Proceedings of the 27th International Conference

July 26 – 30, 2009
Albuquerque, New Mexico, USA

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Welcome

Dear Colleagues,

Bienvenidos! Welcome to the 27th International Conference of the System Dynamics Society. This year we head west, the Western United States that is, specifically Albuquerque, New Mexico, The Land of Enchantment. This is your opportunity to learn, to energize, and to enjoy.

Including the PhD Colloquium and the Bonus Day, over the next six, yes six, days you will have a chance to present, listen to and discuss system dynamics work presented by academics and practitioners from around the world. This year for the first time there will be a day dedicated to K-12 education and system dynamics. Plus, on Friday, the Bonus Day, there will be a wide variety of exciting opportunities.

The conference is a wonderful opportunity to meet an amazing collection of people. We encourage you to walk up and say hello to everyone – generally we are a pretty friendly bunch. We are always energized when meeting friends and colleagues and making new ones, not to mention the wonderful opportunities to ponder practical and methodological issues with them.

To further increase your enjoyment of the conference we have also scheduled a variety of social events including a Welcome Reception on Sunday night, an informal visit to Old Town Albuquerque on Monday night, and the Conference Banquet on Tuesday. We also welcome those who may be accompanying conference participants but not attending the formal sessions. We hope that you will take part in the special events and enjoy the attractions of New Mexico including the pre-arranged tours, children's activities, and visits on your own, including Santa Fe.

This year, 415 volunteer reviewers screened and commented on a record number of submissions. In addition, many dozens of volunteers worked many hours to ensure a successful conference; without their commitment our conference would be impossible. A special thank you goes to all who helped.

In addition to all our sponsors and our conference host, Sandia National Laboratories, we are also very fortunate this year to have The Boeing Company as a conference partner. We sincerely appreciate the enthusiasm and support of all our sponsors.

We hope 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, and, once more, bienvenidos!

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

Len Malczynski, Aldo Zagonel, Andy Ford, David Ford,
Edward Anderson, Jack Homer and Roberta Spencer

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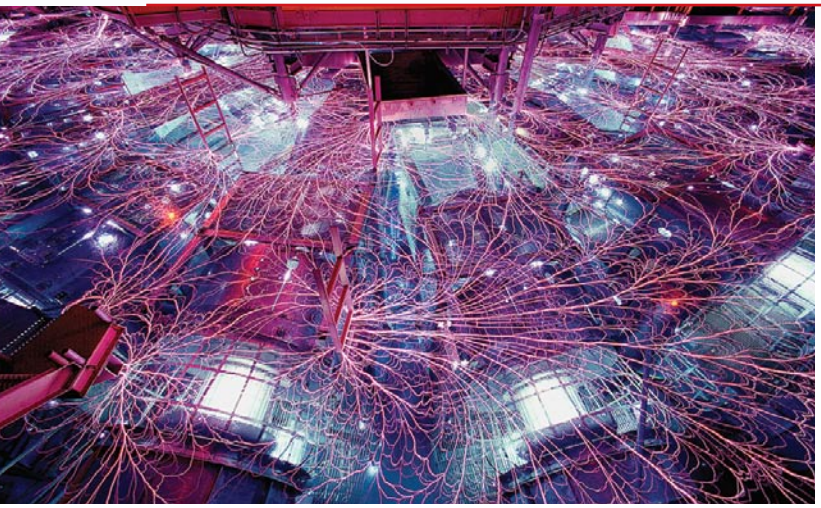

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Sandia has about 8,600 employees, and our workforce consists of highly educated and skilled engineers, scientists, and technologists. About 18 percent of our employees hold doctoral degrees, and about 30 percent hold master's degrees.

System Dynamics at Sandia

Sandia has been active in system dynamics since 1975. Today Sandia is highly vested in SD-based studies of critical infrastructure protection, energy economics, and water resources management. Efforts to understand the dynamics of coupled infrastructures, examine alternative energy sources, and highlight short- versus long-term trade-offs in strategy and decision making are currently funded at the level of millions of dollars annually.

Modeling for Water & Energy Decision Support

System Dynamics modeling for water and energy decision support has focused on the issue of sustainability. An international effort to build a high-level model of water resources in China, and a local initiative to model household water conservation in the Rio Grande Basin of New Mexico, have spun off many other water resource management studies, both domestically and abroad. The energy models have been used to contrast alternative, renewable energy sources against petroleum-based fuels.

A Global Energy Futures Model simulates key aspects of nuclear and non-nuclear energy, nuclear materials storage and disposition, global nuclear-materials management, and nuclear-proliferation risk, along with oil, gas, coal, greenhouse gas emissions, and other measures of environmental impact. The model has been used by government officials to simulate future energy trends and has created interest in bio-fuel and renewable fuel studies, as well as integrated water, energy, and food modeling projects.

These multi disciplinary projects have been client based and stakeholder-driven. The assumptions embedded in the models have been scrutinized by a gamut of scientists and experts. A groundbreaking effort is under way to integrate system dynamics, border gradients models, and spatially explicit modeling environments, such as GIS.

Modeling for Critical Infrastructure Protection

Today's open and technologically complex society includes a wide array of critical infrastructures. Many have historically been physically and logically separate systems that had little interdependence. As a result of advances in information technology and the necessity of improved efficiency, however, these infrastructures have become increasingly automated and interlinked. These same advances have created new and possibly cascading vulnerabilities.

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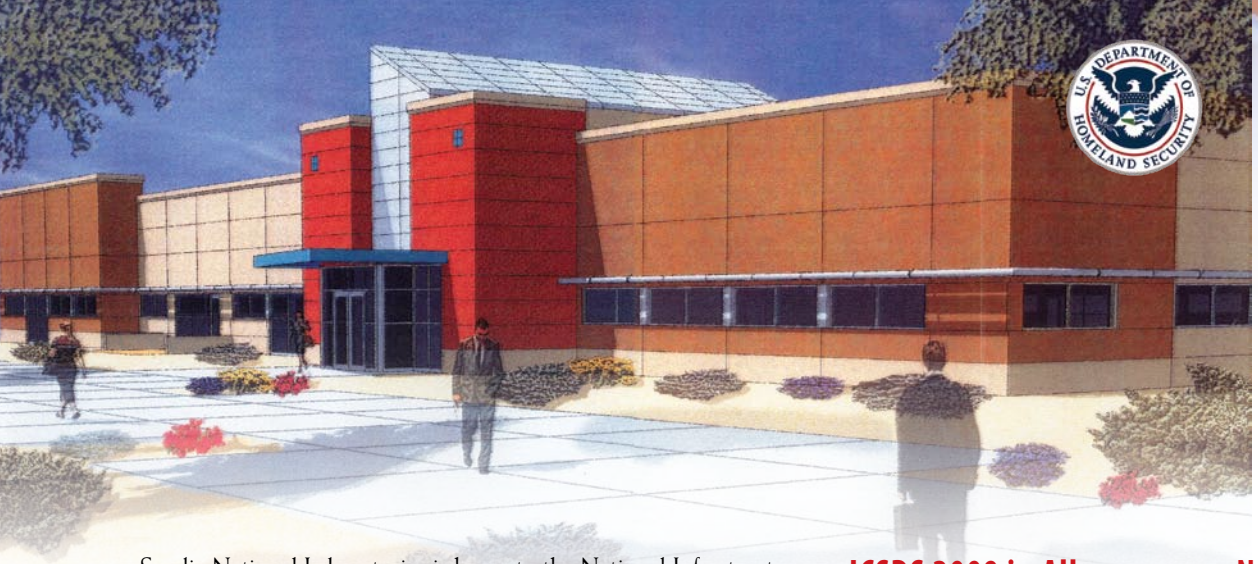

Sandia National Laboratories is home to the National Infrastructure Simulation and Analysis Center (NISAC)

Sandia National Laboratories is home to the National Infrastructure Simulation and Analysis Center (NISAC), established to integrate the national laboratories' expertise in modeling and simulating complex systems. System dynamics is an important modeling capability used to quantify and evaluate the effects of infrastructures and their interdependencies on supply and demand under different conditions.

Given a specific threat or vulnerability scenario, the model-based analyses estimate the potential magnitude, location, and timing of disruptions. Further, the analyses establish propagations throughout infrastructures and national regions, examine limiting factors, capacities, and redundancies and quantify overall consequences. The models incorporate the feedbacks created by the interdependencies and their net effects on supply and demand balances. They also aim to identify unintended consequences of policy responses.

Critical infrastructure protection studies using system dynamics modeling include, among others:

- Port security and long-term economic viability
- Loss of multiple telecommunication assets
- Social and economic effects of animal and plant diseases
- Physical disruptions due to natural disasters

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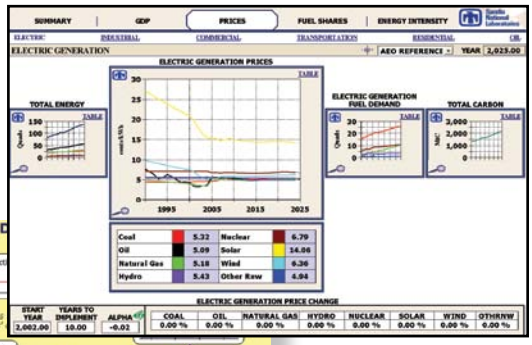
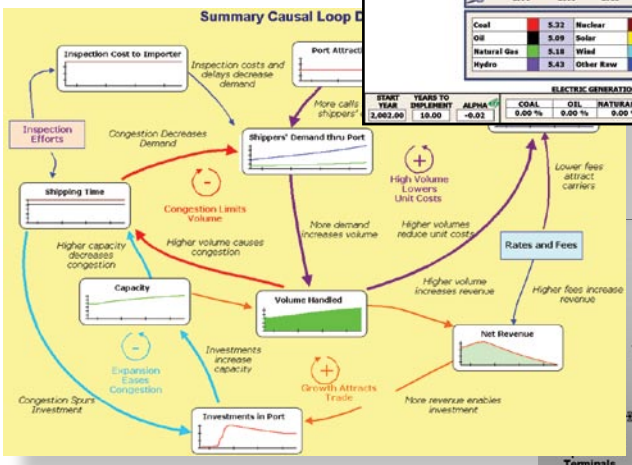
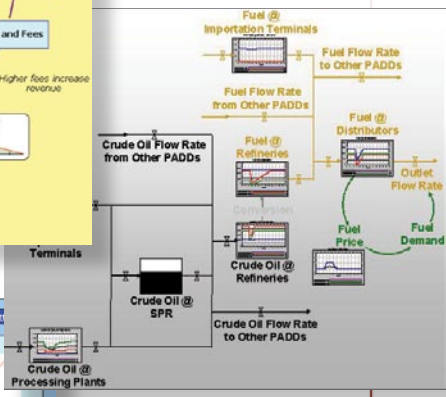
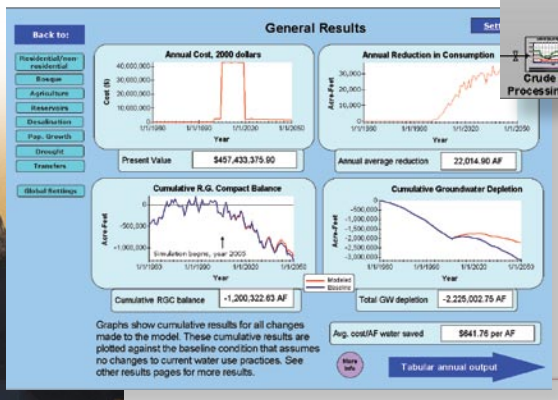
In partnership with other National Laboratories, universities, and businesses in the Southwest region of the US, we are excited to host the 2009 International Conference of the System Dynamics Society in Albuquerque, NM. This pivotal event will help consolidate and enhance the use of system dynamics at the national laboratories and encourage its use in national policy making.









