterprise information system is successfully installed.

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A new dynamic risk analysis framework for CO2 Capture, Transport and Storage chain

CO2 emission of industrial facilities is a major cause of climate change that affects the ecosystems, human beings and environment. Capture, Transport and Storage of CO2 (CTSC) is a novel technology of mitigating the impacts of climate change. The uncertainties concerning long term reliability of CTSC technology give rise to the significance of risk assessment for CTSC activities. Since CTSC is a complex sociotechnical system, traditional risk assessment approaches are not appropriate for CTSC. Lessons learned of industrial accidents show that a combination of technical, organizational and human aspects of risk results in occurrence of accidents. Therefore, we recommend to develop an integrated risk analysis framework for CTSC chain. The framework is developed by modeling CTSC chain by system dynamics approach. System dynamics is a support for risk assessment that allows understanding the interactions of CTSC system's elements in the first step, and then study the behavior of the system over time both in normal operation mode and in case of a failure or deviance. In this paper, the methodology is explained in detail, and the application of the methodology for an integrated CTSC project is discussed.

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Hockey-stick phenomenon: supply chain challenges in Emerging countries

The objective of this study is to investigate a very common phenomenon in an important emerging country, namely the spike in demand at the end of the sales period, known as the hockey stick phenomenon. The analysis will encompass the causes as well as the impacts of this phenomenon, in a way that allows alternative policies to be proposed that are able to provide a better financial result for the agents involved. Data collected from a Brazilian branch of a large multinational in the non-durable consumer goods industry and in semi-structured interviews conducted face-to-face with executives of 26 clients. After internal and external validation of the model, scenarios were generated to identify causes, impacts and alternative policies. The findings showed that the phenomenon negatively impacted the manufacturers financial performance in the long term and indicated requisite changes able to eliminate it. The study showed that companies should not assume the hockey stick phenomenon to be an exogenous problem; it showed that there are alternative policies; and it provided ideas regarding ways to carry out the change process. This is the first empirical study on the hockey stick phenomenon, a problem that affects diverse companies in emerging countries.

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From Fossil Fuels to Renewable Energy: The Dynamics of Replacement in Brazil

The widespread replacement of fossil fuel for biofuels led to a discussion on its potential side effects. Despite the consequences of biofuels are still in discussion, some authors suggest biofuels should be taxed so as to guarantee food safety as well as for other reasons. Others suggest biofuels should be banished. Brazilian ethanol seems to have reached independence on government subsidies and is now an economic activity in Brazil. The maturity of this independence has been achieved due a new technology the flex fuel electronic injection. But before this new technology the ethanol program suffered from a severe decline of demand, with relevant economic and social consequences. This paper explores the dynamics of the periods of growth and decline of the PROALCOOL program in Brazil, in order to generate insights to support public politics as well as to contribute to academic community discussions. (1970 to 2002). Multiple information sources were used to structure a theory to explain the dynamics of a period of growth followed by a decline of usage of ethanol in Brazil. Results permit to conclude that a sudden change in politics actions, charging biofuels can lead to a fuel shortage and some relevant social and economic consequences.

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BioPOL: biofuel modeling, sensitivity analysis and discussion on biofuel support policies under inherent uncertainties

The aim of this paper is to describe the biofuels model BioPOL, to explain how a Monte Carlo simulation can be applied to it and to illustrate how different biofuel support policies can be analysed. BioPOL was developed and applied within several European projects, among them TRIAS, PREMIA, HOP! and iTREN-2030. It is based on a recursive year by year simulation until 2030. In each year a level of biofuel production is found at which the costs of biofuels equal those of the fossil alternative they substitute, taking into account the feedback loops of the

agricultural market and restrictions in the annual growth rates of capacity. However, the development of the biofuel production depends highly on several input parameters which are inherently uncertain. Therefore, we focus in this analysis specifically on the way we deal with this uncertainty. The model delivers detailed outcomes for the different types of biofuels with regard to production capacity and produced volumes, costs and well-to-wheel emissions of greenhouse gases. It considers the main production pathways of biofuels, namely first generation biodiesel with rapeseed and sunflower and first generation ethanol with cereals and sugar beet. Furthermore, it includes advanced 2nd generation pathways from ligno-cellulosic feedstock.

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The use of qualitative modeling to derive qualitative policy implications from structural aspects of a model – a practical case

This paper reports about and interprets a qualitative system dynamics effort undertaken in the context of urban transportation systems in Latin America. In this case, the available time was too short to attempt model quantification and simulation. A stock-and-flow diagram with units of measure and tentative equations was developed and its structure analyzed. The analysis of the reachability between variables and of the shortest independent loopset around one centrally important variable have allowed to elaborate a series of qualitative indications and recommendations. The case is used to argue that, if cautiously interpreted, a qualitative model can yield helpful insights.

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A System Dynamics Model of Pharmaceutical Opioids: Medical Use, Diversion, and Nonmedical Use

A dramatic rise in the nonmedical use of pharmaceutical opioids has presented the United States with a substantial public health problem. Nonmedical use of prescription pain relievers has become increasingly popular in the US over the last two decades, and diversion of medical prescriptions is assumed to be a major source of supply for nonmedical use. Policymakers striving to protect population health by ameliorating the adverse outcomes of nonmedical opioid use could benefit from a systems-level model which reflects the complexity of the system and incorporates the full range of available data. To address this need, the current project describes the conceptualization and development of a System Dynamics model that is used to complement and leverage results from existing research. Additional testing is needed to authenticate preliminary intervention simulation results, which suggest reducing the initiation of nonmedical use may have a more profound impact on the total number of opioid overdose deaths than more tamper resistant formulations, decreases in opioid prescribing, or decreases in rates of nonmedical use among medical users. Results indicate that System Dynamics can help to identify points of high-leverage for policy interventions as well as bring attention to the unanticipated negative consequences of these interventions.

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Forio Online Simulations

How best to present model structure to decision makers? An experimental study of the effectiveness of the Forio model explorer

Making decisions in a complex dynamic environment is very difficult, and often decision makers do not make optimal choices (Moxnes, 2004). Typically system

dynamicists attempt to reveal model structure to decision makers so that they can better understand the system and make better choices. For this study I test the effectiveness of a tool called the model explorer vs. a stock and flow diagram to see which is more effective at helping decision makers make better choices in complex dynamic environments. The results of this study were inconclusive. The model explorer participants succeeded at the task 33% of the time vs. 12.5% of the time for the stock and flow participants. There were not enough overall participants for this result to be statistically significant. Also in this experiment I devise a method for testing for type 1 error due to trial and error and discover that it is quite effective at catching participants whose results are based on guessing rather then understanding of the dynamics of the task.

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The role of collaboration through manufactured goods' exportation process under System Dynamics analysis

In the recent years, there has been an increasing interest by the countries in expand their exportation volume. Although large amount of goods are exported, in some countries as Brazil, the major contribution in the exporting balance is derived from the primary goods. Thus, a possible way to increase the countrys wealth is to increase the participation of added-value goods. In this context, the aim of this study is to present a new approach to analyze the behavior of the collaboration in the maritime transportation in order to reduce freight costs pertinent to the manufactured goods exportation process. Firstly, the general exportation process is described considering the main agents involved in the logistic chain. In the sequence, two possible methods to model and analyze such problem are described (Agent Based Modeling and Simulation - ABMS and System Dynamics - SD). After a comparison between both methods, SD method is chosen as the best appropriated and its primary implementation considering causal-loop diagram is presented. As a further step, a stock-flow diagram is developed, considering the main dynamic variables included in the exportation process, permitting a better comprehension of the transportation offer-demand mechanism, freight price definition and the collaboration formation.

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A System Dynamics Perspective on Applying a New Energy Efficiency Metric for Data Centers

This paper explores the dynamics of energy reduction policy setting for data centers in the face of new metrics and related regulation. With these new metrics there is a potential for management to establish policies that achieve the specific metric target while sub-optimizing the total energy reduction opportunity. This paper will address the question of whether new insight can be gained by using a system dynamics approach versus static return on investment forecasting. The first part of this paper will describe the unique dynamics of energy consumption in a data center and the application of one particular metric used to indicate energy consumption efficiency. The second part of this paper proposes a model that represents the interconnected behavior of data center energy consumption and metric based policy implementation. This approach is compared to static methods and the insights gained from taking a systems approach.

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Distributed Group Problem Solving

There are a multitude of grand challenges facing the United States, ranging from global climate change and energy needs to growing deficits and health care costs.

The increasing urgency of these challenges brings into question the abilities of society to solve such complex problems. At the same time, the Internet and social media have come to provide unprecedented access to the millions of stakeholders. While this capability has helped facilitate changes as far reaching as the 2011 revolution in Egypt it is still unclear if it can be used as part of a broader constructive process. For grand challenges the process will need to be massively collaborative and yet well structured. This paper explores how system dynamics, combined with web technologies can provide both the workflow and framework required. A model-based approach is ideal because theories can be made more transparent and easily compared to real world data. To explore the concept of using the system dynamics methodology as part of a distributed group problem solving approach this paper also describes a work in progress demonstration web site. The site uses existing web applications to illustrate the necessary components for creating a problem solving process on a grand scale.

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Development of System Dynamic Model of Latvia's Economic Integration in the EU

Joining the European Union big opportunities in the international markets have opened for Latvia. Paper purpose is to investigate influence of international integration processes on development of economy of Latvia. Latvia's incoming in EU increased the amount of received means from structural and cohesion funds, removed the trading barriers, increases foreign investments, reduced unemployment and increased labor migration. In the paper the system dynamics model, which describes integration of the Latvian economy into EU, is developed. In the model international financial flows connected with Latvia and EU; import, its relation to internal producing; and migration processes are considered. Model functioning is measured considering various scenarios of situation development. The developed model can be used not only in the analysis of Latvias economic integration in the EU, but on its basis it is possible to create models of regional cohesion in Europe.

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Application of System Dynamics to Inform a Model of Human Papillomavirus Vaccination Efficacy

The uncertainty of prior Human Papillomavirus (HPV) infection is a major limitation in evaluating the effectiveness of HPV vaccination within populations 19-26 years old. We used Systems Dynamics to simulate a prospective cohort of 100,000 women age 19 years old at entry. Using data from prospective natural history and vaccine efficacy studies, we followed these women for both the incidence of high-risk (16/18) HPV types and for Cervical Intraepithelial Neoplasia (CIN) grade 2 or higher. At 20 years of follow-up, we found that the relative risk (RR) for developing CIN2+ lesions in a vaccinated cohort of women exposed to high-risk HPV was 8.8 (95%CI: 7.8-10.0) when compared to a vaccinated cohort who were high-risk HPV naive (serology & DNA negative). We also found that the RR of developing CIN2+ lesions in women exposed to the vaccine after a resolved HPV infection was 0.32 (0.27, 0.37). The RR of developing CIN2+ lesions in women exposed to the vaccine after a persistent infection was 1.06 (1.02, 1.10). Thus, our model demonstrates the fundamental difference in CIN2+ lesion incidence between women who with past exposure to HPV 16/18 and nave populations. Therefore, our model has important policy implications for future vaccination strategies.

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Description and demonstration of a simulation learning environment for discovery learning about simple accumulations

This poster presents a web-based simulation learning environment for facilitating discovery learning about accumulations. It was designed to complement an Introduction to Environmental Science course at the college level, but will eventually be available as a stand-alone package. The primary learning objective is to develop the users understanding of the relationship between inflows, outflows, and accumulations, as well as the effect of changes in inflow and outflow rates. Results from the use of this simulation in freshman Environmental Science classes will be presented in another paper. Here we describe the domain and discovery learning objectives, storyboard, and interpretive scaffolding of the simulation learning package, and present insights from user feedback on the design. We plan to have a demonstration version of the simulation available at the conference.