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

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What is it? The *SD Career Link,* started in 2000, is hosted by the System Dynamics Society. It includes on-line 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 of system dynamics. Please visit the *SD Career Link* bulletin board at the conference.

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 of the career link, 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.

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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 a number of utilities or directly on some operating systems. File types that may be contained with supporting materials include plain text files or commonly used files types such as .doc, .ppt, .pdf, .htm, .html and .jpg. 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
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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:
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Note that a Studio 8 installation will automatically replace any previous version of Studio.

Vensim by Ventana Systems:
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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

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Plenary Presentations

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Mimicking Network Structure Effects in a System Dynamic Model of Competing Technologies

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"Simply, we need to build a new dam:" Is it really "SIMPLE"?

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The Ford Method: A Sensitivity Analysis Approach

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Expanding Adoption of Drinking Water Treatment Systems in Developing Countries: A Case Study from Tamil Nadu, India

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Resource allocation in multi-project management

Poster Presentations

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Partnership Development Among Mental Health Agencies

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Methodology for Bus Rapid Transit Ridership Estimation and Deployment Phases Implementation

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A system dynamics model of body weight regulation and obesity

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Policy scenario modelling with the land-use transport interaction model MARS Austria

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Systems Dynamics approach of understanding Africa's evolving social systems: special reference to South Africa

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How can a systems perspective aid an understanding of corruption?

Parallel and Poster Session Papers

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Drought and Production Capacity of Meat: A system Dynamics Approach

The persisting drought in Iran, where the livestock are mostly fed by natural pastor-lands, has caused a higher rate of sheep slaughter, thus an increase in the supply of meat and a reduction of the price in the Summer 2008. On the other hand, the higher slaughter diminished the available level of the cattle which in turn reduced the production capacity of the following year. This is inherent and unique to this production sector that the production capacity depends on the inventory. This study, based on a modified supply chain dynamic model, indicates that the short term effect of drought is a lower meat price; however, in the coming season a sudden increase in the price should be expected. It can be concluded that using right policies, such as importing provender, could save the hardly recoverable production capacity of the country.

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Russian-Ukrainian Gas Conflict Case Study

The following paper examines the ongoing gas conflict between Russia and Ukraine. Europe have become collateral damage, as large part of the natural gas destined for the EU pass through Ukraine. Numerous precursors preceded the crisis; nevertheless, some countries have not taken steps in advance to mitigate consequences. Failing to adopt a wide perspective, both timely and structurally wise, can lead to major crises. This research analyzes the lifecycle of this crisis and focuses on the evolution of crisis' variables. Causal Loop Diagrams are built to represent the structure that possibly originated this crisis. The information gathered here could also be used as an input for future modeling and simulation exercises.

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On modeling some essential dynamics of the subprime mortgage crisis

We develop a Systems Dynamics model for capturing the key interactions involved in the evolution of the subprime mortgage crisis. In particular, we propose an aggregate modeling resolution that involves three main sub-systems, namely, an aggregate banking system, an aggregate housing market and an economic environment. The model exposes the physics of each individual system as well as influences and interactions among the three systems. The model is useful for developing intuition about the evolution of the crisis as well as the lagged timing and magnitude of the effects of various corrective actions, such as an economic stimulus package. We present three scenarios using simulated data. In the first scenario, we establish an equilibrium state that represents a steady state normal condition. In the second scenario, we introduce a step function for the availability of subprime loans and hold it for certain duration. This practice eventually culminates in a credit crisis, where the aggregate bank experiences insolvency. In the third scenario, we study the application of an economic stimulus, which steers the entire system back to a new equilibrium state. We note that the economic stimulus needs to be larger than a certain critical lower threshold in order to enable the system towards reaching a new equilibrium.

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ScriptsMap: A Tool for Designing Multi-Method Strategy Workshops

This poster presents ScriptsMap, a tool developed to facilitate the design of workshops using system dynamics group model building and group problem structuring using a group strategy support tool (Decision Explorer). The poster explains the genesis and purpose of ScriptsMap as a means for articulating an extensive range of activities (scripts) useful when designing model-building workshops. The map comprises building blocks allowing a group facilitation team to construct, with the maps aid, a thoughtful workshop design. The poster will illustrate the ScriptsMaps structure through two multi- method workshop designs, which in their own right provide interesting means of combining approaches.

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Using Stakeholder Goals and Dynamics to Surface Feedback Loops

Exploring a particular set of paths in ScriptsMap, this poster describes and illustrates a new multi-method approach designed to help elicit feedback loops in a group model building or strategy support workshop. The approach uses a GSS tool (Decision Explorer) to map stakeholder goals, system conditions, and stakeholder responses to goal-gaps. The poster will show the process as it was used in a recent group strategy support workshop.

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Panel Discussion: Distributed Talent Management: Planning, Metrics and Oversight

The last decade has seen the rise in many types of distributed talent management challenges -- global sites, disrupted demand, integration problems, omnipresent collaboration and communication technologies, political pressures and threats from talent poaching and/or downsizing. In this session, we wish to host a set of presentations followed by lively discussion generated by questions and dialogue with the audience. The presentation of case studies will describe three separate system dynamics models aimed to examining policy options and allied metrics. The first case examines the challenges at an insurance company while implementing a scorecard in the face of an unbalanced evolution of a population of agents across heterogeneous geographic market segments. The second case addresses the management of software development and maintenance at another large insurance company, where "cause and effect" are separated in time and space. These characteristics make attributions about system improvement difficult and can impede the ability to manage human resources. The third case describes the unanticipated side effects of global demand growth when a leading software services firm is faced with poaching of workforce from its most productive talent segments.

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Modeling Insurgencies and Counterinsurgencies

A system dynamics model of insurgencies is built using the US. Army and Marine Counterinsurgency Manual (FM 3-24) as a basis. It must, however, be supplemented by additional theory from outside sources to enable calibration to a historical data set. Parameter and policy analyses are conducted. These highlight the criticality of some features of insurgencies described by FM 3-24 such as the importance of obtaining and maintaining popular support and employing sufficient counterinsurgency forces to gather intelligence. Other features, not highlighted by FM 3-24, also are shown to be important such as how quickly does violence escalate during the insurgency and how easily can detained/eliminated insurgents be replaced. Finally, contraindicating the expectations of FM 3-24 and other conventional wisdom, results from optimization simulations suggest that the level of force used in a counterinsurgency should increase only once a preparatory period of intelligence gathering by those same forces has been completed.

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Economic Growth Accounting: Policy Analysis of Transitional Dynamics

The GDP growth pattern of Ghana from 1960 to 2000 shows a rollercoaster behavior. Because of this, the Ghanaian population today is almost as poor as it was then. This phenomenon has been studies by several researches all of whom have created important but atomistic insights about this issue. We want to offer a richer explanation. The paper develops an economic growth model to explain the GDP growth pattern in the relevant time frame. We are (1) able to replicate the historical GDP growth, (2) use the model to estimate the contribution of factors of production and labor productivity to economic growth, (3) offer a consistent causal explanation about the growth pattern, and (4) conduct a counterfactual policy analysis offering insights about what could have been possible if different policies would have been executed. In conclusion, the main cause of slow growth in Ghana from 1960-2000 was the declining labor productivity and low physical capital stock. The low physical capital base and lack of innovative production processes of the workforce, is responsible for the poor growth performance. The counterfactual policy analysis puts forth that a policy to encourage investment through increasing propensity to save is most successful.

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Diverging Incentives and Evolutionary Dynamics within Supply-Chain

The relationship between a supply-chain and a main contractor within a local cluster of production unveils elements of complexity. While fates of supply-chain and main contractor are often interlaced, as the relationship unfolds dynamically incentives may diverge dramatically. This paper addresses a dilemma main contractor faces in taking decisions concerning technology transfer towards local suppliers. On the one hand, main contractor has an incentive in transferring technology

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with the aim at increasing technological content of input supplied locally. On the other hand, as the technological content of the supply-chain increases, local suppliers may have an incentive in diversifying their sales towards global clients thereby increasing their bargaining power. Grounding on formal modelling and computer simulation, this paper explores different scenario emerging by the matching of different policies of technology transfer and different attitudes of supply-chain towards diversification of sales towards global clients. We explore the circumstances in which cooperative behaviour leads to more efficient scenario than non-cooperative behaviours.

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Capacity Utilization in Electricity Market Behavior: An Experimental Analysis

This paper describes a laboratory experiment to study the effect of variable capacity utilization over the behavior of an electricity market. Capacity utilization is an important factor in order to explain the multiple cycle periods observed in many industries. Investors make investment and capacity utilization decisions in an expanded Cobweb market of the power generation sector. The experiment has four year investment lag, power generation capacity with a sixteen year lifetime and it does not assume full capacity utilization. Cyclical behavior results in three out six markets. Tests show that one market presents well-defined and pronounced cyclical behavior, while other two markets present minor oscillations. Results suggest that varying capacity utilization favors stability, rather than a cyclical behavior.

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A System Dynamics Model for the World Coffee Market

Commodity prices cycles have a negative effect in developing countries. This paper applies system dynamics to study the long term cyclical behavior of coffee price. The model is based in Meadows (1970) and Deaton and Laroque (1996, 2003). The model includes the price dynamics, investments, capacity, and demand. Our model is the first stages and not fully calibrated. Nevertheless, the model provides a better understanding of the commodity cycles, focusing on the internal structure of the system. The model replicates the reference mode, thus, coffee price exhibits cyclical behavior in the long term. In particular, we have founded very difficult the estimation of investment functions; therefore, future work will be focus on validation and use of laboratory experiments to estimate investment function with coffee farmers.

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System Dynamics and Laboratory Experiments

This paper is a review of research on the application of laboratory methods to System Dynamics (SD). Although laboratory methods have been used in psychology for many years, our review focuses on the laboratory experiments developed from the experimental economics field

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and on their contributions to SD and the management sciences. In particular, we examine the use of experimental methods for estimating the decisions used by SD models, and the intersection of SD and laboratory experiments in theory testing and theory building.

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Energy Management in Residential Buildings: a system dynamics approach

Due to rapid population growth, unavailability of resources and climate changes, energy saving has become of great interest especially during the last 30 years. One of the most evident human activities weighing down on pollution and energy consumption is the construction of residential buildings. However, the construction phase is but one of the stages in wasting resources. In fact, once a residential settlement has been built, it is time for the dweller to use up resources. In our work, we propose an analysis of the socio-technical mechanisms which move people towards energy efficiency and the technology innovation that make it possible. We will then describe the model structure and the various leverages that the users are able to handle during the innovation process. Finally, a discussion of results and implications for future research will also be provided.