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Using Simulations for Discovery Learning about Environmental Accumulations

This paper presents findings from the use of a simulation learning environment to teach college students about principles of accumulation. The simulation package is part of an ongoing study testing the utility of systems simulations for teaching students about the complex systems relationships in environmental studies and science. We have conducted paired experiments over the past five semesters in a team-taught, college-level Introduction to Environmental Science course using system dynamics simulations. We have progressively refined the systems learning objectives, simulations, and assessments. The focus that has emerged from this research is the need for building systems understanding about the dynamics of accumulations. While most students are able to define and identify everyday examples of accumulations, they have difficulty understanding relationships between flows and accumulations in any but the simplest cases. The pattern-matching tendency is strong. In this paper we present a simulation developed specifically to address simple issues of accumulation and discuss lessons we have learned about best practices for discovery learning in this setting.

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Illuminating the Logic of Stock Management Failure – How Much Does the (Mis)Understanding of Accumulation Explain?

The stock management (SM) problem is of high relevance for a broad range of decision makers in society, business, and personal affairs. Although in some areas highly sophisticated models and control concepts have been developed, human stock management performance is lamentable. One recent explanation for this failure is offered by a stream of research, which finds evidence for widespread and persistent deficits in understanding how flows accumulate in stocks. This misunderstanding of accumulation (MoA) is proven even among well-educated adults. This research uses laboratory experiments to test the hypothesis that the better people understand accumulation, the higher is their performance in SM tasks. Correlation and univariate regression analysis show that MoA indeed contributes to explaining performance differences in stock management.

However, the effect is moderate and vanishes almost completely when intelligence and economic knowledge are included as control variables in a multiple regression model. The value of this paper lies in explicitly testing the relation of MoA and SM, whose existence is widely taken for granted. Future research could explore a broader set of control variables and should increase the number of cases to allow for advanced theory testing using, for example, structural equation modelling.

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Strategies for Transportation Electrification: Overcoming Thresholds and Overly Optimistic Forecasts

With increasingly volatile oil prices, unprecedented US dependence on imported petroleum, and growing environmental concerns, the creation of economically sustainable markets for alternative fuel vehicles (AFVs) is vital. However most efforts to supplant the current transportation system have failed or had limited success. The diffusion of AFVs is complex, being both enabled and constrained by powerful positive feedbacks arising from scale and scope economies, experience curves, network effects and complementary assets. While such feedbacks are sometimes discussed, dominant mental models among both policy makers and academics may underestimate the strength of these feedbacks and the fact that they also operate to advantage the current dominant technology. The result has been a series of overly-optimistic forecasts for the extent and speed of diffusion for AFVs and EDVs, and insufficient investment in standards and policies to help such vehicles over the tipping point to self-sustained adoption. We describe a model we have developed a suite of behavioral dynamic, spatially disaggregated models with a broad scope and its key actors. We demonstrate, through various thought experiments, that higher oil prices, while important in speeding EDV adoption, are less effective than many expect, due to a range of compensating feedbacks that enable internal combustion-gasoline technology to adapt.

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Non-communicable Disease Dynamics and Prevention: Dynamics of Nutritious Food Market Transformation Initiatives

This paper examines challenges and opportunities for policy actions that transform healthy living behaviour. We examine how policies and other decisions, made by various types of actors (i.e. consumers, industry, agriculture, government, NGOs, and global institutions) evolve as they interact and collectively shape nutritious food markets over time. Such a transformation is characterized by multiple feedbacks and long-term delays, and involving disjointed public and private level interactions, produces counterintuitive behaviour. To develop an in-depth understanding of the major challenges and identify high-leverage strategies in transitioning away from low nutrition / high motivational (LN-HM)-based food system we have developed a behavioral dynamic model with a broad scope. Key actors in the models include consumers, producers, and policy-makers. In this paper we describe the model and carry out simulation experiments designed to examine barriers to self-sustaining market shifts between supply and demand factors. Collective action among producers to improve nutrition, while important in achieving nutritional change, builds up slow and is failure prone, due to a range of compensating supply and demand feedbacks. We analyze and discuss the role of cross-product category substitution, the contextual role of consumer switching dynamics, and a variety of initiatives,

including those oriented around marketing and R&D. We conclude by discussing the importance of coordination and commitment across actors and model extensions.

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Language Evolution in Québec: Network effects and clustering

Language dynamics in multi-language societies is a growing field of study. Most extant research focuses on the dynamics of language death in multilingual societies. However, empirically, languages form more complex patterns, including survival in local clusters. This paper lays the foundation for a model to explain the process by which dominated languages sustain themselves. The key mechanism we explore in this paper is the social-network effect that affects single or multiple language adoption. In particular we hypothesize an important role of bilangualism. To analyze this we extend existing, stylized, models that predict one single dominant language. We simulate the competition of two language groups who interact through a bilingual population. We include factors such as language status and ease of learning. The model is tested against the empirical case of Quebec from 1931 to 2006. We explore the importance of bilingual parents raising their children as bilinguals or unilinguals according to the relative attractiveness of each language. We find that this factor, while not critical in explaining qualitative patterns, is instrumental to replicate more accurate patterns. We conclude by developing a hypothesis of how spatial disaggregation of the network effects may explain the local cluster survival of dominated languages.

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Human Stress Response from the System Dynamics Point of View

This paper introduces system dynamics approach to the domain of psychiatric research. We have tried to develop a computer simulation model based on theoretical findings and facts known to clinicians and looked for an answer to the problem of different cortisol reactivity between major depression and PTSD patients with respect to trauma severity, length and proposed genetically based differences in hippocampal volume. Modeling PTSD and depression in one structure is to our knowledge the first attempt to grasp these widely spread disorders with substantial societal and clinical burden. Even though the current model structure is simplified, proposed approach has a powerful predicting potential in clinical practice and social policy. Model structure and model equations are in Appendices 1 and 2.

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A Soft Landing Model and a Mass-Spring Damper Based Control Heuristic

This paper presents a soft landing model and a related control heuristic. The aim of this modeling effort is to represent the process of landing a spacecraft on the surface of a celestial body. This problem is known as the soft landing problem because crashing the spacecraft to the surface should be avoided. At the same time, long landing period necessitates extensive use of fuel, which should also be avoided. Consequently, the main goal in soft landing problem is to land the spacecraft as gently and as fast as possible. We adapted a control heuristic from the mass-spring damper model. According to the initial simulation runs, the adapted heuristic is successful in landing the spacecraft.

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A Dynamic View on Knowledge Development: A Case of Industrial Aerospace Supply Chain Development in Indonesia

Indonesia, through a state-owned aircraft industry named PT. Dirgantara Indonesia (PTDI), is trying to develop its national capacity in aerospace industrial technology. The strategy being thought to realize this objective is to build the aerospace supply chain industries through which the Small & Medium Enterprises (SMEs) can take a role in the global aerospace supply chain industries in the near future. As a main focus for this purpose, the Quality Management Systems (QMS) like AS 9100 has to be internalized in the SMEs; because, in reality, the Indonesian SMEs have not yet been experiencing with the quality requirement. Therefore, it is important to simulate the QMS learning process in the SMEs through an outsourcing collaboration between PTDI and SMEs. To simulate the learning process, a system dynamics model of knowledge development is constructed based on the inter-organizational learning dynamic model developed by Otto and Richardson (2004). A modification of the original model is made to accommodate an assistance mechanism for SMEs learning process in order that the QMS knowledge and experience of SMEs is adequate enough prior to the outsourcing partnership with PTDI. This study shows that the assistance is very important for SMEs those have not adequate prior knowledge and experience in QMS to increase their knowledge level.

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System Dynamics of Diminishing Family Size on Living Arrangements of Singaporeans with Ageing-related Dementia

Over the next several decades, population trends sweeping across the world will challenge cultural traditions, health systems capacity, and social infrastructure. As average age of populations increase, health care needs change from acute to chronic. Of all the causes of age-related dependency, dementia presents a particular problem: the elderly with dementia have extensive care demands and, as their dementia progresses from mild and moderate to severe, institutionalization becomes more likely. Our research applies system dynamics methodology to estimate future population-level severity of dementia and the challenges of age-related dementia to family and community infrastructure.

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Comparison between Individual-based and Aggregate Models in the Context of Tuberculosis Transmission

The desire to better understand the transmission of infectious disease in the real world has motivated the representation of epidemic diffusion in the context of quantitative simulation. In recent decades, both individual-based models and aggregate models (such as System Dynamics) are widely used in epidemiological modeling. This paper com-pares the difference between aggregate models and individual-based models in the context of Tuberculosis (TB) transmission, considering smoking as a risk factor. The merits and impact of capturing individual heterogeneity is examined via representing Bacillus Calmette-Gurin vaccination and reactivation in both models. The simulation results of the two models exhibit distinct discrepancies in TB incidence rate and prevalence. Results also suggest that, at the level of practical application, individual-based models

offer significantly greater accuracy and easier extension, especially when representing a decreasing reactivation rate, waning of immunity and heterogeneous individual at- tributes. Another experiment sought to evaluate the impact of network structure on TB diffusion. Simulations are conducted under three widely used network topologies, namely random, scale-free and small world. The results reveal large differences between results of individual-based models and aggregate models, which further give insights into the difference between these two model types in the context of practical decision-making.

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Agile Essence

This paper explores the Agile software development methodology to discover the essence that has enabled it to prosper and grow since the declaration of the Manifesto for Agile Software Development in 2001. Examined is the role of feedback in the Agile methodology and its relationship to single and double loop learning.

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Establishing a framework to check the ablility of learning system dynamics--the experience of Taiwan scholars

Jay W. Forrester(2007) pointed out the three challenges facing system dynamics in the 21st century.The first is about the education of system dynamics experts.We try to make some contribution in this aspect. We think the field of system dynamics lacks an ordered learning process, especially in modeling.Therefore, we investigate investigate several system dynamics experts who have engaged in this field over ten years.We induce their experience and Barry Richmonds research to establish a framework to check the ablility of modeling which included six phases and thirty levels. Instructors can use the framework to arrange the adapted materials in different level in order to make the learning process of system dynamics systematically.Learners can use the framework to understand theirown ablility of system dynamics and plan the next learning program.

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Using a Qualitative System Dynamics Approach to Investigate Perception of Corruption

Over the past few decades, many studies of corruption have been carried out. These studies have mainly focused on specific characteristics such as: economic issues, legal issues, and social propositions. In this article we have described the concept of modeling corruption in Pakistan using a Causal Loop Diagram (CLD). Corruption represents a very dangerous social phenomenon observed in many parts of the world. However, its manifestation in a developing country is an especially destructive agent against human development. The System Dynamics (SD) approach has been extended in the past several years through its application to new problems such as modeling state instability, supply chain management, and analysis of different nation building policies. The main objective of this study is to develop a theoretical framework which can be used to study corruption dynamics by means of SD. The methodology employed is a case study. Semi structured interviews with key stakeholders such as: government ministries, donor agencies, judiciary, police departments, non-governmental organizations and the general public are done. On the basis of literature and social theory we have

developed three preliminary CLD models of corruption. The data for the qualitative system dynamics analysis comes from 30 interviews conducted in (Islamabad) Pakistan.

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Analyzing Training Programs from a KM perspective: A System Dynamics model

Service operations depend intensively on human resources because of their interaction with customers and suppliers and thus, training becomes a must in order to ensure higher performance. Knowledge Management (KM) may be looked as a framework for training programs since it addresses knowledge conversion from explicit and tacit knowledge. This paper proposes that dynamic simulation might be used as a tool to analyze training programs effectiveness from a KM perspective. Thus, a SD model was built using data from a customer support service of a software-house in Brazil. Three scenarios were considered, relying on the number of trainings per month. The main contribution of this work lies on shedding light over the intangible effects of tacit and explicit knowledge that support the effectiveness of training programs over organizational performance.

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Strategic Analysis of Product Recovery Management by Using System Dynamics Approach

In this study, by using system dynamics approach we aim to investigate the profitability of a company if it is engaged in remanufacturing, which is the most advanced form of product recovery. Our motivation is to find out whether investing in remanufacturing is advantageous for a company/sector in terms of long term profitability and, what should be the quality and price levels of the remanufactured and newly manufactured products. The model shows that a company involved both in new and remanufactured versions of the same product, endogenously generates interesting customer-base dynamics. Different from the studies in the literature that deal with micro level models, we analyze the effects of being involved in remanufacturing of electronic products on the profitability of the firm at macro level, by taking into account the government incentives for the firms that perform product recovery.