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A System Dynamics Model of the Mauritian Power Sector

Mauritius, a Small Island Developing State and one of the most successful economies in Africa, has experienced sustained economic growth during the past three decades. Mauritius' power sector has evolved considerably during this period to cater for increases in electricity demand following such growth. The island has continuously invested in additional capacity to meet such increases in demand in the medium term. Approximately 78% of Mauritius' electricity needs are met through imported energy sources, mainly oil and coal. However there are increasing concerns about price volatility and security of supply from such sources. Policymakers are thus committed towards a sustainable energy development plan for the country. In this line, authorities have embarked into elaborating a comprehensive energy policy for Mauritius. Threshold-21 (T21) is a tool that applies system dynamics to aid in policy making in an integrated manner. This paper documents the first iteration in the development of a power sector model for Mauritius based on T21 models. The aim is to provide a description of the Mauritian power landscape and translate the same into a system dynamics model. Future work includes expansion of the model to cover the whole of the Mauritian energy system and to do policy analysis.

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Automating Model Testing and Improvement: SiS Software

System dynamics model validity consists of two very different types: structural and behavioral. A crucial property of system dynamics method is that structure validity must precede behavior validity; the latter has no value without the former. But the dilemma is that structural validity testing is in general highly qualitative, subjective, hence not suitable for algorithmic automation. An important exception is indirect structure tests that combine the strength of structural orientation with the advantage of being quantifiable. These structure-oriented behavior tests seem to be the most promising direction for research on model validation. We developed a software package at Bogazii University, SiS software that does automatic dynamic pattern recognition and indirect structure testing. SiS also does automated parameter calibration with respect to a given (desired) dynamic pattern, hence can help with policy improvement design. In this presentation we will show the main features of SiS by a demonstration of the new version of the software.

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Examining the role of simulation models in health planning

Simulation models can occupy very different roles modelling in the planning of health care infrastructure and services. They can be a close replica of the real world used to produce exact answers or as a tool in building consensus among stakeholders with different views and objectives, as a boundary object. The role a simulation model can have in a decision process is constrained by the degree to which the model and its results are accessible to stakeholders with no or limited experience with modelling. The visual representation of the model and its results are likely to be of a major influence on the accessibility of the model. However, whether a visually more accessible model will result in improved stakeholder buy-in, creative problem solving and more effective decision processes remains an empirical question. This paper draws on a currently ongoing research project on the use of system dynamics and discrete event simulation tools in health care and presents some early conceptual work on the role of modelling in the planning process.

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Reports from the Field: Assessing the art and science of participatory environmental modeling

Since the early work of Tansley (1935) and others we have embraced the concept that an ecosystem is a synergy of its parts and the relationship between those parts. Many science-centric approaches have been developed to address ecosystem management while at the same time taking into account the needs of the public. Participatory environmental modeling that uses system dynamics is an effective process for facilitating the integration of ecosystem science and social concerns.

Using the art of facilitation and the science of model building the methodology creates a common language that integrates various types of information into simulation models. This paper describes a diversity of case studies, modeling and facilitation technique, and the inventiveness of practitioners who adjust their efforts to the needs of the stakeholders and the environmental problems they are facing. Participatory modelers who use system dynamics create customized platforms through which stakeholders can simultaneously explore their system, stressors to that system, potential tipping points, whether it is fragile or resilient, and any variety of potential policies that address the environment, social concerns, and long-term sustainability.

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Model the Interaction Between Leaders and Society During Conflict Situations

This paper describes an effort by Sandia National Laboratories to model and simulate populations of specific countries of interest as well as the population's primary influencers, such as government and military leaders. To accomplish this, high definition cognition models are being coupled with an aggregate model of a population to produce a prototype, dynamic cultural representation of a specific country of interest. The objective is to develop a systems-level, intrinsic security capability that will allow analysts to better assess the potential actions, counteractions, and influence of powerful individuals within a country of interest before, during, and after a conflict event.

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Dynamic Simulation of a Thermal Water Quality Trading Program and Implications for Policy Design

This paper describes the Riparian Shading Simulator, a system dynamics model of a thermal water quality trading program, in which point sources are allowed to offset their effluent by paying landowners to plant shade trees. The model is used to explore consequences of policy designs with varying trading ratios and upstream-only rules. Results from the model can be used to help choose a trading ratio that balances the goals of enhancing ecosystem services and reducing costs. The model also indicates that policy makers should be careful about using upstream-only rules, since they can potentially cause shading to be concentrated in upstream areas and contribute to downstream hotspots.

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Implementing a sustainable CSR Strategy through a System Dynamics Perspective: evidences from a Colombian case-study

During last decades, Corporate Social Responsibility (CSR) strategies received a growing attention from both businesses and non profit organisations. However, very often organisations fail to correctly implement a successful CSR strategy. Through the analysis of a case-study, this paper tries to demonstrates how a CSR strategy could fail in

the long term if a open-loop logic is adopted. On the contrary, by making explicit the feedback loops structure underlying a CSR strategy, the system dynamics approach is likely to better support decision makers in implementing effective CSR strategies able to foster sustainable long term growth. After discussing the main benefits and limits of the CSR concept reported in literature, the case-study is introduced and the method adopted to introduce a CSR strategy is explored. Then, such an approach is reconsidered in a feedback perspective and presented with reference to the case-study investigated. Finally, conclusions and further remarks are outlined.

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You meant what? Socially constructing meaning with ongoing interactions

Begun as a consulting project to resolve "disconnects" within large aerospace programs, this research effort asserts that we can gain new perspectives on innovative knowledge-work through simulations that represent the causal relations suggested by George Mead's foundational theory of how we create shared meaning. In Mead's interactionism we find principles and assumptions that underlie comprehensive social theories of structuration and practice as well as many studies on knowledge work, cognition, sense-making, and decision-making. In earlier work, we produced a formal theory represented in a simulation model of what exacerbates and reduces "disconnects" among four organizations interdependent in their innovative work. Here we describe how we collected and analyzed qualitative data in which the model was grounded; identified constructs in the data and literature relevant to the presenting problem; and proceeded with model-building and analysis, particularly detailing how we "traversed" from rich, qualitative empirical data to themes and higher-level abstractions useful as constructs in a theoretically informed simulation model. We now carry theory-building a step further by revisiting sociological theories of meaning-creation and knowledge-construction to probe how they inform and re-form our understanding and provide new insights about managing knowledge-work.

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The Validity and Utility of Participatory Research Strategies

Participatory research strategies, like Group Model Building, are of increasing importance in social science research. These strategies are especially used to support practice oriented research, where decision-making needs to be supported or solutions for practical problems need to be found. We argue that participatory research strategies can be differentiated into practice based and expert based research. They offer suitable alternatives for mainstream data based types of research to tackle practical problems. In this paper we formulate methodological criteria that are necessary to evaluate the practical utility of research strategies and the extent in which they produce valid results for practice oriented research.

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A Systems-Oriented Analysis of the Corporate Tax Department Data Collection Work Process

System Dynamics modeling techniques are applied to examine underlying dynamics affecting corporate tax department operations. Focusing on the complex work process of collecting data to make book to tax adjustments, a model is constructed that illuminates the cause and effect impact on tax department performance of having errors in collected data, and of the iterations required to resolve these errors. The model provides a basis for examining and justifying investment in process improvement alternatives that can not only have a financial impact on the enterprise, but also reduce risk with respect to meeting Sarbanes Oxley imposed standards.

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Platinum Supply and the Growth of Fuel Cell Vehicles

This report addresses problems associated with U.S. fuel cell vehicle production and a limited platinum supply. Polymer Electrolyte Membrane (PEM) fuel cells, which use a platinum catalyst, could place strain on the platinum market if fuel cell vehicles are widely produced. We developed a dynamic hypothesis, identified causal relationships, and created a system dynamics model in iThink. Based on this model, we found platinum prices would likely reach $50,000 per kilogram in 30 years and the cost of platinum for a fuel cell vehicle would be $2,500. At this price, the platinum barrier is surmountable if the cost of other FCV components is drastically reduced. If a world FCV market takes hold, it was concluded that only about 15% global market penetration is feasible.

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Endogenous Transformation in the Automobile Industry

Established industries develop and mature along continuous trajectories defined by the underlying technological paradigm relevant to serve the value network of the industry. Technological discontinuities and/or preference shifts at the higher levels of the value network may trigger a

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technological transformation in the industry. Depending on different circumstances, the technological transformation process may have significant impact on the industry, reverting the continuous maturation process, creating new structures and changing the way business is done in the future. Here we describe the transformation process that is evident in today's automobile industry, which we call Endogenous Transformation, and compare it two transformation processes previously described in the literature (Disruptive and Radical Transformation). In an Endogenous Transformation process, a new technology is developed in a joint effort by most organizations in the industry to substitute the old technology, with which their value network cannot be served any longer in the future. Important conditions for an Endogenous Transformation process to develop is that new knowledge must be effectively protectable from being freely copied by the competition and that new knowledge is traded between organizations, preventing significant knowledge asymmetries in the industry.

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System Dynamics and the role of History in economic growth theory

Recent literature in economic growth suggests that a theoretical research convergence among historical studies and neo-growth theory is presently taking place. We argue in this paper that system dynamics, due to be a flexible methodology, may be an instrument for helping to bridge those two strands of thoughts. The paper begins for presenting a stylized historical background for endogenous growth theory which is perhaps one the more appealing modern interpretation of growth process available. A simple endogenous growth model based on this historical background is then provided and re-written in system dynamics language. An enlarged version of the basic growth model is next presented and it is shown how to assess the strength of the different feedback loops involved in the process of economic growth. The conclusive section of the paper finally suggests that system dynamics can be an important complementary tool for understanding and perhaps enhancing economic growth in less developed countries.

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Too early, too quickly: Impact of short-term decisions in fleet renewal programs

Decisions made in the air transport industry are defined by perceptions. Airlines order aircraft when they believe the conditions to upgrade their fleet are appropriate in terms of profitability and market opportunities. However, the financial performance of an airline can be easily affected by several variables. Many types of delays are decisive in the income and expense structure of the organization. Fleet renewal, for instance, is a very lengthy process, since deliveries usually take five years from the date the order is placed. This paper uses System Dynamics to evaluate the performance of different strategies concerning fleet renewal in a commercial airline, taking into account the complex interdependence between variables and the delays involved in the process. The simulation model is absolutely based on real information retrieved from databases of aviation authorities and actual airlines in Colombia.

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A Qualitative System Dynamics Analysis of the Effects of an Emissions Trading Scheme on the New Zealand Forestry Value Chain

As part of New Zealands obligations to the Kyoto Protocol, New Zealand has developed an Emissions Trading Scheme (ETS) as a mechanism to reduce its national greenhouse gas footprint, and to encourage and support global action on climate change. The forestry sector in New Zealand was the first sector to enter the ETS, effective from 1 January 2008. So far many forest owners in New Zealand have been slow to join the scheme. To investigate this situation further, a systems thinking group model building workshop was held to discuss the effects of the ETS on the New Zealand forestry value chain. A qualitative system dynamics analysis was undertaken, whereby a range of relevant issues were generated by a group of stakeholders, and based on these a set of causal variables were identified. These showed a strong bias towards an economic viewpoint of the basic issue being examined. Causal loop diagrams were made from these variables, and the dominant loops were briefly analysed. This paper will discuss some of the insights gained from this project to date. Keywords: Systems thinking, qualitative system dynamics, New Zealand forestry value chain, carbon sequestration, carbon dioxide, emissions trading.

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A Model of Goal Dynamics in Organizations: a case study

This work is an attempt to go ahead on a suitable system dynamics model for goal dynamics in organizations proposed by Barlas & Yasarcan (2008). Even if the proposed model doesn't have any pretension to be exhaustive, the main objective of this paper is to propose a model of goal dynamics in which Goal Setting, Management by Objectives and Training are viewed as human resources practices able to enhance workers' goal commitment, and therefore, organizational performance. In the first part of this paper, an analysis of Goal Setting Theory and the role of goal setting practice in enhancing worker's performance are remarked. In the second part, the case-study, the causal loop and a quantitative model of goal dynamics in organizations are described. In the third part, behaviour reproduction test, optimization analysis for parameter estimation and scenario analysis are presented. Limits of this research and conclusion are finally discussed.

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Understanding the impact of whiteboard on A&E department operations using hybrid simulation

This paper uses hybrid simulation to evaluate the impact of a whiteboard on the workflow of an A&E department. Hybrid simulation in this context is defined as the integrated use of discrete event simulation and

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system dynamics; we illustrate how discrete event simulation and system dynamics, by themselves, are incapable of meeting the objective. "Parsimonious" and "divide and conquer" principles for model-building have been followed. We also highlight how a slight modification to the "divide and conquer" approach can assist multi-method users. This paper has deployed novel approach of hybrid simulation in the context of healthcare. It attempts to link value proposition of information system (whiteboard/ electronic patient tracking system) to workflow of A&E department. Due to technical limitation with respect to automatic exchange of information between system dynamics and discrete event simulation, potential of hybrid simulation could not be deployed to maximum level.

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On the underlying structure of system dynamics models

The underlying structure of system dynamics models is that of a proportional feedback controller. We propose a broader framework for system dynamics models, where systems are modeled using a combined feedback-feedforward structure. While the traditional structure for system dynamics models only uses proportional feedback of error for control, the proposed structure for information feedback employs the use of proportional, integral and derivative (PID) error. Hence, existing system dynamics models only use a small subset of the proposed structure for modeling systems. We argue that the proposed structure provides a more flexible framework for modeling and designing systems.

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A System Dynamics Model of the TFT LCD Industry Development in Taiwan

The TFT LCD (Thin Film Transistor Liquid Crystal Display) industry is one the most rapid growing high-technology industry in recent decades. The development process of this industry is complex and dynamic, requiring the accumulation of technology, capital, production capacity, and human resources. For a late coming country, the development process also involves tense interactions with the national innovation systems and international industrial networks. Taiwan has become the second largest TFT LCD producer within two decades; the underlying structure behind the success is an interesting topic to explore. This study used system dynamics to analyze the development process of the Taiwanese TFT LCD industry. A qualitative model was derived based on the development history. Implications of this study are also discussed.

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Psychological Safety and Group Learning: Cycle-Time Reduction for Collaborative Product Development

This study presents a system dynamics analysis of collaborative product development in a manufacturer-supplier dyad. We conduct a SD-based case study in Taiwan high-tech electronics where a manufacturer and a supplier form vertical product development partnerships. The SD inquiry helps inter-organizational project teams understand how cognitive and social factors such as psychological safety, level of collaboration, and group learning rather than technical factors such as the deployment of collaboration software affect the development cycle-time more. We set up a simulation model and give propositions based on simulation experiments. Simulation results show that higher level of psychological safety and collaboration contributes to the cycle-time reduction and facilitates group learning. Interestingly, the highest level of psychological safety and collaboration does not necessarily lead to most group learning activities. Moreover, project teams exhibit poorer group learning and team productivity when they merely set up higher performance goals without enhancing initial level of collaboration and psychological safety.

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System Dynamic Modeling of Plant Maintenance Strategy in Thailand

This research studied about plant maintenance strategy and condition monitoring technology used in Thailand compared to typical and benchmarking plants in United States. The research first reviewed literature on plant maintenance strategy used in typical and benchmarking plants in United States and related information of condition monitoring technology as well as previous research in this field. A set of questions was used for structured interviews with respondents working in power generation, petrochemical, refinery and gas separation plants in Thailand. Next, System Dynamics was used to model a generic plant maintenance system and then the collected data from interviews was used as input for the model. The system's behavior was studied focusing on plant uptime and maintenance cost. The results imply that industrial plants in Thailand should reduce preventive maintenance levels and increase predictive maintenance levels to better meet the benchmark as well as to increase plant uptime and reduce maintenance cost. The simulation model can be used as a starting point for particular plants to study plant maintenance behavior for finding a suitable maintenance policy. Actual plant data can be used for model modification and simulation studies. Keywords: Condition monitoring technology, Plant maintenance strategy, Maintenance management, System dynamics.

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Post Adoptive ERP Use Behaviors: A Dynamic Conceptualization

A conceptual model of post-implementation enterprise resource planning systems (ERP) use is developed and operationalized using a dynamic systems perspective. The primary purpose is to enrich our collective understanding of how companies might facilitate ERP usage to enhance the business value of this technology investment after the initial installation. The conceptual model represents a dynamic information feedback structure that illustrates the relationships among several post-adoptive factors including software and work process training, experiential interventions to facilitate extended and deeper usage, user software and work process understanding, the extent of features implementation, the range of ERP system usage, and ERP benefits. The model is drawn from findings about post-ERP implementation described in the literature. Pragmatic insights are provided by the conceptual model and recommendations for future research are discussed.

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Modeling the Employee Life Cycle to Address the Insider Threat

Within an organization, the employee population is the source of potential malevolent insiders. To investigate the evolution of the insider within an organization, we are developing a model of the employee life cycle. The employee life cycle model is designed to define and analyze interactions of the employee population with insider security protection strategies. The model was exercised for an example scenario that focused on human resources and personnel security activities, specifically, pre-hiring screening and security clearance processes. This modeling effort provides a framework to understand important interactions, interdependencies, and gaps in insider protection strategies. This work is part of a larger effort to develop the basis for an integrated systems-based process for designing and evaluating effective insider security systems.

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Growth of Enterprise Information Technology Application: System Dynamics Model and Empirical Evidence

The present research on the growth of enterprise information technology applications is to build an effective system dynamics model which can reveal the internal laws of the general process experienced by an enterprise integrating the application of modern information technology and management. Based on the literature review and surveys on more than two hundred companies, we sum up the mechanism among the information technology application and key impact factors. In accordance with the conventional modeling methods of system dynamics, a model has been built and tested. The model is also supported by the empirical evidence.

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The Identification of Potential Policy Intervention Points in the Battle against Childhood Obesity

The purpose of this research is to discuss how system dynamics and social marketing together can develop an understanding of how to effect behavioural change in over-weight and obese children and to reverse the current trends towards average weight gain. A review of the literature has uncovered many potential factors which comprise the obesogenic environment. The relationship between obesity and these factors is outlined. The research to date has also included a review of system dynamics work on the obesity issue. At the present stage we have conceptualised the model to include a population sector, a meal consumption sector and the consequent energy intake from these meals. Energy expenditure also plays a part in determining whether an individual gains weight and this too is addressed. We strive for the identification of the potential (versus the cost) of social marketing interventions to change the behaviour of children vis-à-vis food and physical activity.

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Developing Causal Map Codebooks to Analyze Policy Recommendations: A content analysis of floodplain management recommendations

Policy recommendations in public policy venues take on several forms. In some cases, they are well-crafted arguments in favor of a particular course of action. Strong policy recommendations will frame issues in a way that lead decision-makers towards a preferred set of solutions. This paper presents a codebook for developing causal maps from policy recommendation reports and texts. The codebook's strengths and weaknesses are discussed, as applied to a set of recommendations made to reduce flood damages and increase the quality of floodplain

management in the U.S. This paper shows how the internal validity of causal maps constructed from qualitative data will be improved by developing codebooks that are reliable, consistent, and transparent.

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A Simulation Model for Bloodcholesterol Dynamics and Related Disorders

Cholesterol metabolism and other factors affecting its dynamics comprise a complex system. The goal of this study is to construct a system dynamics simulation model that can generate long term dynamics of cholesterol metabolism in healthy and hypercholesterolemic subjects, with respect to body weight, diet, and exercise. For both healthy and hypercholesterolemic subjects, the model generates realistic behavior patterns for different types of blood cholesterol and body weight. It is shown in this study that a person can have healthier cholesterol levels by changing her diet and/or doing more exercise. Also it's observed that exercise is more effective than diet even in cases when the subject does not lose weight. In the case of hypercholesterolemic patients, the model effectively mimics the way typical drugs work and shows how the patient can reach healthier cholesterol levels.

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Foreign Direct Investment and Spillovers in Seed Sector Development

The role of foreign direct investment and intellectual property rights in economic development is discussed widely in the literature. However, an integrating framework is missing to assess the role of FDI and IPR for agricultural development. This paper establishes a framework to assess the role of FDI and IPR for seed sector development in developing countries. The impact assessment is carried out with a System Dynamics model that shows local capacity development to develop new seed varieties in the scenario of a multinational company penetrating the market and spillovers occurring. Simulation runs reveal the impact of IPR on the quantity technology transferred by multinational companies and on spillovers. The development path of the local industry depends crucially on the capacity of the local seed sector when the multinational company enters. A pattern for seed sector development is derived.

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Italy facing the EU Emissions Trading Scheme: some scenarios by the ICE model

This paper focuses on Italy in the context of the Kyoto Protocol. According to the Annex I to the last National Allocation Plan (NAP), Italy's emissions are 95 Mt. CO2 eq. above the Kyoto target of -6.5%, i.e. 19% over the goal. This paper proposes a critical analysis of the Government plan and NAP (National Allocation Plan) based on the analysis of recent Italian energy history and a wide set of policy measures that have been stated in formal documents and not implemented. The study is performed using the ICE (Italy's Carbon

Emissions) model. ICE generates energy and carbon emission paths up to 2020 and elaborates sensitivity analysis on caps, carbon prices, and other variables. In particular, the research focuses on the Italian power sector under alternative scenarios of emissions and caps. A conclusion of our analysis is that a significant purchase of carbon credits on the international ET market is necessary. Given the troubled Italian public finance situation, buying carbon credits could represent an unplanned, and maybe not feasible, heavy burden.

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Magical Realism? The Evolution of Paramilitary Forces in Colombia

This article analyzes the evolution of paramilitary forces in Colombia, and how under successive efforts from the Colombian government to tackle problems related to the lack of state presence in the country (particularly the country-side) there have been successive bullwhip effects around those efforts. These unintended consequences have emerged as a result of the inertias related to the socio-political system of Colombia, and how the paramilitary forces have adapted themselves and rooted their "institutions" to the new environmental conditions of Colombia. To analyze these inertias and the bullwhip effects system dynamics is used.

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Reducing income volatility through better resource-sharing policies: The case of the investment banking industry

This paper is based on the hypothesis that income volatility is influenced by endogenous resource sharing policies. The effect of competition on internal resources on income volatility is examined using the case of the investment banking industry. After analyzing income volatilities of different industries, specific characteristics of investment banks are illustrated guided by the service production theory. After this, the income volatility of two product groups of investment banks is analyzed on an industry wide level. To gain deeper insight into the competition on a shared resource the two-shower model of Morecroft et al. is analyzed. By discussing the adaptations of a translation into an investment banking context, a stylized causal loop diagram is derived. In this last step, a product group is identified and the real internal production data is broken down into primary and secondary business units is analyzed. The results show first indications of a competition from primary and secondary units on shared sales teams.