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Simulation based Analysis of Service Levels in Stable Production-Inventory Systems

The performance analysis of a general productioninventory control system under uncertain demand is presented. In the model, the production order releases are determined based on the information feedback on the forecasted demand, work-in-process discrepancy and inventory discrepancy. Stability conditions are obtained in terms of the control parameters that manage the rate at which the above discrepancies are corrected. The service and cost performances of the system in terms of order fill rate, item fill rate and average system cost are analyzed for various values of the control parameters within the stability region. Additional safety stock is considered to help achieve a desired level of service (desired order fill rate). Results based on numerical simulations are presented and their implications are discussed.

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Quantitative systems dynamics: Comparison of modeling techniques for the simulation of electro-mechanical systems

This paper presents some comparative examples of the use of system dynamics (SD) for the modeling of electro-mechanical systems. The authors argue that many simulation models coming from sciences can be easily translated to SD, with a large number of advantages. The work has been developed in a multidisciplinary environment, where a lack of knowledge transfer between practitioners of these di
erent disciplines is appreciable. In everyday practice, it does not exist a clear methodology to evolve from a classical engineer education to a system dynamics approach, from mathematical thinking to SD thinking. As engineers are xed to quantitative results to speci c problems, they need strictly quantitative models, and this use to be a critical point to SD where there is a large amount of qualitative modeling and quantitative modeling with soft variables. Through the comparison of the same problems solved with di
erent modeling techniques, it is possible to show the advantages and disadvantages of each of them, and improve to a better understanding of both approaches.

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Retailer's Order Decisions under Delays: System Dynamics and Experimental Results

When final customer demand exceeds available supply, retailers often hedge against shortages by inflating orders to their suppliers. As several retailers compete for scarce supply, the amplification in orders lead to excess supplier capacity, high inventory variability, low capacity utilization, and financial and reputation losses for suppliers and retailers. While the amplification in orders caused by the competition for scarce resources has been described in the literature almost a century ago (Mitchell 1924), there is little research quantifying the impact of such order amplification by retailers. This paper quantifies retailer order amplification decisions during a surge in demand. First, we motivate the problem and present a simple formal mathematical model describing its dynamics. We then develop an experimental environment to test subjects ordering decisions, when compared to a performance benchmark. Finally, results from different treatments (different ordering and supplier capacity acquisition delays) allow us to characterize subjects performance in this system and formulate a heuristic that closely replicates subjects ordering behavior in all treatments.

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System Dynamics in Reverse Logistics Processes

This paper/poster explores the role and contribution of dynamic models in reverse logistics processes. The purpose of reverse logistics processes within a manufacturing supply chain is to disassemble or reutilize products, or their components, in order to generate value. The first part of the paper describes the general process involved in reverse logistics as found in the supply chain management literature. The second part of the paper presents three dynamic models that represent the main factors driving product returns: The green factor or consumer sensitivity towards environmental issues; the regulatory factor or governmental requirements; and the profit factor or business opportunities. The third part of the paper combines the three factors behind products returns in order to create a general dynamic model of reverse logistics. Emphasis is placed on two

major issues: The non-linear relationships involved in reverse logistic processes and business opportunities as the main driver of reverse logistics. The last section of the paper centers on the similarities and differences of dynamic models that aim to simulate forward logistics and reverse logistics. While forward logistics are centered in concepts such as assembly and bullwhip effect, reverse logistics models emphasize disassembly and funnel-like behavior.

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A System Dynamics Examination of the Use of Performance Enhancing Drugs

Athletes face tremendous pressure to perform, and, when conventional means prove insufficient for performance improvement, some turn to performance enhancing drugs (PEDs). The present paper uses system dynamics to examine one example: the use of anabolic androgenic steroids in Major League Baseball (MLB), which operates in the United States and Canada. The authors provide an explanation of a detailed causal loop diagram of the problem, along with a stock and flow model, based on the Bass Diffusion Model, of part of the problem. They provide a few policy recommendations based on model runs.

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The Egyptian Revolution 2011: The Fall of the Virtual Wall - The Revolution Systems Thinking Archetype

18 days, 850+ martyrs, 6500+ injured are all the quantitative facts of one side of the 25th January 2011 Revolution of Egypt which resulted in the fall and collapse of Mubarak's regime and his power. As for the other sides of the revolution, there are a lot of explanations about its birth and trigger and the dynamism of the pre-revolutionary period as well as during the revolution. Egypt revolution has its similarities to, and differences from all other revolutions that happened across the human history. Many researchers have invested all their efforts to explain and theorize the revolutions in many aspects. This paper is an attempt to apply systems theory on the dynamic parts of the revolution by developing a systems thinking model with the purpose to understand the dynamism of the causal and effects relations among all involved factors/variables in the pre-revolutionary and during-revolution periods till the collapse of the Regime. The by-product of this work is to propose an initial trial to develop an archetype for a revolution.

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Calibration of Complex System Dynamics Models: A Practitioner's Report

A practitioners perspective on the calibration of complex system dynamics models is described in the context of a specific project in which a large, complex business training simulation model was converted from one language into I-Think and design flaws in the original implementation were corrected. The model utilized 57 inputs and provided 296 outputs. The fact that calibration interacts with verification and validation is acknowledged, as well as the fact that the calibration strategy required for large models may not scale practically to smaller models. In additional to traditional best practices such as units checking, sensitivity testing, transient testing and graphical comparison, the paper focuses on a) simplifying and isolating interactions via submodels, using shims, slowing down feedback loops, creating cause and effect maps, testing at submodel level, and checking qualitative variables; b) Redesigning along the way; c) carefully

documenting throughout the process; d) knowing when to step away; and e) building/acquiring automated tools. Having a calibration strategy for a large model is essential. The time required to apply the recommended methods can be significant, but the benefits clearly outweigh these costs. Nevertheless, even experienced modelers often wait too long before initiating the necessary disciplines.

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Evaluation of the effects of congestion-tackling measures in Beijing: a system dynamics approach

This paper presents a modeling framework based on a system dynamics approach. This framework offers policy makers an assessment platform that focuses on the medium-and-long term effects of congestion-tackling measures in Beijing and as a consequence understands the dynamic and complex behavior of affected transportation system in Beijing. The simulation results show that limit new car license plates amount policy is an effective measurement to ease traffic congestion in Beijing.

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Dynamics Model of Eco-Security Surveillance System for the Tamsui River in Taipei City

Current research on river ecosystems in Taiwan is mostly focused on water conservancy, ecology, and afforested viewpoints. There is a lack of integrated strategy on urban river ecosystem management. This study aims to examine river quality based on ecological safety. By means of systems engineering technology, the related ecological safety operation mechanisms have been analyzed. Also, through the new Fuzzy Delphi expert survey, the index system of urban river ecological safety (IES) has been compiled in order to explore the variables. The key indicators affecting urban river ecology safety can be fully defined by sensitivity analysis in order to engage in effectiveness evaluation and to create a dynamic simulation model. The study results indicate that the strategic implementation of improved embankment vegetation structure, a reduction in the degree of river channelization, and the maintenance of a high degree of longitudinal connectivity of rivers can effectively enhance the urban river ecology risk prevention, strengthen the efficient use of resources, and promote the sound development of urban river ecology. Keywords: ecological safety monitoring, Tamsui River, Fuzzy Delphi, system dynamics.

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Exploratory Policy Design

This paper is the first of two that focus on the policy design phase of system dynamics modeling. The literature contains relatively few examples of efforts to restructure a model in realistic ways to alleviate problematic behavior. Much more common is policy parameter analysis, perhaps because it can provide useful policy insights with only a little time and effort. Building new policy structure can be difficult and time-consuming. One reason may be the lack of a framework to guide the policy design process. Good examples of structural modification rarely reveal the method behind the masterpiece; indeed, the method often appears to be more craft than science. This paper proposes a framework to facilitate model-based policy design and thereby enhance the practice. A public health policy

model is used to illustrate the first part of the framework: exploratory policy design. We conclude with a brief preview of the second partimplementation policy designthat is the subject of a companion paper.

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Time to Bite the Hand that Feeds You

The average life expectancy of a company is sadly only 40-50 years. You would think that a company lifetime could easily surpass our lifetimes because many generations can work at a company and pass down its products, brands, know-how, competencies, customer base, etc. to successive generations. But ultimately companies die because they fail to adapt and change. One area of adaption that is the most difficult to navigate is when to start de-investing in the traditional markets that initially built the company, and to invest in building new markets. Too many companies get themselves caught in a trap of continual investment in their core markets, which are no longer growing and missing out on growth adjacencies that can fuel the companys next generation of growth. This paper will explore the reinforcing feedback loops and systemic delays that cause most companies to invest too much and too long in their traditional market and recommends a new R&D portfolio management process that breaks this cycle. Its critical that companies understand what drives long-term success and how to fund innovation and change in a methodical way.

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Raising Implementation Effectiveness of Innovations by Considering Structural Aspects of Organizations

The purpose of this study is to analyze the impact of informal communication networks on the implementation process of innovations within organizations. Therefore, a System-Dynamics model is built to simulate and analyze implementation-specific dynamics that influence implementation effectiveness. The findings of this study suggest that senior management of an organization can use its limited resources more effectively by focusing on employee groups that are connected to each other and by isolating excluded groups from other groups that are not influenced by senior management. In addition, managers should only apply pressure on groups until a specific tipping point is reached after which the innovation diffuses by itself within the respective group. Major limitations of the study are that only one network structure was examined and that all groups are considered to be homogeneous.

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Application of System Dynamics model and GIS in sustainability assessment of urban residential development

Considering rapid population growth and urbanization, sustainability assessment of residential development has become increasingly necessary for understanding environmental impacts and supporting urban planning. In this paper, due to the urban activities cause impacts not only on local level but also a broader scale, a simulation model, using System Dynamics (SD) methodology, was structured to quantitatively investigate the developmental tendency of housing demand and supply. And then the estimated results were displayed in ArcGIS and CityEngine. The integration of GIS and SD model can better explain the interaction and the variation with time of the sustainable indicators for residential development. Hence its able to support the Decision Maker to view the sustainable level of urban residential areas more comprehensively.

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SILVERVIZ: Extending SILVER for coordination in distributed collaborative modeling

System Dynamics modeling projects commonly involve distributed team collaboration. Remote Collaboration can impose substantial burden of extra work for team project coordination, and research suggest that the difficulties of distance coordination have been a major contributing factor in shaping the success or failure of teams in some domains. (Gary M. Olson and Judith S. Olson. 2000). It is currently difficult for modelers to keep track of what changes fellow collaborators have made as a modeling project evolves. While proper information technology support is known to lessen the difficulties of remote collaborations, there is limited software support available for collaboration across System Dynamics modeling projects. The use of general technology such as email systems and wikis can lead to much needless effort to establish common understanding regarding the current status of work and in communicating recent changes. This paper describes the design of an extension to the open source SILVER system that provides a visual workspace that reduces such effort by keeping modelers notified on fellow modelers past activities and changes within modeling project, and to identify commonalities shared by multiple elements of a model.

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Workings of A Public Money System of Open Macroeconomies - Modeling the American Monetary Act Completed

Being intensified by the recent financial crisis in 2008, debt crises seem to be looming ahead among many OECD countries due to the runaway accumulation of government debts. This paper first explores them as a systemic failure of the current \textit{debt money system}. Secondly, with an introduction of open macroeconomies, it examines how the current system can cope with the liquidation of government debt, and obtains that the liquidation of debts triggers recessions, unemployment and foreign economic recessions contagiously. Thirdly, it explores the workings of a \textit{public money system} proposed by the American Monetary Act and finds that the liquidation under this alternative system can be put into effect without causing recessions, unemployment and inflation as well as foreign recessions, and simultaneously attaining a higher economic growth. Finally, public money policies that incorporate three balancing feedback loops are introduced for curbing GDP gap and inflation. They are posed to be simpler and more effective than the complicated Keynesian policies.