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Design of a Master of Science Degree Program in System Dynamics at WPI

Graduate degree programs in system dynamics are rare and thus of critical importance to the future of the field of system dynamics. However, to a large extent such programs have not yet been made

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transparent to the system dynamics community as a whole. The present paper describes the design and rationale for one such program, WPI's M. S. degree program in system dynamics. The goal of the paper is to invite feedback from the SD community about our specific program as well as to facilitate wider discussion about the appropriate content, design, and pedagogy of degree programs and courses in system dynamics.

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A Little REDD Model: Reducing Emissions from Deforestation and Forest Degradation

A simple model allows a rapid comparison of some typical policy scenarios which might be considered under international programs to avoid CO2 emissions caused by forest clearing (Reducing Emissions from Deforestation and Forest Degradation). These REDD policy scenarios can also include consideration of CO2 stored in forest products. The value of avoided emissions can also be determined if expected carbon prices are included. The model focuses on specific simple scenario comparisons. The paper also discusses feedback effects within larger scale setting of CO2 offset availability, CO2 price and emissions reductions.

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A System Dynamic Model to Examine Students' No-continuation Trends: A Mexican and British Cases

Universities (and funding bodies) have been trying to tackle high rates of no-continuation of students in higher education. This paper presents the results of a preliminary investigation into the different factors affecting 'non-continuation' (or its other side, 'retention') of students in higher education institutions. For this purpose, we sketch a systems dynamics (SDy) model and we plan to use data from Universidad de las Americas, Puebla, Mexico and Manchester Metropolitan University, UK, to run the model. We report on relevant literature in the area of the managing retention by assembling a list of retention-related terms; then, relevant models developed to map students' satisfaction, are reviewed. A SDy model that captures the factors affecting the transit of students' from enrolment to graduation is proposed; these factors are synthesised into four sectors as the core of the SDy model: Introduction; Retention; Motivators; and Finance sector. The study is in a developmental stage, we expect to implement the model when data is collected. In this paper, we only report on the literature reviewed and we sketched the SDy model. This investigation, when completed, will provide a tool to understand the factors affecting students' non-continuation and will help education administrators to manage their retention.

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Setting a Target to Increase or Reduce Carbon-Dioxide Concentration is Not the Same: Lessons for Climate Change

It has been observed that Kyoto protocol has defined CO2 emissions reduction goals that are less than what they should be. On the other hand, Intergovernmental Panel on Climate Change has set CO2 concentration stabilization goals that are definitely attainable in the near future but much above the current CO2 concentration than being below. In this study, we investigate reasons behind these real world observations in climate policies using an interactive simulation in a relevant climate change context (Dynamic Climate Change Simulator or DCCS). DCCS was used in a laboratory experiment to test participants' control of CO2 concentration to a realistic goal over 200 simulated years. Participants confronted two different but symmetric initial values of CO2 concentration stock that provided different degrees of task difficulty: below the goal (minimum difficulty), and above the goal (maximum difficulty). Results show that on account of task difficulty participant performance remained poor under all conditions in the task when compared to the optimal performance. Also, participants starting above the goal had poorer performance than those starting below the goal. Reasons for these results were found in different from optimal participant emissions trajectories across different conditions. Real world policy implications of this research are discussed.

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Communication about Water Management in the Australian Capital Territory: A System Dynamics Modelling Approach

The Australian Capital Territory (ACT) is increasingly threatened by risks to its water security driven by climate change effects, growing population and water-intensive lifestyle. As an inland territory, the ACT has few supply options which are economically and ecologically expensive. Demand management strategies seek to deliver sustainable consumption patterns. Effective communication is an essential part for achieving resilient reductions in consumption by raising public understanding of the problem in order to inform decision making, stimulate public dialogue and ultimately promote behavioural changes. Whereas System Dynamics is a promising approach for learning and communication about water management, its potential for communicating systemic risks to the public has not been fully exploited yet. This ongoing research aims to build a SD Interactive Learning Environment (ILE) to help residents in the ACT to develop a systemic perspective about water management inherent complexity and uncertainty. This paper describes a structured modelling process adopted to build the model through a series of knowledge elicitation cycles, including interviews with stakeholders and electronic workbooks. A key lesson can be taken from our experience through this modelling effort that the modelling process must be flexible and adaptable with several research and real world trade-offs.

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Managing Marketing Multi-Channel Conflict to Maximize Profit in The Egyptian Consumer Electronics market

In todays global competition, companies are obliged to go to market using multiple channels strategy for various reasons. However, channel conflict is inevitable in multi-channel structures causing sharp decreases in the demand of one or more channels. In this article, a system dynamic model was developed to simulate the complex multiple channel structure and various factors that affect the demand and channel conflict. The model aims to simulate the real situation of the supplier decision maker who has to take fast decisions in one of the various variables that he controls to achieve maximum profits and minimum channel conflict. The model was validated using real data of a major consumer electronics supplier in Egypt that has traditional distributors and Hypermarkets as two different channels. Various policies of inventory allocations in each channel and different promotion rates were tested in order to achieve the objective of maximizing supplier profit and minimizing channel conflict. It was found that the policy of allocating the inventory with the equal quantity in both channels with a promotion rate of one promotion per month in the hypermarkets is the optimal policy.

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Simulation Modeling of Electronic Health Records Adoption in the U.S. Healthcare System

Increasing the efficiency of the healthcare system in the United States is an important subject due to rapidly rising costs. Among many propositions to improve the operation of the system, adoption of Electronic Health Records is widely discussed. This study uses a system dynamics methodology to develop a simulation model of the adoption process that will allow for the exploration of policies. This paper presents the development and the preliminary findings of this model.

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Service industries lean assessment methodology using dynamic systems approach

Service in world class is one of the important subjects that most of the service industries have an especial attention to follow it. World wide development of service concept is dealing with lean approach techniques. The basis of lean approach is made of identification and waste (muda) elimination. Because of both customer and personnel's simultaneous attendance in process, as well as process waste and as a nature of service, seven root wastes are defined by using system thinking, pressure transmission model and environmental observation. The aim of this paper is to design a dynamic leaning assessment model in service industries by using system dynamic. It identifies weak and strong points and helps to design and develop a suitable strategy to change current situation to world class service in future. This research is based on a case study in Maskan bank. The basics of codifying this dynamic model in service industries are profitable service chain

conceptual model, balanced assessment technique and system thinking. In the other word, lean approach is effective in service industries (leading to profit and income) When it can be compatible with service profit chain. Research contribution is presenting a model based on system thinking, service profit chain and balanced assessment structure to leaning assessment service.

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How Well Can Students Determine Simple Growth and Decay Patterns From a Diagram?

Six of the 35 national (United States) mathematics standards for high school (ages 15 to 18) instruction relate very well to the use of system dynamics modeling methods, especially in algebra. A very important concept, recognizing the underlying factors that produce different patterns of behavior could be considered a unifying theme throughout algebra, pre-calculus, and calculus. Most of the assignments given to algebra students do not ask students to consider this underlying theme (growth/decay pattern) except when studying a particular function. They never combine functions they have studied in isolation to determine potentially new growth or decay patterns. An assessment was given to 62 advanced algebra students to determine if they could predict the growth or decay patter for six different scenarios, given a STELLA diagram and a few numbers. This paper explains the assessment given and presents the results produced by the 62 students.

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Group model building effectiveness: a qualitative method to assess changes in mental models

Group model building is supposed to support the development of shared mental models. This paper illustrates the application of a qualitative method to assess changes in mental models as result of Group Model Building. A quantitative measurement of effectiveness of Group Model Building has been applied by Rouwette (2003). Recently some researchers have been experimenting with a qualitative approach towards measuring effectiveness, which is useful for measuring individual cases and small groups (Dwyer and Stave, 2008, McCardle-Keurentjes, 2008). This paper focuses on the foundation of such a qualitative method from a methodological viewpoint and applies it to a particular case. In this way we aim to introduce a potential standard for evaluating changes in mental models in single cases and to open up the possibility to systematically compare single cases.

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Simulating a Thermal Water Quality Trading Market for Classroom Education

Thermal water quality trading is an emerging tool for managing water temperature. Trading programs give point source thermal polluters the option to comply with effluent restrictions by paying nearby landowners

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to plant shade trees. The shade trees cool the water, offsetting the thermal pollution emitted by the point source. One of the main obstacles to the propagation of these markets is the problem of convincing landowners to participate. Simulation can help reduce stakeholder barriers and explore the potential benefits of trading. Simulation can help participants understand markets structures and ease the impression of market complexity. Simulation can also allow participants to explore potential market outcomes under different scenarios and policy designs. The Riparian Shading Simulator exercise was created to allow students to play the roles of land owners and point source polluters.The classroom exercises create a common experience which sets the stage for concrete discussions about how the market could work within the larger system. The classroom exercises have also set the stage for system dynamics modeling of alternative market designs.

Effects of Payment Delay on the Performance of Private Insurance Companies: a System dynamics Approach

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Appropriate management, policy design and suitable infrastructure are vital for making insurances companies to be successful in the industry. One of the critical issues in insurance management is the number of clients. The main determinants of this variable are the delay in paying compensation, tariff and advertisement. Thus majority of managers hope to reduce payment delay, tariff and increase advertisement. But in Iran, regarding to the governmental rules tariff is forced to companies commandingly. Also the privatization of insurance industry is one of the government programs, which makes this obligation intolerable. In this paper we attempt to model the present condition of Iran's insurance industry and simulate the impact of payment delay on clients' behavior by the help of System Dynamic. The model is then used to simulate the ways, which pioneer countries applied in insurance industry, to control the positive and negative effects of the mentioned phenomenon.

System Dynamics Approach to Biofuels in Colombia

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The biofuels production in Colombia is growing in recent years but low investment in refining capacity, crops and difficulties to transport the biofuel to the distribution centers are obstacles to fulfill the demand. In order to analyze these problems a System Dynamics model was constructed for learning about the system behavior and for understanding the response mechanisms to different policies from the production side. An analysis of the current government policies as far as incentives to refining facilities was developed in this paper. According to the model results, alternative or complementarily policies could be appropriated to accelerate the growth in the supply side of biofuels in Colombia.

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A System Dynamics approach to understand an agricultural supply chain in Colombia.

Simulation modeling has become a tool to understand and improve decision making in complex systems. In this particular case we analyze the mango supply chain in a Colombian region through System Dynamics. The system is characterized by high intermediation and lack of alternatives for the growers. Nowadays, the Colombian government is implementing a number of policies to both increase the living standards of producers in the country side and bring to cheaper food to the poorest areas of the populated areas. The main idea of this paper was to simulate such policies and study their impact. Through System Dynamics we found a number of problems related to the supply capacity of the system (due to the seasonality of the crops), that mainly affects the revenue of the growers of that region.