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A System Dynamics Approach to the Regional Macro-economic Model

The advent of a depopulating society has become apparent in Japanese economy. There is a rising concern that a declining population diminishes Japanese economic growth. This concern is much more significant in regional economies, in which aging workers in the basic industry or an excessive population decline have been longstanding problems, than the national economy. I have developed a quantitative method for population and economic forecasting to examine the current status of a declining population. Linking the population estimates, which are consistent with the population census, to the macroeconomic model with gross

domestic product by industry, we are able to examine the effect of a depopulating society on the regional economy. The simulation of this model reveals following future pictures: industries, which are dependent on domestic demand, will decline and per capita income will increase for the while. A declining population has an impact not only on macroeconomic outcomes but also on microeconomic aspects inside the region. Many core areas in the economic growth are losing their positions. I will also point out that the interdependency between core areas and peripheral areas has started changing.

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Information Sharing in Supply Chains: A Systemic Approach

In a supply chain system, movements in the end-customer demand is amplified throughout the chain as one moves from the lowest echelon (retailer) to upper echelons (wholesaler, distributor, factory). It is reported that this amplification, which is known as the bullwhip effect, can significantly be reduced by sharing the end-customer demand information. In this paper, we first introduce a four-echelon supply chain model, add penalty variables to it, and simulate the model under two conditions; with and without sharing the end-customer demand information. We observe similar results as reported by other researchers; sharing the end-customer demand information has a strong effect in decreasing the amplification, which also results as decreased penalty values. We then introduce a new approach that requires sharing of further information and run the model with the new decision making heuristic based on this new approach. According to the simulation runs, the decision making heuristic suggested in this paper results in further improvement.

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Systems Modelling of New Media Services

Energy consumption has long been identified as a major sustainability issue through its contribution to global greenhouse gas emissions and the limited supply of non-renewable resources. Current research on energy consumption for online media distribution identifies server operations as a main contributor. Based on work with an online news-publishing group we explore the system dynamics of energy consumption in the distribution of media. Building on concepts developed in a causal loop model based on previous work we present a system dynamics model of energy consumption for online digital media distribution and explore a number of scenarios. According to the model we have developed the future dynamics of energy use for the delivery of media services are apparently bounded by three factors; i) the overall energy efficiencies deliverable by the ICT supply chain into the data centre, ii) the overall media richness of content and how that is effected by investment, mutualisation and content synergy, and iii) growth in the user base. Questions arising from the use of the abstractions for richness, synergy, and mutualisation in the modelling have opened up a profitable area of further work to explore.

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A Simulation-based Analysis of Transition Pathways for the Dutch Electricity System

Recent developments constitute a backdrop of change for the Dutch electricity system. Institutional change driven by liberalization, changing economical competitiveness of the dominant fuels, new technologies, and changing end-user preferences regarding electricity supply are some examples of these

developments. In order to analyze the conjoint impact of such developments on the internal dynamics of the electricity system (grid-based and distributed generation), a simulation model is developed. The simulation experiments with the model indicate the continuation of fossil fuel dominance as the energy source, and a shift from natural gas to coal seems likely in the base case. In other cases, it is seen that a transition away from carbonintensive mode requires significant regulatory intervention, since technological developments and greening end-users fail to trigger a system-wide transition. Moreover, it is observed that policies for carbon abatement and renewable generation support are intertwined, and may lead to unintended shifts of abatement costs to endusers.

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Energy Transition in The Dutch Dwelling Stock: Exploring the Extent of Inertia Against Change

The residential sector accounts for 30% of the total energy consumed by all sectors on average worldwide. This significant share makes an energy transition in the residential sector one of the most important frontiers of sustainability transitions. Netherlands aims to achieve a remarkable reduction in the energy consumption in residential buildings with policies mainly aiming at new constructions, and little attention is being paid to the existing dwelling stock. However, the existing dwelling stock creates an inertia against a transition. Although this is a widely accepted issue, the extent of such an inertia has not been analyzed explicitly. In that respect, we aim to conduct a preliminary study in order to demonstrate the importance of the existing dwelling stock, and the inertia it can cause during an energy transition process. Besides, we also aim to explore effectives of certain policy options that can alleviate this inertia. For that purpose, a simulation model is developed and initialized based on the Dutch housing system. The set of experiments discussed in the paper provides a better understanding about this inertia, as well as what needs to be done for achieving significant progress in a residential energy transition.

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Extending System Dynamics approach to higher index DAE's

The aim of this paper is to propose an extension of System Dynamics approach for modeling systems to systems described by higher index DAEs (Differential Algebraic Equations). Existing implementations of Forresters methodology are commonly based on fixed step integration methods such as Euler or n-order explicit Runge-Kutta. The main reason for using fixed step integration schemes is their simplicity of imple-mentation as well as the the simplicity of modeling environments based on these integration schemes. On the other hand using fixed step integration can lead to incorrect results especially when equations are stiff. The problems with adequate integration schemes can be overcome by using variable stepsize integration methods such BDF or implicit Runge-Kutta. Since these methods require jacobians of right-hand sides of equations these numerical methods must be supported by procedures for evaluating jacobians either by finite difference, or by automatic differentiation (in order to keep the simplicity of modeling environment). Once we have variable stepsize integration procedure we can attempt to extend Forresters approach to systems described by fully implicit DAEs the paper shows how it can be achieved.

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Mechanisms of consumer boycotts: Evidence from the Nestlé infant food controversy

Quality criteria do not only relate to the products mere quality, but to the production and marketing process of the product as well. Customers often express their dissatisfaction with low ethical standards in this area by consumer boycotts. As there are complex relationships between financial aspects and compliance, a system dynamics model is used to unveil causal relationships and explain behavioral patterns. The model highlights the links between a companys dilemma situation and the effectiveness of a boycott for those demanding different corporate conduct. It also demonstrates possible levers for triggering different behavior.

Meetings, Special & Convened Sessions

Listed alphabetically by Session name

Anson Kin Tat Li
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Australasia Chapter Annual Meeting

The Australasian Chapter will have a meeting to discuss whats going on in the region, see how we can help foster the update of SD and welcome interested in joining our little club. Nominations will be called for President.

Barry Richmond Scholarship Award Announcement (External Award)

The Barry Richmond Scholarship Award was established in 2007 by isee systems to honor and continue the legacy of its founder, Barry Richmond. Barry was devoted to helping others become better Systems Citizens. It was his mission to make systems thinking and system dynamics accessible to people in all fields and professions. The award is presented annually to a deserving systems thinking/system dynamics practitioner whose work demonstrates a desire to expand the field or to apply it to current social issues. Applicants are considered based on quality of work as well as financial need. The recipient receives a $1,000 cash scholarship to help offset the cost of attending the annual System Dynamics Conference.

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Benelux Chapter Annual Meeting

The Benelux Chapter of the System Dynamics has been instituted in the beginning of 2011. The objective of this chapter is to provide a platform for information exchange for anyone interested in System Dynamics from Belgium, Luxembourg and the Netherlands. The Chapter has been organizing two conferences in Delft, namely on 02 December 2010 and 16 April 2011. In the annual meeting information will be provided on the present activities of the chapter. The recent activities will be evaluated, future activities will be planned and tasks will be divided.

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Brazil Chapter Annual Meeting

The chapter activities during the year will be discussed and future steps to manage the chapter will be planned. Also this meeting is the opportunity to get involved with Brazil Chapter activities and develop the networking required to develop System Dynamics in our country.

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Texas A&M University

Etiënne A. J. A. Rouwette
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Conference Debriefing Meeting

All are welcome to attend this meeting to talk about what worked and what needed improvement at the conference. Also, please remember to complete and return the conference survey. Post-conference you may complete our online survey at http://www.surveymonkey.com/s/TY8JHZV.

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University of Texas

Ignacio J. Martínez-Moyano
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University of Chicago Computation Inst

Conflict, Defense and Security Roundtable

This roundtable of the CDS/SIG will focus on exchanging ideas related to the focus of the Conflict, Defense and Security SIG and on announcements of SIG activities and plans. The CDS/SIG focuses on modeling and simulation of social phenomena related to conflict and conflict resolution, defense, and security. Some application areas include: cyber security, information security, military applications, terrorism and counter-terrorism actions, and insurgency studies.

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C-ROADS Climate Simulation Roundtable Discussion

We will meet with past and future partners (all interested are welcome) to: -- give free copies of the simulation in Vensim and "Sable" -- give access to support materials to lead the simulation-based role-playing exercise "World Climate" -- share the latest developments in our "Energy Supply" sector of C-ROADS -- hear what users and partners need or think we all ought to do next for system dynamics to accelerate the transition to clean energy and a stable climate -- support each other Session will include C-ROADS modelers, facilitators, interface designers and ambassadors, including Drew Jones, Tom Fiddaman, John Sterman, Phil Rice, Travis Franck, Lori Siegel, and others. (More background is available at climateinteractive.org).

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C-ROADS -- Reflections and New Directions

A team of system dynamicists from Climate Interactive, Ventana Systems, and MIT Sloan have created a policy-maker-oriented climate and energy simulation that is used at the top levels by the US State Department, the Chinese Government, and others. The modeling team will reflect on their lessons about getting a model to be USED and introduce a new extension that explores the energy transition. Drew Jones, Tom Fiddaman, John Sterman, Phil Rice, Stephanie McCauley, Lori Siegel, Travis Franck.

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Dana Meadows Award Announcement

The Dana Meadows Award was established in 2001 to honor the late Dana Meadows and encourage the next generation of students in the field of system dynamics. The award is given annually for the best paper by a student presented at the annual System Dynamics Conference. Students can self-nominate any

manuscript that has been submitted for inclusion in the conference. The winner receives a cash award, a conference registration and an allowance for travel expenses.

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Economics Chapter Annual Meeting and Roundtable

The Economics Chapters annual meetings are dedicated to welcome new members, discuss the past years events and the coming years themes, and to determine the new president elect. At the Seoul conference, discussion centered on a possible model repository at one hand and the possibility of a Special Issue for the System Dynamics Review on the other. For this year, besides the yearly report and the election, the following topics shall be discussed during the annual meeting: 1. Improving the communication between members by a collaborative newsletter. 2. Implementation of a model repository We will have a special roundtable dedicated to the challenging idea of developing a SDR Special Issue.

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Education Roundtable and Education SIG Annual Meeting

The Education SIG of the System Dynamics Society- Developments in 2011 Michael Kennedy University of Bedfordshire Department of Accounting & Finance, School of Business Park Square, Luton, Bedfordshire LU1 3JU E-mail: Michael.Kennedy@beds.ac.uk Carol Frances Claremont Graduate University 165 E. Tenth St. Claremont, CA 91711 E-mail: carolfrances100@hotmail.com Key words: System Dynamics, Education Abstract The System Dynamics Society (SDS) Education SIG continues to pursue it's twin interests in publicising and enhancing both the contribution of System Dynamics (SD) to Education Management and the evolution of the contribution of SD to the curriculum - in both cases the interest spans the whole span of education from K-12 to Higher Education. Please come to the E-SIG sessions to tell us about your work and find out what others are doing. See you there!!!

Andrea Marcello Bassi
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Millennium Institute

Energy Roundtable and Energy SIG Annual Meeting

The Energy SIG Roundtable and Annual Meeting will have two main purposes this year. Firstly, we will update all interested parties on past and present activities and will collect ideas on possible next steps for the Energy SIG. Secondly, specific relevant energy issues will be discussed, to identify what critical contributions the SD community could provide.

Exhibitor Demonstrations

Exhibitor demonstrations will be held during breaks to showcase products and services in practice.

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Advance Management Group LLC

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Formation of a Biomedical System Dynamics SIG - A Planning Meeting

The purpose of this meeting will be to discuss the formation of a biomedical system dynamics special interest group (BPSD SIG). Medical research, medical education, and clinical practice each present a compelling need for deeper, actionable insight into the complex dynamics of biophysical processes at the level

of the individual. Systems within the human body amenable to the disciplines of ST/SD range from the molecular to higher level complex physiological processes. Recent developments in embedding simulation models within clinical applications for individualized care have delivered significant results and clearly demonstrated the feasibility and value of biophysical modeling in healthcare. We would like to have a dialogue with meeting participants about topics of mutual interest and to receive feedback on a proposed action plan aimed at equipping healthcare professionals with the insights and skills to be gained from the application of ST/SD to individualized medicine.

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System Dynamics Society

Getting to Know the System Dynamics Society

This event gives newer conference attendees an opportunity to learn more about the Society and meet a few of the officers. This is a very informal meeting with a web tour of how to best use the Society's website. Most of the time will be spent on questions generated by the audience.

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Health Policy Special Interest Group Business Meeting for Exploring Collaborations

The Health Policy Special Interest Group formed more than eight years ago and has grown to around 300 members (of whom about 80 Society members). We are a worldwide SIG with active collaborations that use dynamic analyses to advance major policy initiatives. Current activities include gathering on-line teaching materials, fostering international collaboration in understanding health system change, and assembling a library of SD health models. Regardless of whether you are new to the field or a veteran modeler, we welcome your participation in exchanging ideas about how SD can better engage and support health policy leaders around the world. HPSIG at will run a poster session, Sunday Session and Business Meeting, covering Highlights of Health Policy Modeling Around the World, with brief summaries of significant activities, including Africa, Asia, Europe, Latin America, North America and Oceania. We will discuss ways of balancing demand, supply and quality in health policy modeling, priorities for practitioners, funders, educators, peer reviewers and the like. The Business Meeting will explore collaborations and elect new office bearers. The Lupina Young Researchers Award in Health System Dynamics will be awarded and a new award will be launched.

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The World Bank

Innovating Through the Crisis: System Dynamics Modeling Applied to International Development Work and World Bank Operations

The recent financial and economic crisis in the worlds richest economies has exposed developing countries, already affected by the lingering impact of the fuel crisis, to an economic slow-down. Moreover, emerging economies continue to face exacerbated challenges in providing adequate nutrition and care to its poor populations. The devastating consequences of weather-related disasters deterred governments' efforts to contain the food crisis and undermined the need for a holistic approach to poverty alleviation agenda. In view of these unprecedented events, it is essential to facilitate nutrition and health efforts and implement effective disaster-risk management strategies. It is also vital to look for new drivers of growth within the hard-hit economies, such as developing information

and communications technologies (ICT). The later are increasingly used as a transformational tool to foster economic growth, accelerate knowledge transfer, develop local capacities, raise productivity, and alleviate poverty in a variety of sectors. To support policy-makers in designing optimal development strategies, this Roundtable aims at bringing together development experts and system dynamics modelers. Although very little known and used by large international organizations, such as The World Bank, system dynamics modeling technique is increasingly proving its applicability and relevance to developing work.

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Latin America Chapter Annual Meeting

The Latin-American Chapter meeting that will place at the 29th International Conference in Washington will bring us the opportunity of interacting and being an actively involved with different colleagues from the Society. We will talk about our annual meeting, the 8th. Latin-American System Dynamics Conference which took place in Medellin, Colombia, November 17 through 19, 2010. (http://convena.upb.edu.co/8encuentrods/). The conference had more than 140 participants, from Colombia, Mxico, Per, Argentina, Brasil and USA. Also we will announce our next conference, which will take place in Brasilia, Brasil, and it will be a great opportunity to joint to the Brazilian Chapter.

Lifetime Achievement Award Announcement and Introduction of Winner

System Dynamics Society occasionally recognizes people for making a significant contribution to a field or a practice over an extended period of time by giving them Lifetime Achievement Award. This is the only award of the Society that is based on a body of work done over lifetime and not on a single article. This award has been given very sparingly in the past, actually only once, in 1999 to Robert Geoffrey Coyle. No nominations are solicited for the award and the Jay Forrester Award Committee decides on the winner. The award carries a plaque recognizing the achievement of the winner. The second lifetime achievement award in System Dynamics Society's history will be presented at the 2011 conference.

Lupina Young Researchers Award Announcement (External Award)

The Health Policy Special Interest Group (HPSIG) of the System Dynamics Society is proud to announce the Lupina Young Researchers Award for work in health system dynamics. The award is sponsored by the Lupina Foundation of Toronto, Canada, and will be accompanied by a check in the amount of CAN$5000. The award will be present to the recipient (or recipients) during the HPSIG meeting on Sunday afternoon just preceding the conference. This award will be given to people at early stages of their careers to encourage them to do further work in health system dynamics.

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Model Analysis Roundtable and SIG-MA Annual Meeting

The Special Interest Group on Model Analysis (SIG-MA) focuses on the development, use and advancement of formal model analysis methods in System Dynamics. These methods currently include: Pathway Participation Metric, Fords

Behavioural Analysis and Eigenstructure-based methods, amongst others. The focus of this group is not so much on the validity of model equations as, given the equations, how can they best be analyzed and interpreted back to reality. The activities of SIG-MA also includes the further development of tools for model analysis and clear communication of their use (and benefits) in applications. The SIG-MA is open to all system dynamicists interested in formal analysis.

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Modeling Assistance Workshop

Modeling assistance is available at the conference to enable people to receive one-on-one coaching with an experienced system dynamics practitioner. Opportunities include two scheduled sessions, as well as the possibility of assistance at any time during the conference. Assistance is available for modelers at any level of modeling ability, from beginner to advanced, with questions about a specific model, methodology, or software. Questions may address problem identification, dynamic hypothesis development, model formulation, model testing, or policy design and evaluation. Modelers should bring whatever materials they need to describe their modeling question, including pencil and paper, articles, books, or laptop computers. Spectators are welcome to observe, and even contribute their own ideas, during the scheduled modeling assistance sessions.

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Newcomer Orientation

The Newcomer Orientation Session is a special event for newcomers (first-time conference attendees) scheduled for either a half hour on Sunday afternoon or at Monday lunchtime (refer to the conference schedule). Newcomers and veteran attendees (guides) will be brought together based on their topics of interest. The guides will answer questions and provide information to help the newcomers get the most out of the conference. The orientation session will "self-organize" into groups to cover general topics, such as: Business, Education, Energy & Environment, Health Policy, Information Science & Information Systems, Security, Economics, Psychology, Public Policy, Social Science, Strategy, and Organizational Change. Newcomers will also be advised of the Society Chapter meetings and the Special Interest Group (SIG) meetings that might match their interests. If you are a newcomer and would like to participate in this program, please check the box on the registration form for first-time participant.

Outstanding Service Award Announcement

The System Dynamics Society Outstanding Service Award recognizes individuals that have, on a volunteer basis, made exceptional contributions to the Society over an extended period of time. The Society has a long and proud tradition of volunteer service, and Julie Pugh, who volunteered as the first Executive Director, has inspired this award. Even after establishing a central office with a paid professional staff in 1996, the growth and development of the Society has been heavily dependent on the work of volunteers. To acknowledge this work, emphasize its importance in achieving Society goals, and highlight efforts that can inspire others, this service award was formally established in 2009. Winners for this award, as well as other recognition awards, are listed on the Society website.

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Panel Discussion: System Dynamics Research in Conflict, Defense, and Security

The recent attempted or actual overthrow of long incumbent governments in Egypt, Iran, Libya, Algeria, and Tunisia, the continuing engagement of Western powers in a number of counterinsurgencies, and a rise in global religious, nationalist, narco- and cyber-terrorism have highlighted the continuing importance of modeling conflict, defense, and security issues. System Dynamics, because of its ability to integrate political, organizational, and material factors, is ideally suited as a vehicle to investigate these great problems. This potential, however, contrasts greatly with the relative sparseness of academic publications in this area. The goals of this panel, which is composed of several distinguished panelists with research in this area, are: (1) Identify specific conflict, defense, and security (CDS) issues that system dynamics academics should be researching and publishing. In particular, are there specific aspects of CDS that need special attention, which have been neglected in the past? (2) Encourage academic research in the CDS area, particularly by discussing the upcoming System Dynamics Review special issue on Modeling and Simulation of Terrorism and Insurgency Movements. (3) Highlight those areas of system dynamics wisdom that is not part of the conventional wisdom with respect to CDS issues?

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Peer Review Dialog Meeting

This year's peer review dialog meeting is the opportunity for all involved in the reviewing process to revisit the efforts undertaken to improve the paper quality of the conference. Conference quality is a complex subject, since it interacts with other conference criteria. Since the outset of this meeting in 2005, many have stressed the need to think and work in terms of the whole processes from the authors to the Programme Committee. This year, we will recall the different proposals; attendees will be invited to examine previous proposals and initiatives, consider the perceived quality of these conferences - including the current one - and to identify priorities and practical ideas that can help to make a contribution to strategically raise the conference quality. Reviewers, thread chairs, members of the Programme Committee and of the Policy Council are invited to invest one hour in this important subject.

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Bogaziçi University

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PhD Colloquium

The PhD Colloquium is a whole day event for students to present and discuss their current research about foundations, techniques, and applications in the area of system dynamics. Junior and senior system dynamics practitioners and academics meet here every year to exchange ideas about students projects in an inspiring international and open-minded atmosphere. Plenary presentations by students at the colloquium will identify common problems encountered by student researchers in their theses. Each presentation will be followed by a discussion session, providing a unique opportunity for learning among all attendants, and particularly for young researchers. Combined with a poster session, we expect the all-day colloquium to be an exciting and insightful event. Even if you are not presenting your work, you are still more than welcome to join the PhD Colloquium for the day. It is a great opportunity to meet students from around the

world and exchange ideas. More information is available at www.systemdynamics.org/chapters/student. Any questions about participating in the colloquium can be directed to phdcolloquium@systemdynamics.org.

David W. Lounsbury
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Einstein College of Medicine Yeshiva

Psychology Roundtable and Psychology SIG Annual Meeting

The Psychology SIG cordially invites you to its annual business meeting and round table, faciliated by Co-Chairs David Lounsbury and Ralph Levine. The business meeting will focus on member updates and on nominating new SIG leadership. The round table will discuss epistemological issues of including psychological, or soft variables, in formulating, simulating, and validating system dynamics (SD) models. Specifically, we will present examples of how qualitative as well as quantitative data can be used to identify patterns of change and interdependent relationships among variables (feedback), and to capture complex behavior modes, including the effect of discrete events. We will also describe how qualitative methods can be used to elicit estimates of key model parameters initial values of the state variables, as well as how cross sectional data to specify table functions that involve non-linear dynamics. Finally, we will present issues concerning model validation and how it is often equated with conducting a statistical analysis of how well the model fits the original, empirical data. Quantitative and qualitative approaches for assessing model output quality and managing output discrepencies will be discussed. Participants are encouraged to share information about their work and to bring questions for group discussion.

SD Career Link

The SD Career Link includes online information and links to organizations that employ candidates with system dynamics and systems thinking backgrounds. The SD Career Link provides a valuable forum for the exchange of information about organizations, positions, and people in the field. Please visit the SD Career Link bulletin board at the conference. In addition to the bulletin board with job postings, plans include a Job Seekers Reception.

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Student Chapter Annual Meeting

Meeting to review activities for the student chapter from 2010-2011 and to select a new leadership team for the next year. All students are welcome!

System Dynamics Applications Award Announcement and Introduction of Winner

The System Dynamics Application Award is presented by the System Dynamics as often as once every two years for the best "real world" application of system dynamics conducted within 10 years of the submission deadline. The best application will be based primarily on demonstrated measurable benefit to an organization through the use of system dynamics, and secondarily for new ideas that improve the art of applying system dynamics, or for related work to existing system dynamics literature and/or other disciplines.

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SYstem Dynamics Italian Chapter (SYDIC) Annual Meeting

Annual meeting for the SYDIC (SYstem Dynamics Italian Chapter) members to monitor and evaluate present year activities and plan next year events/workshops and in general Chapter activities.