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Is Japanese Manufacturing Style (so-called Monozukuri) really robust? - A Causal Loop Diagram and Modeling Approach -

Monozukuri (Japanese Manufacturing Style) is said to be one of the specialties of Japan as Ezra F. Vogel pointed out in his "Japan As Number One". With the application of causal loop diagram analysis in systems thinking, this paper tries to reconsider the structure which gives strength and weakness of Monozukuri. The Monozukuri model is developed by unifying various elements which has been conventionally argued in various academic areas. There are three layers of positive causal loops (strength): professional spirits on Monozukuri at an individual level, trust-based style of management as an in-house management-policy at an individual corporate level and trust-based transactions on R&D and parts-supplier-network (Keiretsu) at an inter-corporate level However, these strength loops are shown to be easily turned out to be weak ones. This paper identifies five exogenous variables that turn the strength to the weakness. Trust-based management based on Monozukuri is shown to be superior to the Western-style contract-based management, because the latter brings just a temporary increase in profits, but works as a negatively in the long run. The companies which adopted trust-based style of management have robustness in profit to the technological standardization. Japanese company should continuously improve the structure of strength.

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Application of Strategy Dynamics: Starbucks Corporation

Strategy Dynamics (Warren, 2008) provides a quantitative, resource-based approach to understanding a firms performance over time. This paper describes a strategy analysis of Starbucks Corporation using Strategy Dynamics. It demonstrates the usefulness of this approach in addressing business performance issues for a real-world company. The strategic architecture, a key artifact of the approach, is a model that captures the interactions of a firms tangible resources, management decisions, and external factors. Starbucks strategic architecture for its retail store business was developed using employee, store, and financial data from Starbucks annual reports and other public information. The strategic architecture and related models were used to explore several issues that can influence Starbucks strategy: customers with less discretionary income, expanding too fast, impact of staff layoffs on the quality of service, getting and maintaining loyal customers, and rivalry with competitors.

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System Dynamics: A Complementary Tool for Predictive Microbiology

One of the most important concerns for food industry is safety. Predictive Microbiology is the application of mathematical models to describe microbial behavior in order to prevent food spoilage as well as food-borne illness. Because of complexity of microbial behavior and food systems, Predictive Microbiology presents some limitations. System Dynamics could be a useful alternative and complementary tool to model and predict microbiological behavior in foods while providing a graphical interface and structures linked with a series of equations, to clarify and improve quantitative Predictive Microbiology descriptions.

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Causal Loop Modeling of Ethics Force Structures: An Exploration

This paper explores the use of causal loop modeling to depict the structure of forces that influence ethical behavior. Our goal is to demonstrate that this kind of modeling can capture and show the complexity inherent in ethics situations. The desire to increase ethical performance is part of a system which includes the desire to increase other aspects of performance, such as competitiveness, profitability, job securoty, wealth, etc. Three examples are used to demonstrate the approach. The first model depicts the generic framework of forces that shape personal ethics behavior. The second model depicts some of the

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forces that led to the current sub-prime mortgage crisis. The third model focuses on factors and causal loops that can combine to shape the ethical behavior of a business executive. Insights into ethics influences can be gained from the modeling process itself, and from examining the resulting model structures. These insights can provide guidance for policy makers and managers focused on raising ethics behavior. Although our models focus on business ethics in developed free-market economies, the approach is readily applicable to other contexts, such as analysis of the forces impacting on ethics in the professions or in government.

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Giddens Globalization: Exploring Dynamic Implications

The dynamic complexity of the social phenomena that people bundle together and call globalization accentuate a divisive public discourse with strong arguments for and against the globalization process and its effects. To help unearth the dynamic processes that support or inhibit globalization, this article shows the recursive relations and mutual causal links among technology, institutional structures, beliefs and social behavior, which sociologist Anthony Giddens has posited on globalization. Giddens' sociological analysis of the globalization process incorporates not only favorable conditions, such as the development of telecommunications technology and world economy integration, but also political transformations, transnational corporation growth, and cultural effects. These concerns outline the components of a system dynamics modeling example, the experimental and model analysis results of which allow reflecting on Giddens' sociological globalization positions.

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Path Dependency and the Role of Delays in Creating Shared Understanding in Dyadic Communication

Informed by a theory of symbolic interactionism, this research explores the dynamics of dyadic communications within which understanding is socially constructed. Based upon an earlier analysis of a case-study investigation in a large multi-disciplinary governmental project with multiple contractors and subcontractors, we modify, simulate, and analyze a dynamic model of dyadic communications. Our simulation results support the previous findings and, in addition, underscore the role of path dependency in creating shared understanding; that is, “first” interpretations affected by random and imprecise messages can influence subsequent shared understanding and meaning construction significantly. Finally, our sensitivity analysis sheds light on the effects of decision and action delay and observation and orientation delay. Delays, which in part represent how responsive a partner is, can have counter-intuitive effects on players’ convergence or divergence in a dyadic communication. Our study shows that reducing observation and orientation delay can be considered as a leverage point for communication convergence, while increasing decision and action delay may facilitate convergence.

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Towards a better understanding of pension systems

Pension systems are vital components of every economic system. During the last two decades, population aging and financial insufficiencies in many countries forced governments, corporations and private pension schemes to conduct reform to sustain their pension systems. This paper investigates different Pay-as-you-go and funded pension schemes in order to provide a better understanding of the dynamics and the structure behind a pension system. Fully funded and unfunded schemes are modeled in a generic form. Issues of stability, population dependency and redistribution are discussed according to model structure and simulation results. System dynamics provides and efficient tool to understand the nature of each scheme.

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Dynamics of Workforce in Iranian National Petrochemical Company

Iranian National Petrochemical Company (NPC) has recently started a fast development. Because of the imbalance in development of NPC, despite of its reputation and history, is not able to recruit qualified workforce. Managers concern the future of the industry as this flow of low qualified human resources accedes to the top of the organizational pyramid. In this paper, a system dynamics model has been used to consider the impact of structural development on human resources of NPC. The results of simulation show that if managers of NPC desire the industry to grow faster than a particular rate, it will finally collapse. It is a quite counter intuitive result. A number of insights have been obtained through the simulations and some practical policies have been suggested and simulated.

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A Stock Flow Method for Modeling Heterogeneity in Household Demand and its Effects on Real Estate Cycles

AB models are capable of capturing heterogeneity in the attributes of agents in real complex systems by considering one variable for each agent. DE models, however, have not this capability. In this paper we introduce a Stock-Flow technique for modeling heterogeneity in the attributes of agents in DE models by adding only one stock variable to the Real Estate Economy (REE) model. Afterwards, we investigate two insights of our heterogeneous formulation. Firstly, we show that the "transaction time", in contrast with homogeneous models, does not play a significant role in system's behavior. Our second claim is a surprising result which contradicts the current literature of the REE. There is a consensus between scholars that the more supply lag, the greater amplitude of price oscillations in REE. On the contrary, we claim that not only an increase in the construction supply lag does not necessarily lead to a more intensive price oscillation, but also it might lead to a damping oscillation of price in the REE model.

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On the Role of Medical Experience for Overcoming the Stocks and Flows Failure

Accumulation is a fundamental concept in dynamic systems that has been shown to be very unintuitive and hard to understand even for highly educated adults and very simple systems. The only intervention that is reported to improve performance for judging stocks and flows for accumulation systems is practice combined with corrective feedback. This study investigated whether experience in a task domain – namely medical education – can advance students' performance for judging accumulation within their task domain. We compared judgments of 180 medical students and 180 students from other fields for stock-flow problems from the medical field and from generic problems. As expected, medical students performed better than non-medical students for both medical and generic problems but still performed very poor indicating how hard it is to understand dynamic systems. As their non-medical fellows, medical students tend to assume that the level of a stock would follow the development of its flows.

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The Dynamics of Fleet Usage

This paper presents a model that was developed in the Defence Science and Technology Organization (DSTO) in Australia. It is a general model designed to provide insight into the long-term fleet management dynamics of aircraft. The use of system dynamics modelling is an innovative approach to this problem and at the centre of the model is the relationship between aircraft serviceability and usage rates. The paper and the model will assist the Royal Australian Air Force (RAAF) to address a number of specific fleet management issues: • Ageing platforms and the dynamics of degrading serviceability of existing platforms, • The effects of modification and upgrades programs, • Understanding the effects of changing demand (flying rates) and non-steady state operation. The model presented in this paper contains hypothetical data as real figures on Availability and Serviceability of aircraft in Australia is classified. However, the model demonstrates the fundamental dynamics that are in play during the life of any given aircraft.

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Methodological Changes Needed to Meet the World's Grand Challenges

A companion paper to this one identified four "Grand Challenges" for system dynamics. This paper describes the methodological changes seemingly needed to meet those challenges, describing some of the current precedents and rationale for each. The more technical changes are far more explicit model purpose, use of time series, representation of actors' mental models, and working with multiple models. The changes in professional matters are far more soft science expertise, publication in

the language of the public and government, incenting synergistic research, and evolving an open-source online curriculum. These changes do not much alter the core of system dynamics but expand the repertoire of expert modeling activities substantially.

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Key performance indicators in professional service firms - a dynamic perspective

Four major factors affect the performance of project based professional service firms: The ratio of senior to junior staff referred to as the firm's leverage, the average fee charged per unit of time, the percentage of billable time referred to as utilisation, and the profit margin. This paper takes a holistic approach to analysing the performance of these KPI's at a particular professional service firm based on the time senior staff allocates to the following tasks: Project acquisition and delivery, contact and customer maintenance, service innovation and development and hiring junior staff.

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A Validation Methodology for System Dynamics Models

Quality is a critically important issue in almost every discipline. The literature in the field of System Dynamics has bred a number of contributions concerning tests for the validation of simulation models and its epistemological foundations. To date, however, little has been said about a validation methodology for System Dynamics models, even for simulations in gen-eral. By validation methodology, we understand the systematic elicitation, description, and reflection of issues related to the subject of validation. The papers contribution is to initiate the development of a validation methodology. We explicitly address three topics: Complexity engineering through validation tests, integrated validation process, and finally the decision to cease validation efforts. The first defines validation tests according to their capability to ac-count for a certain level of model complexity; the second designs a validation process which addresses the domains of validation (structure, behavior, context validation) and the levels of resolution (micro, meso, macro) integratively and iteratively. And third, the cession decision creates a heuristic method for the saturation of a System Dynamics model and conceptually defines when to cease with validation efforts. The paper concludes by providing further directions of research about a validation methodology.

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Intuitive vs. Deliberate Decision Making a Dynamic Setting: An Experimental Approach

The purpose of the poster is to discuss the effects of intuitive versus deliberate decision making in a dynamic task. An experimental setting is used to study this question; three experimental groups are distinguished:

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immediate decision-making (only limited time for cognitive processing), considered decision-making (time for deliberate cognitive processing), and distracted decision-making (during which intuitive cognitive processing can occur). The experimental stimulus is a simulator based on the Kaibab Plateau model. More than 100 subjects were tested in a pre-test, which led to a substantial revision of the original experimental design. With the new experimental design, we assume to find significant differences between the three groups concerning their decision quality. The value of the study lies in the fact that it connects to a recent discussion in psychology and transfers this to a core interest of the system dynamics community: decision-making in situations with dynamic complexity. Keywords: dynamic decision-making, intuitive information processing, dynamic complexity, experiment.

Supporting Long-term Personnel Planning of a Service Provider

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The purpose of the paper is to demonstrate, how a dynamic aging chain model can support strategic decisions in personnel planning. More specifically, we use a system dynamics model to improve the recruitment and training process in a large German service provider in the wider field of logistics. The key findings are that the aging chain of service operators within the company is affected by a variety of delays, for instance for training, promotion, and ordering of personnel, and that the structure of the planning process generates cyclic phases of personnel surplus and shortage. The discussion is based on an in-depth case study, which was conducted in the service company in 2008. Implications are that planning processes have to be fine-tuned to account for delays in the aging chain; the simulation model provides a tool for gaining insights into the problem and for improving the actual human resource planning process.