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System Dynamics Society Business Meeting

All members and interested parties are invited to attend the annual System Dynamics Society Business Meeting.

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The State of System Dynamics Consulting Roundtable Discussion

The roundtable will build upon the results from the recent System Dynamics Society global survey of the state of SD-based consulting. This setting will allow interested consultants to network directly with one another, and discuss helpful actions following from the survey results.

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Training for the new SDS student/researcher twiki platform

The student chapter of SDS has worked with headquarters to implement a new collaborative Twiki platform that will: 1) enable better diffusion on best practices for SD research and modeling 2) provide a basis for social networking between SD student researchers and others 3) provide a platform for collaborative research and general discussion This hour long workshop will give an overview of the new platform and uses.

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United Kingdom Chapter Meeting

2011: The UK Chapter has regular meetings in the UK, and annually at the international conference. In February we held the 2011 Annual Gathering, with theme of 'Doing (much) More with Less' - in both public sector and corporate settings. You can see the topics of all the great talks we had at the event at www.systemdynamics.org.uk and also view slide-show videos of them all. Congratulations to Peter Lacey who won the Steer-Davis Gleave prize for the best UK application of system dynamics, and Rhys Lewis who won the UK Chapter Student prize for his work on social housing. Our evening networking events have continued: three in 2010. If you are based in the UK and not already on our membership list (membership is free) then please do join on our website and see what we have to offer. There are between 80 and 100 members active in SD in the UK.

Users' Group Meetings

Software users' group meetings will be held during the DC conference.

K-12 Education Developments

Listed alphabetically by First Author within each session.

Session One: Utilizing System Dynamics with K-12 Educators and Students

Chaired by: George P. Richardson and Lees N. Stuntz

For twenty years there has been active work integrating system dynamics into K-12 education using a variety of models. This session will highlight three models of interaction that are currently being used across the US as well as one in China. One is a community-based model that draws on the resources of local business, state based non-profits, and public schools to introduce system dynamics to students. The second example highlights group-modeling work with high school students coached by a local social scientist using a system dynamics methodology. The third presents the use of a system dynamics model to help school systems allocate resources and set priorities. The international model from China includes regional and local education agencies that encouraged the use of SD in education.

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Washington State Coalition

Since 2008 the beginnings of significant, multi-stakeholder interest and activity in systems thinking and system dynamics have been taking place in WA State. This activity has been spurred by a partnership formed between leaders in the ST/SD and environmental and sustainability education (ESE) fields. A catalyst for this growing partnership is E3 Washington: Environment, Education, Economy. E3 Washington has convened leaders in sectors and regions across the state to leverage their common interest in the role of education in the development of sustainable communities. Across the state, leaders from multiple sectors including nonprofits, businesses, tribes, schools and school districts, and government agencies have embraced ST/SD as a central content and pedagogical component of high quality, real-world, applied education system of the future. Key partners across the state including the Office of the Superintendent of Public Instruction, school districts and institutions of higher education have begun to infuse ST/SD as a part of their core curriculum and interdisciplinary environmental and sustainability education programs. This talk will describe key ST/SD initiatives and the role of E3 Washington as a convener, leverage agent and home-base for those pursuing excellence and innovations in education.Two high school teachers, an education researcher, a systems engineer from an aerospace company, and an E3 Washington representative will present.

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Using Group Model Building to Introduce High School Students to System Dynamics

This presentation highlights the experiences and potential of using group model building (GMB) to introduce students and teachers through a series of learning projects. The learning projects were developed as part of larger ongoing collaboration between Ritenour School District and the Social System Design Lab at Washington University in St. Louis. Each GMB project focused on an issue that was relevant to the participants (school safety, educational attainment, and positive teacher-students relationships) and involved students, staff, and administrators as participants. GMB projects were designed and led by university students and staff in the Social System Design Lab, most with a social work interest in K-12. Sessions ranged from single to multiple-session GMB projects using a series of structured or

scripted group model building exercises. The three learning projects illustrated the feasibility of using GMB as a teaching tool for introducingsystem dynamics high school students, training for graduate students in GMB, and capacity building for teachers and administrators in systems thinking. Additionally, participants were able to develop system insights about the structure underlying each issue and identified potential solutions.

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MinSim

Since A Nation At Risk in 1983, America has struggled with various educational reform strategies, none of which has produced any lasting impact. Can system dynamics help explain these failures and suggest better questions and alternatives? This presentation introduces a newly revised and simplified version of a system dynamics model of student performance. The model has been used for planning and policy analysis by educators and others over the last decade. This presentation will focus on its utility as an education version of the Beer Game that demonstrates the power of nonlinear feedbacks and delays in system dynamics.

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Open a New Window, Watch the World with the View of "System"

In 2002, Nanjing Education Bureau began to develop the research on Systems Thinking Application on Creative Teaching. In 2004, the first Systems Thinking learning group was established in High School Affiliated to Nanjing Normal University and in 2005, Systems Thinking was offered as an elective course. We have optimized the course and finished the book systems thinking----school-based curriculum textbook for high school. For many years, systems thinking changes students cognitive model, thinking model, also changes the teaching method. Systems thinking brings to students a comprehensive view and rationality towards the matter in their future life, who might forget some scientific knowledge after leaving school, but will be accompanied by systems thinking for all their life time. We will definitely have a more authentic understanding of our world, if we use the eyes of systems thinking to see every matter surrounding us and try to find interactional relations and the essence of influences.

Session Two: What Does System Dynamics Look Like for Students aged 5-18?

Chaired by: George P. Richardson and Lees N. Stuntz

What do students aged 5-18 do with system dynamics in schools?? This session brings together different examples of how students are using system dynamics in their learning through direct student presentation and videos of students as well as descriptions from master teachers. Examples will show students of a variety of ages using system dynamics in their learning, students presenting models they have built, and a student with the drive and energy to single-handedly create a system dynamics club in his school.

Anne LaVigne
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Waters Foundation

Systems Thinking for Students in Elementary and Middle Schools, Tucson AZ

The Waters Foundations Systems Thinking in Schools Project has been encouraging use of systems thinking and system dynamics in K-12 education for

more than twenty years. This presentation will show what the students themselves say about their learning, through videos of primary and middle school students.

Yannick Ngana
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Haig Dynamics

Creating and Sustaining the Haig System Dynamics Club, Toronto, Canada

The purpose of this session will be to share the story of Haig Dynamics, the System Dynamics Club at Earl Haig Secondary School. This will include the rationale of Haig Dynamics, its mandate as well as its goals and objectives. It will also consist of a recapitulation of the achievements of Haig Dynamics, including the topics discussed, models created, and any feedback from students regarding System Dynamics. This presentation will also embrace lessons learned, including problems the club had encountered and our approach and teaching techniques used. The presentation will include sharing one of the highlights of this year, our System Dynamics Conference, as well as the Haig Dynamics sustainability strategy beyond the founding members. The purpose of this session will be to share the story of Haig Dynamics, the System Dynamics Club at Earl Haig Secondary School. This will include the rationale of Haig Dynamics, its mandate as well as its goals and objectives. It will also consist of a recapitulation of the achievements of Haig Dynamics, including the topics discussed, models created, and any feedback from students regarding System Dynamics. This presentation will also embrace lessons learned, including problems the club had encountered and our approach and teaching techniques used.

Dexter Chapin
dchapin@seattleacademy.org
Seattle Academy

System Dynamics in the Sustainable Systems High School Elective, Seattle WA

Systems thinking and modeling are integral parts of the Sustainable Systems Electives taught to high school seniors at Seattle Academy. This presentation will explain the over-arching goal of increasing student historicity, or the ability to intervene in ones existence, and will connect that goal to a list of objectives achieved by the systems thinking part of the curriculum. Introductory models and how they are used in class will be illustrated, along with a class-built model of intervening for sustainable development. The final portion of the presentation will be a video of a student explaining how System Dynamics modeling played a major role in her post-graduation life. Presentation will be Power-point, including links to functioning models, and video.

Diana Fisher
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Wilson High School

High School Students' Models, Portland OR

Students struggle with abstract concepts. To build an understanding of core concepts in math (algebra, pre-calculus, calculus), in the life sciences, in environmental science, in the physical sciences, in the social sciences, in economics, in the health sciences the creation of visual models has proven to be a powerful and practical tool. Students who have been trained to build models of feedback systems, using a visual software tool have already shown they can think deeply and carefully analyze complex behavior in many situations. Examples of lessons for students and of student work that has taken place at the high school level for over 15 years will be presented.

Chapter & SIG Poster Presentations

Listed alphabetically by Chapter or Special Interest Group name

Australasia Chapter

Anson Kin Tat Li
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University of Auckland

Kambiz E. Maani
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University of Queensland

A collage of Australasian system dynamics work submitted by practitioners, educators and students from the South Pacific.

Benelux Chapter

Inge L. Bleijenbergh
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Radboud University Nijmegen

Erik Pruyt
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Delft University of Technology

The Dutch Chapter of the System Dynamics Society has the objective to provide a platform for information exchange for anyone interested in System Dynamic from Belgium, Luxembourg and the Netherlands. The Benelux Chapter Poster Session will give an overview of recent research activities on System Dynamics going on in this region. It will also provide information on the activities of the Dutch Chapter.

Brazil Chapter

Ricardo Matos Chaim
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University of Brasilia

The Brazilian Chapter was founded in February of 2003 and refounded in December of 2010. With about 33 members registered at SDS and with the mission to promote SD in government and organizations in Brazil, for this year the chapter will host a mini-conference in Brasilia-DF in conjunction with the Latin American Chapter. With the support of University of Brasilia, it will be an opportunity to welcome new members and discuss new ways of actuation. More information of our activities is available from the website at http://www.sdsbrazil.org. If you would like to join us please contact Ricardo M. Chaim (ricardoc@unb.br), Isaias Custodio (isaiasc@fia.com.br) or Niraldo Nascimento (niro.nash@gmail.com)..

China Chapter

Ying Qian
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Shanghai University

An important event for year 2010 was the 4th International Conference on Systems Science, Management Science & System Dynamics (SSMSSD), held in Shanghai from Dec.10 to 11, 2010. This conference turned a Biennial conference to an annual conference, offering more opportunities of communication and presentation for scholars, researchers and students. More fresh academic works were demonstrated. This conference, we received 453 paper submissions. 240 papers were accepted, with an acceptance rate at 53%. More than 100 authors shared their research at the conference. The topics covered in this conference included system dynamics methodology and its application in business management, environment management and etc. In 2011, from Oct, 20th -22nd, we will have the 5th International Conference on Systems Science, Management Science & System Dynamics, together with the celebration of the 10-year

anniversary of Tongji Development Institute. Tongji Development Institute is the leading institute for system dynamics research in China. 10 year ago, Professor Wang Qifan, together with other SD researchers, established this institute aiming at promoting system dynamics research in China. A gathering of system dynamics researchers will be held and together we will review our prior work and seek future development.

Edward G. Anderson
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University of Texas

Ignacio J. Martínez-Moyano
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University of Chicago Computation Inst

Conflict, Defense and Security Special Interest Group

This SIG focuses on modeling and simulation of social phenomena related to conflict and conflict resolution, defense, and security. Some application areas include: cyber security, information security, military applications, terrorism and counter-terrorism actions, and insurgency studies.

Martin F. G. Schaffernicht
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Universidad de Talca

Economics Chapter

The Economics Chapter aims to make contribution to economics in research and education. It is a geographically dispersed chapter. Members use a discussion list to keep in contact, and the main meeting point is the international conference with the "economic dynamics" thread and the yearly meeting. Applications have tended to be found in the areas of money, banking and finance at one hand and in economic development on the other. Other members have made theoretical contributions based upon the particular methodological viewpoint of system dynamics. Still other members develop contributions to education in economics. Geographic dispersion brings with itself the challenge to sustain dialog and collaboration, which is an area of ongoing effort. Since the annual meeting at Seoul, the idea to elaborate a Special Issue for the System Dynamics Review has gained support and we are looking forward to make a decisive step during the current conference.

Michael S. Kennedy
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University of Bedfordshire

Carol Frances
carolfrances100@hotmail.com
Claremont Graduate University

Education Special Interest Group

SIG: Education Special Interest Group Poster Session 2011 Michael Kennedy University of Bedfordshire Department of Accounting & Finance, School of Business Park Square, Luton, Bedfordshire LU1 3JU E-mail: Michael.Kennedy@beds.ac.uk Carol Frances Claremont Graduate University 165 E. Tenth St. Claremont, CA 91711 E-mail: carolfrances100@hotmail.com Key words: System Dynamics, Education Abstract The System Dynamics Society (SDS) Education SIG continues to pursue it's twin interests in publicising and enhancing both the contribution of System Dynamics (SD) to Education Management and the evolution of the contribution of SD to the curriculum - in both cases the interest spans the whole span of education from K-12 to Higher Education. This Poster describes our activities. Please come to the E-SIG sessions to tell us about your work and find out what others are doing. See you there!!!

Andrea Marcello Bassi
ab@millennium-institute.org
Millennium Institute

Energy Special Interest Group

The Energy SIG poster session will update all interested parties on past and present activities of the SIG and will include relevant recent events that may stimulate conversations on the potential contribution of SD to the energy field.

Jürgen Strohhecker
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Frankfurt School of Finance and Mgt

German Chapter

The German Chapter advances networking and collaboration among system dynamicists in Germany. The Chapter has 113 members per end of April 2011 (of which 5 are corporate members) and keeps more than 280 interested researchers, managers, and students updated through its e-mail newsletter. System Dynamics colloquia and roundtables are regularly organized in various German cities (Frankfurt/Main, Munich). These events provide a basis for meeting fellow system dynamicists and for discussing modeling projects. On May 26-27, 2011, the Chapter's 5th Annual Meeting is held in Wolfsburg. This event brings together modelers from the scientific and corporate world, and by combining talks, presentations, and modeling exercises, it offers a formidable and appreciated platform for establishing links within the community as well as for actively advancing SD skills. More information on the activities of the German Chapter is available from our website at http://www.systemdynamics.de (in German).

Erik Pruyt
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Delft University of Technology

Health Policy Special Interest Group

The aim of the poster presentation of the Health Policy Special Interest Group is to attrackt new SIG members active in Health Policy and/or to motivate conference participants to do (more) Health Policy related work.

Karan Khosla
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EarthSafe Products and Services

India Chapter

The India Chapter hosted its first annual conference, in May 2011, in Pune, Maharashtra. Many of the participants at the conference are practitioners in various fields across India; conference proceedings and other a sample of some of the recent work (games etc) of members will be displayed. Collaborations and advice on support for future activities is welcome!

Dong-Hwan Kim
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Chung Ang University

Eun Kyu Lee
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Chung Ang University

Korea Chapter

We will presents our activities including hosting international SD conference at 2010, monthly seminars held at 2010 and 2011, a SD lecture delivered by our chapter at Feb 2011, and a SD book published 2010 by our chapter with the title of "Beyond Broadcasting and Communication Convergence: Challenge for Green Planet and Converging Response".

Valerijs Skribans
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Riga Technical University

Latvian Chapter (Proposed)

Sytem dynamicsts at Riga Technical University are interested in planning a Latvian Chapter of System Dynamics Society. Plans will be presented at the Chapter / SIG Special Poster Presentation session.

Latin America Chapter

Gloria Pérez Salazar
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Tecnológico de Monterrey

Isaac Dyner
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Universidad Nacional de Colombia

Martin F. G. Schaffernicht
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Universidad de Talca

The Latinamerican Chapter, a positive feedback loop The Latinamerican Chapter has the mission to help the SD-community grow in the Spanish speaking countries. Founded in 2003, it has Latinamerican members from Mexico to Chile, from Spain and a growing number of Spanish speakers living in other countries. Since 2003, the annual meeting allows practitioners to gather and newcomers to get in to touch; we have been in Mexico, Chile, Colombia and Argentina so far. These conferences are the base of our positive feedback loop: each year the number of works submitted and presented is increased. Since 2005, the Spanish Revista de Dinmica de Sistemas publishes two numbers per year. The sisTEMAS newsletter and a mail list allow keeping in touch. During 16-18 November, the 9th Latinamerican Conference will take place in Brasilia, Brasil, organized by Universidad de Brasilia (http://www.sdsbrazil.org/congreso.htm.) If you would like to join us please contact Gloria Prez (gloria.perez@itesm.mx), Isaac Dyner (idyner@unalmed.edu.co) or Martin Schaffernicht (martin@utalca.cl).

Psychology Special Interest Group

David W. Lounsbury
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Einstein College of Medicine Yeshiva

The Psychology SIG is a venue for discourse and learning about ways of integrating psychological processes into system dynamics models and to apply system dynamics methodology to the formation of psychological theories. Psychology SIG members seek to promote the following interests and aims: (1) To build psychological and social constructs and processes into more classical system dynamics models, including community-level models, where such constructs and processes would help in understanding the underlying dynamic problem of interest; (2) To develop new molecules or mini-models of psychological processes to promote deeper understanding of existing psychosocial and behavioral theories and to generate new psychological and behavioral theories of psychosocial and behavioral dynamics; (3) To apply system dynamics to a wide range of clinical, public health and community problems to improve therapies and interventions for individuals, couples, families, groups, and communities.

Russian Chapter

Natalya N. Lychkina
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State University of Management

Russian Chapter Poster demonstrates activity of science and business schools, conferences and consulting groups in Russia.

Special Interest Group on Model Analysis (SIG-MA)

Jim Duggan
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National University of Ireland Galway

The Special Interest Group on Model Analysis (SIG-MA) focuses on the development, use and advancement of formal model analysis methods in System Dynamics. These methods currently include: Pathway Participation Metric, Fords Behavioural Analysis and Eigenstructure-based methods, amongst others. The focus of this group is not so much on the validity of model equations as, given the equations, how can they best be analyzed and interpreted back to reality. We plan to expand our activities to the further development of tools for model analysis and clear communication of their use (and benefits) in applications. Open Membership of the SIG-MA is open to all system dynamicists interested in formal analysis.

Katherine Dykes
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MIT

Student Chapter

The student chapter has implemented several new initiatives in 2010-2011 including the launch of a new online store, an overhaul to our website using the interactive web platform "twiki" and changes to our annual colloquium format. This poster will highlight chapter activities from this past year.

Lukas Schmid
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FHS St Gallen

Justus Gallati
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Univ of Applied Science St Gallen

Swiss Chapter

The Swiss Chapter is currently focused on regular chapter meetings, a PhD colloquium, and an annual seminar. The PhD colloquium is the sole opportunity in Switzerland for many PhD students using system dynamics in their research to share their work with students and with peers. It contributes to creating a network between students and universities in Switzerland. Currently it is organised by Ccile Emery from University of Lugano. The annual seminar is aimed at deepening various aspects of systems thinking and system dynamics of interest to practitioners primarily. It offers a platform for learning and exchange in the Swiss chapter and became an important event. System dynamics and systems thinking are being taught increasingly at various universities in Switzerland. A Swiss association called sysdyn (www.sysdyn.ch) promotes system dynamics as a method for teaching and problem solving in high schools and universities. System dynamics in education is expected to become a focal point in our chapters activities. We have also made our website more interactive (www.systemdynamics-swisschapter.ch). We look forward to hosting the international conference in 2012 in Switzerland with many fruitful opportunities for exchange and mutual learning in a beautiful environment! Justus Gallati, Lukas Schmid (co-presidents of the Swiss chapter).

Habib Sedehi
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University of Rome

SYstem Dynamics Italian Chapter (SYDIC)

The annual report of the Chapter members is presented by a graphic poster which will point out, through the geographic distribution along Italian territory, the main activities of the operative members both in the accademic area and in the professional sector.

Kim D. Warren
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London Business School

United Kingdom Chapter

2011: The UK Chapter has regular meetings in the UK, and annually at the international conference. In February we held the 2011 Annual Gathering, with theme of 'Doing (much) More with Less' - in both public sector and corporate settings. You can see the topics of all the great talks we had at the event at www.systemdynamics.org.uk and also view slide-show videos of them all. Congratulations to Peter Lacey who won the Steer-Davis Gleave prize for the best UK application of system dynamics, and Rhys Lewis who won the UK Chapter Student prize for his work on social housing. Our evening networking events have continued: three in 2010. If you are based in the UK and not already on our membership list (membership is free) then please do join on our website and see what we have to offer. There are between 80 and 100 members active in SD in the UK.

Workshops

Listed alphabetically by Workshop name

Yudi Xue
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University of Saskatchewan

Nathaniel Osgood
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University of Saskatchewan

A Hands-On Introduction to SILVER: Software in Support of the Collaborative System Dynamics Modeling Process

While the System Dynamics modeling process can offer invaluable high level insights, it gives rise to a tremendous amount of detail complexity. In the course of their work, modelers must track successive model versions, the motivation for and assumptions underlying particular what if scenarios, and the implicit relationships between scenarios, model versions and various external artifacts such as spreadsheets, symbolic mathematics calculations, and external documentation. Moreover, the current fragmentation of information also raises barriers to effective group collaboration: Stakeholders located remotely from a core modeling team frequently lack ready access to modeling artifacts and output, and sharing even within the modeling team can be awkward and confusing. This workshop will provide a hands-on introduction to open-source SILVER software that seeks to ease management of such complexity, and to facilitate distributed team collaboration. SILVER allows stakeholders to easily access historic versions of a model, maintains explicit linkages between scenarios, the model versions and assumptions underlying them, and the motivations for and external files associated with model artifacts. To facilitate group collaboration, SILVER supports sharing remote project repositories and facilitates awareness of group activity with a visual workspace providing an interactive depiction of project structure, the relationship between artifacts and other information.

Leonard A. Malczynski
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Sandia National Laboratories

Imrana A. Umar
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Powersim Solutions

Advanced Modeling with Powersim Studio

A look at some of the advanced features of Powersim Studio (e.g. IDE, ranges, rsik analysis, optimization, interface techniques, model quality, etc.).

Andrei Borshchev
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XJ Technologies

George Gonzalez-Rivas
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AnyLogic North America

Timofey Popkov
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XJ Technologies

All About AnyLogic - an intro for those new to AnyLogic and a new features update for experienced users

AnyLogic is the only simulation development environment that allows you to build not just System Dynamics models but also Multi-Agent and/or Discrete Event simulations as well. What's more, you can combine them, at the same level or hierarchically, into elaborate Hybrid models. Why? Because more languages and high-level constructs means fewer "workarounds" and "simplifying assumptions" your model can more closely follow your system -- which is the whole point, right? Come by the AnyLogic booth or Workshop to learn more and to see the exciting new changes we've made to have our GUI more closely match the SDS standard look and feel.

Kaoru Yamaguchi
kaoru3@muratopia.org
Doshisha University

An Introduction to Macroeconomic Modeling - Accounting System Dynamics Approach

Macroeconomics is one of the core subjects in social science and behaviors of marcoeconomy such as the recent financial and debt crises affect all of us. With the help of system dynamics method, this workshop tries to explore the macroeconomic system structure and its complex behaviors by introducing a step-by-step construction of macroeconomic models based on the accounting system dynamics approach. Specifically, participants will learn the following modeling methods: double-entry booking/accounting system dynamics (which is itself helpful for business modeling), money supply by the central bank and creation of credit process through a fractional reserve banking system, Keynesian macroeconomic models, including IS-LM model and an integrated macroeconomic model of real and monetary sectors. All models are distributed in the class, which run on Vensim Model Reader, a free shareware for PC and Mac. Participants are recommended to download it and bring their laptops. Yet no knowledge of Vensim Software is required, not to mention economics. Running the models step-by- step, participants are invited to the world of macroeconomic system, and explore a complex structure of macroeconomic behaviors, through simulation, with their own working hypotheses of macroeconomic scenarios.