An Operational Framework for Seeing and Simulating Feedbacks in Land Change Science

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Feedbacks, nonlinearities, and time delays are at the heart of dynamic interactions of socio-economic and biophysical systems. Land use land cover change (LUCC) is a significant component of these dynamic interactions. Land change science community recognized the need to go beyond static depictions of feedback processes. This requires explicit focus on the embedded feedbacks within and across scales as influential, endogenous structural sources of the observed behavior patterns in integrated social and biophysical systems. We present an operational framework that takes its strength from its clear emphasis on nonlinear feedback interactions as drivers of LUCC. The framework addresses both micro- and macro-level processes by employing complementary use of system modeling and spatially-explicit discrete-choice modeling. We demonstrate the potential of the approach on a rapidly urbanizing region, Pearl River Delta (PRD) in South China. To this end, we employ our systemic framework and identify the most influential feedbacks and linkages impacting the urban land conversion over the course of urban and economic growth as experienced in PRD. We also discuss the

potential of systems approaches and use of complementary methods in advancing land change science both in theory and in practice. Our remarks, invariably, have implications for sustainability science as well.

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A model for overreaction and underreaction of stockholders in Tehran Stock Exchange using system dynamics method

Overreaction and underreaction of stock holders in response to information and news are the events which challenge efficiency of capital market. Using EPS modifications of companies represent on TSE during 2006 to 2008 years, this research surveys over reaction and under reaction of stock holders in response to new information. Finally, utilizing system dynamics, we suggest a model to discuss these events. Inputs of the model are as follows: earning per share – price ratio, first earning per share of stock, time of memory, Time to change perception and Average historical price . The model is for the facts in the companies which have at least 20% free float and over 10% benefit modifications.

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The System Dynamics of the "Invisible Hand": Simulating a Neoclassical Economy

It is maybe not exaggerated to state that the relation between system dynamics and economics (and related models) fluctuated between ignorance and open hostil-ity in the past. One plausible explanation for this observation could be a lack of mutual understanding, which this article aims to address. The article sets out with dynamic hypothesis about economic equilibrium, a central concept in neoclassical economics. It is argued that the emergence of an economic equilibrium, i.e. a balance between supply and demand, depends on the relative speed of change within the economic system itself and its economic environment. A model exhibiting such behaviour would arguably conform to basic principles of sys-tem dynamics and might pave the way for a fruitful adoption of elements of micro-economic theory in system dynamics models. The article consists of a brief and (hopefully) accessible exposition of neoclassical theories of consumption, production and general equilibrium; a presentation of a numerical general equilibrium model and the equivalent system dynamics model, highlighting the relation between the models; an analysis of simulation and sensi-tivity results; and conclusions with respect to the dynamic hypothesis stated at the outset, the potential usefulness of the SD model for applied analysis and some more theoretical conjectures.

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Estimating Impacts of Water Scarcity Pricing

Water resources in Western U.S. are increasingly scarce due to population growth and climate change that reduces water supplies. The collision of these two realities implies that if water remains under-priced, a likely externality is over consumption, premature resource

exhaustion, and shortages. This paper develops a hybrid, hydro-economic model of social welfare maximization constrained by groundwater availability in a control theory framework. The model provides optimal water use and the efficient price given consumer preferences and resource constraints. The model suggest that water prices should be at least 23 to 36 percent above current levels. We consider one way to overcome the historical, institutional barriers to scarcity pricing by distributing back to consumers the scarcity value collected. Estimates of U.S. water infrastructure investment needs reach as much as $2.2 trillion dollars over the next 30 years. Investing the scarcity value in water infrastructure is one way to distribute excess revenue to consumers while allocating water efficiently, essentially solving two problems with a single policy prescription. We simulate the model's effectiveness and identify impacts using data from Albuquerque, New Mexico.

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Using System Dynamics to Develop Organizational Learning Process: the Collingwood Neighbourhood Justice Centre

The development of the Neighbourhood Justice Centre (NJC) in the Melbourne suburb of Collingwood is a first for Australia and reflects a universal growing interest in addressing the underlying causes of criminal behaviour and disadvantage as well as improving access to justice. The paper documents the findings that arose from an intervention in the NJC that involved analysis of the NJC processes using process maps, causal loop diagrams and systems modelling. From this analysis, plans for organizational change were developed through a series of workshops. The paper also documents the change in sense making processes to include ideas of process flow, feedback systems and causation. The processes that were modelled in the NJC have much in common with other case management systems, particularly in hospitals and it appeared likely that the NJC would soon be addressing the problems Wolstenholme's (2007) identified where "the normal mode of operation is beyond their safe design capacity.".

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Capturing the Dynamics of a Psychiatric Illness

The present study undertakes a partial system dynamics (SD) translation of the contemporary biological and psychological conceptualizations of panic disorder (PD). It makes explicit the dynamic processes implicit in the narrative presentations in the literature. It serves as a facilitator for the discussion about PD for it provides an easy-to-understand and illustrative language for commoners to understand, and researchers of different fields to critically examine, the biological, psychological, social and cognitive aspects of PD.

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Exercise in application of System Thinking in the water purification system

This is about the water purification system which named eco-machine system. Based on the Model built by STELLA software, the system is used to simulate the wastewater treatment process of Constructed Wetland. This system can increase the amount of dissolved oxygen and absorb nitrogen and phosphorus. Through analyzing the elements influencing dissolved oxygen, we designed the experiment which is divided into 4 parts of circulation: Aquarium which contains ornamental fish; physical treatment which contains oxygen increasing pump; emerged plant absorbing nitrogen and phosphorus; submerged plant increasing oxygen. The power of pump indicates the speed of circulation of water. The amount of oxygen successfully increases with the help of our water purification system in the lab. We assume that the dissolved oxygen is the dominant indicator of the effluvium, so we consider the increase of the dissolved oxygen as the decrease of the effluvium. Meanwhile, all the cost we need is the electrical energy for operating water pump, some aquatic creatures and water plants. In another words, our eco-machine system is an efficient way to improve the water quality.

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System Dynamics Model for the Sustainable Management of Theme Park

The goal of this study is to examine the problems in making investment decisions for tourism products from a perspective of sustainable management and development. With System Dynamics as the basis and the STELLA computer software as the tool, a systemic approach is adopted and system factors identified using the Fuzzy Delphi method to construct a sustainable system dynamics model for the Jianfushan Fancyworld in Taiwan. By modeling, simulating and analyzing the dynamic scenarios in the tourist product market, how corporate economic development impacts on the environment can be understood. Beneficial development and management strategies may then be proposed to the operator of the themed park to help them arrive at the right development decisions. Keywords: Theme park, sustainable management, system dynamics.

How best to reduce cardiovascular risk? Dynamic modeling to integrate public health and medical science

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A system dynamics model has been under development since 2007, supported by the federal CDC and NIH, for evaluating alternative interventions to reduce cardiovascular risk in a population. The Phase 1 model, presented at last year's conference, focused on first-time cardiovascular events, risk factors, and costs, and was applied nationally and to Austin/Travis County, Texas. The expanded Phase 2 model includes the post-cardiovascular event population, post-event care, and recurrent events. The expanded model also depicts treatable borderline risk conditions (pre-hypertension, borderline cholesterol, and pre-diabetes) and former smokers. We will apply the expanded model again in Austin, and also for the heavily disadvantaged Delta region of Mississippi. The local applications support community planning about the likely impacts of interventions and their tradeoffs. We will also apply the model to explore (a) targeting interventions by age category or by gender; (b) lowering treatment targets for blood pressure, cholesterol, or blood glucose; (c) other risk factors (e.g., excess salt consumption, vitamin D deficiency, periodontal disease, and C-reactive protein); and (d) the effects of race and ethnicity. The results will provide evidence-based support for improved strategies combining public health and clinical interventions to reduce cardiovascular risk and its direct and indirect costs.

The Hero and the Warrior in New Venture Growth

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Many entrepreneurial successes are attributed to the strong personalities of the new venture leaders, who offer vision, inspire loyalty, and display tenacity in solving problems to achieve their goals. Successful start-up ventures may bias perceptions of the anecdotal benefits of personality-driven leadership in firms too young to have established processes, operationally and organizationally. Those ventures destroyed by the personalities of early leaders, because they no longer exist, offer few anecdotes with which to compare and counter legendary successes such as Apple and its visionary leader Steve Jobs or Amazon and its creative founder Jeff Bezos. This paper advances our thinking about the risks and rewards of personality-driven leadership in start-ups by exploring the dynamics that can arise from heroic leadership gone awry. Building on a

case study of a key manager in a medical-device start-up, we identify causal relations and essential dynamics that may bring success to the leader but at the expense of the new venture's viability. We discuss insights from the causal loops as they relate to the literature on leadership and outline next steps to advance the research.

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Real Options Approach for Innovation Implementation Strategies

Many interventions that are effective in one setting may be ineffective or even harmful in other settings. This poses a problem for organizations and communities engaged in planning efforts seeking to improve outcomes. This paper introduces the use of managerial real options combined with system dynamics models to design strategies for implementing community interventions when their effectiveness may be uncertain. A new notation for representing implementation strategies using real options is introduced. The approach is illustrated with an example of domestic violence community interventions. Results show that there are potential benefits to using a real options approach.

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Modeling the Dynamics of the Energy, Environment, & Poverty Nexus: A Study of Biogas Unit Diffusion in Andhra Pradesh, India

In this paper, we use system dynamics modeling to look at the broad set of socio-economic and ecological factors which together play a role in determining a households decision to adopt a biogas plant. Informed by data we collected during the summer of 2008 with the Foundation for Ecological Security (FES) in Andhra Pradesh, India, and with corroboration from the relevant technology diffusion and energy transition literature, we model the process of biogas adoption and traditional technology replacement. We find that only by improving biogas interventions to address this complex interplay of energy, environment, and poverty-related factors, notably household usage of a multiple-stove strategy and the incapacitation of the poorest households, can an intervention realize desired outcomes around both human and ecological wellbeing. We conclude with a discussion of model applications for both FES and the broader rural development community.

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Supporting Strategic Conversations: The Significance of the Model Building Process

This paper reports on the use of both qualitative modelling (i.e. Journey Making) and quantitative system dynamics simulation modelling for a strategy making process in a UK police force. The main focus of the

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work is on the tension between the supply of resources (i.e. police officers) and the demands placed on those officers. The strategic conversation that took place was facilitated by 2 modellers - one focussing on managing the strategic enquiry, while the other considered the implications of the conversation for the system dynamics model. Three key strategic conversations emerged: the management of quality with respect to staff, measuring productivity, and the role of public expectations. The work raises issues for both model building processes and the strategic management of any public organization.

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Clean Technology Startup Management Flight Simulator

How to run a successful clean technology startup company? What are the strategies that enable a startup to escape the "valley of death" and emerge as a winner in the market? To gain some insights in this, we developed a Clean Technology Startup Management Flight Simulator, a system dynamics based computer simulation game to study the dynamics of clean tech startups. The model builds on the previous work by Miller (2007) and Oliva, Sterman and Giese (2003). It includes the prospect chain, product development, sales, marketing, human resource, finance and accounting. The player makes decisions on headcount (growth rate and allocation), compensation (salary, stock grants and options) and financing (VC financing and IPO). We aim to use it as a teaching tool for learning various trade-offs clean tech startups face in a cash constraint environment.