Thomas Fiddaman
tom@metasd.com
Ventana Systems

Building and Analyzing Models with Vensim

This hands-on workshop will introduce the basics of building and analyzing a feedback model using Vensim. The class will center around a variation of Dennis Meadows' classic commodity model. Participants will reconstruct portions of the model in order to master the mechanics of building simple stock-flow structures and exploring positive and negative feedback behavior. We will create a simple control panel for the model. Then we will use those tools to work through a critique of the model, making on-the-fly changes to the structure and parameters, and exploring the implications of decision rules. Participants will walk away with a basic understanding of the process of building a model with Vensim, using it to gain policy insight, and assessing model quality.

Joanne C. Egner
jegner@iseesystems.com
isee systems

Jeremy Merritt
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isee systems

Creating Simulations for the Web with STELLA and iThink

This workshop is intended for new or current STELLA and iThink users who want to share models online. Using STELLA or iThink, participants will create a web interface to a model and publish it online with the isee NetSim wizard - no HTML programming required! The session will be conducted as a hands-on workshop and will include guided instruction for creating an interface to a model, publishing models online with isee NetSim, and editing models that have already been published. Participants are encouraged to bring their own models for publishing and sharing with others online. Please bring a computer with the current version of STELLA or iThink and isee NetSim installed or arrive 15 minutes early to install the software.

Kim D. Warren
kwarren@london.edu
London Business School

Christina Spencer
cspencer57@gmail.com
Strategy Dynamics Ltd

Getting Started with My Strategy Software

In this workshop, we will give a short summary of the main benefits that mystrategy offers, compared with larger, more complex and more costly system dynamics software. We will also offer existing users a chance to raise suggestions that have arisen from their use of the software.

J. Chris White
jcwhite@viasimsolutions.com
ViaSim Solutions

Robert Sholtes
rsholtes@simblox.com
SimBLOX LLC

Getting Started with pmBLOX

This workshop will provide instruction on how to use pmBLOX, the only commercially available project planning tool that uses SD as its foundation. The workshop is intended for SD practitioners (at any level) that are involved in project management or scheduling for their organizations. The session will be conducted as a hands-on workshop and will provide software that participants can use at their own organizations. Participants will learn how to navigate pmBLOX, how to build project plans within pmBLOX and run simulations, how to import plans from Microsoft Project format, and how to conduct advanced analyses that are not available in planning tools today. Participants should bring their own computers. Prior to the session, participants can download the required pmBLOX software application at www.pmblox.com. CDs will also be provided at the workshop. People without computers are welcome to watch or team up with some else that brought a computer.

Leonard A. Malczynski
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Sandia National Laboratories

Imrana A. Umar
imrana.umar@powersimsolutions.com
Powersim Solutions

Getting Started with Powersim Studio

This workshop will be an introduction to building system dynamics models using Powersim Studio. The workshop is intended for people who are relatively new to the field or do not have experience using Studio. The session will be conducted as a hands-on workshop and will demonstrate basic techniques for building and analyzing causal loop diagrams, stock and flow diagrams and simple simulation models. It will also point out some of the advanced Studio features such as arrays, user interface tools, VB scripting, and the powerful Studio interactive development environment (IDE). Sample models will be available.

Joanne C. Egner
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isee systems

Karim J. Chichakly
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isee systems

Getting Started with STELLA and iThink

This workshop will be an introduction to building and communicating system dynamics models using STELLA or iThink software. The workshop is intended for people who are relatively new to the field or do not have experience using the current version of STELLA or iThink. The session will be conducted as a hands on workshop and demonstrate basic techniques for building, analyzing and communicating simple simulation models. Participants should bring their own computers with the current version of STELLA or iThink installed or arrive 15 minutes early to install the software.

J. Chris White
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ViaSim Solutions

Robert Sholtes
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SimBLOX LLC

Getting Started with the Beer Game on Steroids (BGOS)

This workshop is intended for SD practitioners looking to apply the concepts of the Beer Game to real-world supply chains. The session will be conducted as a hands-on workshop and will provide software that participants can use at their own organizations. Instruction will be provided for how to navigate the BGOS application, how to set up simulations in BGOS, how to plot results, and how to make model changes. Participants will learn how to model large, complex supply chains using a simple drag-drop-connect approach. Participants should bring their own computers. Prior to the session, participants can download the required BGOS software application at www.beergameonsteroids.com. CDs will also be provided at the workshop. People without computers are welcome to watch or team up with some else that brought a computer.

Lees N. Stuntz
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Creative Learning Exchange

Diana Fisher
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Wilson High School

Anne LaVigne
a.lavigne@watersfoundation.org
Waters Foundation

Hands-on Simulation Curriculum in K-12 Education

This interactive session will highlight resources available for K-12 students, with illustrations of various curricula available on the Internet and in published form. This will include recent work done in a personal finance curriculum, simulations from the Characteristics of Complex Systems Project as well as both new and older time-tested lessons. Please bring your computers.

Jennifer M. Andersen
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P. Jeffrey Potash
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CIESD

Jack B. Homer
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Homer Consulting

Bobby Milstein
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Fannie E. Rippel Foundation

Gary B. Hirsch
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Creator of Learning Environments

HealthBound: The National Health Reform Game

The HealthBound game (available online at http://www.cdc.gov/HealthBound) was developed in 2008-09 under the auspices of the US Centers for Disease Control and Prevention, and was described in a plenary talk at ISDC 2009 in Albuquerque. The underlying SD model is the most integrative tool available anywhere for national health policy analysis, and presents the challenge of balancing different types of policies in order to effectively improve population health, lower costs, and achieve greater equity. This workshop starts with introduction to the model and the game, followed by an extended opportunity for small teams to experiment and play the game at their laptops, and concluding with discussion of results and their implications.

Michael Bean
mbean@forio.com
Forio Online Simulations

William Schoenberg
wasbridge@gmail.com
Forio Online Simulations

How to Build Collaborative Online Planning Simulations for Public Policy and Business

Modelers building simulations for long-term public policy or business planning need to be aware of the varied needs of their clients. During this workshop simulation developers Billy Schoenberg and Michael Bean of Forio Online Simulations will lead you through the deconstruction of an example planning simulation in order to show you techniques you can use when you build collaborative online simulations for your own clients. We will show you how you can leverage Forio Simulate, a web-based development environment to create simulations using drag-and-drop design tools. No programming skills are required. Topics we will cover include: 1. Using browser-based drawable Line graphs for creating varied scenarios. 2. How to create run comparisons to allow

your clients to explore the differences in the scenarios they create 3. How to share scenarios online among different users through a web browser. 4. Techniques for separating assumptions from policies or strategy decisions. Our presentation will start explain how each of these features can be developed using tools available online. Throughout this workshop we will be using Forio Simulate to illustrate the development process.

Michael Bean
mbean@forio.com
Forio Online Simulations

William Schoenberg
wasbridge@gmail.com
Forio Online Simulations

How to Build Online Simulation Games for Classroom Use

Building sims for the classroom can be a daunting task. Simulations need to be easy to use, easy to debrief, engaging, and resistant to user error or technology breakdowns. During this workshop online simulation developers Billy Schoenberg and Michael Bean will lead you through the techniques Forio has developed over the past decade for building online simulations for use in the classroom. We will show you how you can leverage Forio Simulate, a web-based development environment to create simulations using drag-and-drop design tools. No programming skills are required. Topics we will cover include: 1. Building effective debriefing tools for faculty. 2. Creating scenarios for multiple classes. 3. Creating engaging user interfaces. 4. Making sure your simulation is re-usable across different classes in multiple semesters. 5. Creating in sim quizzes so you can get instant feedback from your students. We will spend the first quarter of the session reviewing simulations we have built for MIT, Harvard, Kellogg, and others. During the rest of the workshop we will build a classroom simulation with you. As always there will be plenty of room for Q&A throughout the entire session. Laptops are not required for this workshop but you are welcome to bring one and follow along with us.

John D. W. Morecroft
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London Business School

Metaphorical Models for Limits to Growth and Industrialisation

In this interactive half-day workshop we develop and run system dynamics models and simulators to explore sustainability and limits to growth in industrial society. I first describe a small model of the fishing industry. I then use the same model as a metaphor to think about global growth and industrialisation and to interpret the closed-loop feedback structure and dynamics of Jay Forresters World Dynamics model. This famously concise (yet dynamically intricate) model represents an industrial society whose growth is eventually curtailed. We also consider how the conceptual framework from World Dynamics might be adapted to address the societal effects of global warming. In the spirit of SD conference workshops, participants not only listen but also join-in. There is an opportunity to build a tiny metaphorical model and to run a sustainability simulator. We then use these experiences to discuss the role of models in shaping public debate and political action on global warming and climate change.

Diana Fisher
diana.fisher2@frontier.com
Wilson High School

Modeling Dynamic Systems: Lessons for a First Course

Modeling Dynamics Systems: Lessons for a First Course (third edition) provides a set of materials that enable educators at the secondary and college levels to teach a one-semester or one-year course in System Dynamics modeling. These lessons are also useful for trainers in a business environment. Developed for

beginning modelers, the lessons contained in this book can be used for a core curriculum or for independent study. The lessons include some of the classic System Dynamics problems (population change, resource sustainability, drug pharmacokinetics, spread of an epidemic, urban growth, supply and demand, and more). Feedback analysis is integral to the lessons. Guidelines for an independent project and an outline for a technical paper explaining the creation process and structure of the final model, together with scoring guides for both the model and the paper, are included. Participants in the workshop will have a chance to build some simple models (participants should bring laptops) and gain a sense of the progression leading to a more sophisticated model. Student work will be demonstrated and can also be viewed at www.ccmodelingsystems.com. New materials in the third edition (oscillations, transfer of loop dominance, mapping systems in the news,) of this book will be presented.

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Optimization with Vensim

This workshop will introduce the process of optimizing dynamic feedback models using Vensim. We will look at two uses for optimization: calibration and identification of good policies. We will work with a simple market model to estimate parameters consistent with data, and then develop a marketing policy that works well in the calibrated market. The workshop will focus primarily on practical aspects of optimization, but will introduce enough theory to give participants insight into the fundamentals of the process.

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Policy Modeling Workshop

This workshop focuses on the policy design phase of system dynamics modeling, when efforts are made to change a model in realistic ways to alleviate problematic behavior. The participants practice with a disciplined and structured method of policy modeling. Participants design policies for some interesting public policy and business issues.

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Reviewing for Conferences and Journals

Writing and publishing is necessary in academia. The main objective of the workshop is to improve reviewing skills. The workshop familiarizes the participants with the specifics of reviewing System Dynamics-based manuscripts and thereby improves their capabilities to write such papers. Anybody interested in reviewing and writing in the field of System Dynamics is welcome. Experts in the field will address such questions as: What constitutes a good review? What are the differences between reviewing empirical and theoretical papers? How should reviewers handle papers outside their area of expertise? What are editors looking for in reviews and reviewers?

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System Dynamics Model Documentation and Assessment Tool (SDM-Doc)

Extending work by Oliva (2001) on model documentation, the System Dynamics Model Documentation and Assessment Tool (SDM-Doc) developed at Argonne National Laboratory (ANL), in an effort to enhance model transparency and robustness, creates HTML-based documentation of models developed with Vensim. The model documentation created by the SDM-Doc tool allows modelers

to navigate through model equations and model views in an efficient and practical way creating documentation of the model sorted by variable name, type of variable, group, view, module, module/group/name, and variable of interest. Additionally, model tests are performed allowing modelers and reviewers of models to gain confidence in fundamental characteristics of model structure. The tool, its use, and the different model assessments included in it will be presented and explained. Participants are encouraged to bring their laptops to be able to use the tool during the workshop. A copy of the software will be distributed to participants at the workshop.

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Using Simulation to teach project management skills

Come for a half-day session on using simulation to teach basic software project management skills to students. This session will show how to students test the impact of their decisions and iterate to achieve the preferred outcome. Dr. A. April is the dean of Software Engineering & IT at TS University in Montral, Canada and he will lead this workshop.

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