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The Ford Method: A Sensitivity Analysis Approach

In dynamic models, a system's behavior is determined by the interaction of its feedback loops. The challenge for system dynamics modellers is to identify these loops, and also understand, over the runtime of a model, which loops dominate system behavior. The Ford method is a procedure that identifies changes in atomic behavior patterns in the presence, and absence, of feedback loops, in order to identify loop dominance for a specific time interval. For a candidate feedback loop, dominance is calculated based on setting the loop control variable to a constant value. Our approach proposes a variation on this method. Using sensitivity analysis, we explore a wider search space around a range of possible values for the control variable, and thereby the value of the loop gain. The outcome of this analysis is a richer set of loop dominance analysis for each atomic behavior pattern in the model. The sensitivity of various feedback loops is measured as an indicator of dominance. This approach has the potential to be selected for modellers and policy makers to analyze the structure-drive-behavior dynamic systems. The approach is illustrated through an analysis of the Yeast Model.

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Korean Real Estate Market Mechanisms and Deregulation of Mortgage Loans: Qualitative Analysis

The Korean real estate market is currently experiencing a slowdown due to the global economic crisis which has resulted from subprime mortgage lending practices. In response, the Korean government has enforced various policies, based on intention to deregulate real estate speculation, such as increasing the Loan to value ratio (LTV) in order to stimulate housing supply, demand and accompanying housing transactions. However, these policies have appeared to result in deep confusion in the Korean housing market. Furthermore, analyses for housing market forecasting—particularly those which examine the impact of the international financial crisis on the Korean real estate market—have been partial and fragmentary. Therefore, a comprehensive and systematical approach is required to analyze the real estate financial market and the causal nexus between market determining factors. Thus, with an integrated perspective and applying a system dynamics methodology, this paper proposes Korean Real Estate and Mortgage Market dynamics models based on the fundamental principles of housing markets, which are determined by supply and demand. As well, the potential effects of the Korean government's deregulation policies are considered by focusing on the main factor of these policies: the mortgage loan.

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Fringe Area Growth in Chennai - A systems approach

Growth is the catalyst for all the issues related to landuse and transportation planning. It is very much necessary to regulate this growth to achieve a sustainable planning of the cities. The cities have become almost saturated in the inner core and their growth is more in the peripheral areas i.e. urban fringes or periurban areas. The population growth rate of periurban areas of Chennai is 3 to 3.5 compared to the city growth rate of 1.23. In this paper an attempt has been made to establish the need for development planning of periurban areas by simulating the growth of periurban area through system dynamic modelling under various scenarios.An ideal growth scenario is simulated. The study area selected is one of the most rapidly developing periurban areas in Chennai. Also a system dynamic model is built for the whole of Chennai metropolitan area to project its growth and estimate the present and future supply demand ratio of transportation facilities.This will enable planners to perceive the future conditions and plan accordingly for a better, efficient and greener city of tomorrow.

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A system dynamics model for the German electricity market - model development and application

Aim of this paper is the description of a system dynamics based model for the German electricity market and its application. With the model "Zertsim", developed by EIFER, impact studies of economic and environment related constraints on the German elec-tricity spot market should be made. A first application of the model was in a workshop with entrepreneurs of the region of Karlsruhe in Germany. One result of the workshop was an order of impact factors for the development of electricity prices and CO2 emis-sions. The most determining factors for high electricity prices are: 1) environmental constraints, 2) fuel prices, 3) electricity demand, and 4) extended operation time for nuclear power stations in Germany. Regarding CO2 emissions the highest impacts could be find in the case of: 1) environmental constraints, 2) extended operation time for nuclear power, 3) electricity demand and finally 4) fuel prices.

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Policies for Improving Design-Build Delivery System in Korea

Increasingly adopted by both public and private organizations, Design-build (DB) has become a favored construction project delivery system, outperforming other systems in terms of cost, schedule, and quality. However, DB has been especially criticized by the public sector for practicing subjective evaluation and for providing only limited accessibility to small and medium-sized contractors. In Korea, similar critiques have been raised, as these qualities have prevented public owners from benefiting from the potential advantages of DB. In order to address these challenging issues, the present research will systematically be analyzed the characteristics of the DB delivery system in Korea. Based on industry surveys and an extensive literature review, a qualitative system dynamics model will be developed and used to propose and test hypothetical DB policy alternatives that are expected to enhance DB performance. Furthermore, after the appropriate customization processes, these research findings can also be applied to the industry settings of different countries.

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A Countdown towards Solar Power at Grid Parity: Evolution of Price-Performance

The price-performance of solar power generation seems to be on the verge of reaching grid parity. With this paper we examine first the effect that government sponsored renewable portfolio standard initiatives will have on the true cost of solar electricity for consumers and second the degree to which the problem of meeting the consumer demand may become more significant once solar electricity reaches parity with conventional sources of electricity generation. The true costs associated with grid parity include the investment in generation capacity, backup

infrastructure, along with the production and the distribution costs. The generation and production costs are on track to drop over time, on the other hand the distribution and allied infrastructure costs can increase owing to daily production variation, grid congestion and long distance transmission loads as the demand for solar power grows. This context offers a dynamic setting for examining a set of policies that will affect the diffusion of solar power technologies.

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A System Dynamics Approach to the Bhaduri-Marglin Model

This paper starts from the observation that the global financial and economic crisis cannot be explained by mainstream neoclassical models. There is a need to promote the development of macroeconomic models that put emphasis on the demand side. A promising starting point for such a development is the Bhaduri-Marglin model. A drawback of this model is the lack of dynamics. As the first part of a more comprehensive research program this paper proposes a system dynamics approach to the Bhaduri-Marglin model which yields additional insights into this model.

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The Renewable Energy Industry in Massachusetts as a Complex System

An abstract model of a local photovoltaic market was developed from a model-based field study. The system described by informants displays features of distributed and embedded agency: actors have the ability to take meaningful action, but that action and its effects are limited by the complexity of the system and by the actions of other actors. The structures necessary for dynamic growth are present, as expected in an industry that has had the growth of the PV market so far. Under several reasonable conditions, growth can be halted before reaching its potential: if reinforcing feedback processes saturate; if industry capacity grows too slowly; or if goals are too low or if they erode. Coordinated action - multiple small interventions - are more effective than isolated large actions as a policy for market growth.

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Sustaining industrial growth in Africa: A reflection on South Africa's automotive industry support model

The use of selective industrial policy to re-integrate South Africa's previously protected automotive industry into the global business is one of the few successful cases on the African continent in recent times. South Africa's success provides a useful reference point for other African countries in which selective industrial policy is a key part of national development strategy. Despite the re-integration, the automotive industry has experienced deteriorating trade deficit since 1995 contrary to what had been envisaged. The paper uses a system dynamics model to explain this apparent contradiction. It is found that the offer fiscal incentives to the industry had a positive effect on industry investment and exports but not long-term competitiveness. The paper argues that for a replica of

South Africa's selective industry support model to sustain industrial growth and subsequent international trade, it has to be implemented in conjunction with a targeted technology acquisition strategy.

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The Effect of Chaotic and Instable Portfolio on House Price in Tehran as a Case Study

Investigation into house price changes during time has been the focal point of numerous researches and lots of great scholars such as Wheaton[1,2] have put in a great deal of effort to explain and model its behavior. In researches carried out so far, there were two main approaches: first, most of the vacillation in house price was assigned to delay in supply and demand market while in the second approach house was considered as a durable good and the characteristics of those goods were utilized to justify the house price behavior. In this paper we are trying to dynamically model and investigate the effect of a chaotic portfolio (meaning capital flow between three key markets: House, Stock and Bank) on house price change trend, focusing on house price in city of Tehran as a case study. Eventually some policies are suggested to manage the aforesaid chaos.

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An Investigation on The Process of Modification of Subsidy Policy

In recent years, increase in energy price in international markets has turned paying energy subsidy into a serious challenge, because those countries paying subsidies are in constant pressure (Gupta 2003)[6,7]. Rise in energy price and demand in those countries has resulted in earnest problems in energy pricing (Davis 2001)[4]. Besides, subsidy elimination and imparting the resulted money to the society, without planning for solving its short-term and long-term consequent problems, will lead to public dissatisfaction as well as industrial performance downturn and also it will cause inflation[5]. In this paper while offering a comprehensive model for this problem and dynamic analysis of the policies implemented so far and also investigation of those policies in short-term and long-term frames, another policy is suggested for solving this problem which not only guarantees industrial development and increase in public welfare level but also will gradually remove energy subsidy from government budget and thus will help the government to get rid of this intolerable burden.

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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

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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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Science, Technology, Engineering, and Mathematics (STEM) Career Attractiveness

A system dynamics model was developed in response to the apparent decline in STEM candidates in the United States and a pending shortage. The model explores the attractiveness of STEM and STEM careers focusing on employers and the workforce. Policies such as boosting STEM literacy, lifting the H-1B visa cap, limiting the offshoring of jobs, maintaining training and a combination of strategies are explored as possible solutions. The system is complex, with many feedbacks and long time delays, so solutions that focus on a single point of the system are not effective and cannot solve the problem. A deeper understanding of parts of the system that have not been explored to date is necessary to find a workable solution.

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A Review 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 partial 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. This paper therefore presents Review of System Dynamics Models in Education. This paper builds on the earlier taxonomy by widening the scope of the survey of completed SD investigations in educational management. The findings from these investigations are briefly described. The Review classifies the completed investigations into seven specific areas of concern and five hierarchical levels. Key words: System Dynamics, Education.

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A Review of System Dynamics Pedagogic Techniques

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 partial 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. This paper therefore presents Review of System Dynamics Pedagogic Techniques. This paper builds on the earlier taxonomy by widening the scope of the survey of SD Pedagogic Techniques. The findings from these investigations are briefly described. The Review classifies the completed investigations into specific areas of concern and hierarchical levels. Key words: System Dynamics, Education.

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A System Dynamics Framework for Sustainable Manufacturing

This paper proposes a framework for application of system dynamics modeling to sustainable manufacturing. Sustainable manufacturing involves interaction of multiple complex systems including those in manufacturing, environment, financial and social domains. A concerted effort involving a number of researchers may be required to develop the requisite capability to model sustainable manufacturing with a flexible scope. At present, it is difficult for researchers to collaborate, share and reuse models and components due to lack of consistency in several aspects including taxonomy and modeling approaches. The proposed framework is a first step to move towards composability of sustainable manufacturing model components developed by different research teams. The proposed framework organizes the major factors influencing sustainable manufacturing into four interacting complex domains. The framework is intended for use as a platform to develop model components that may be interchanged to analyze sustainable manufacturing for different industries and geographies.

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

Use of system dynamics 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 is entirely new. This paper seeks to demonstrate the practicality of the use of a triangulation of

methodologies called DSM combining System Dynamics 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 author presents and understanding of DSM and then describes the iterative model development process including model validation. Analysis is made of the model to identify the dominant loops so as to suggest important factors to consider in design of a possible tool. 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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Using System Dynamics to Evaluate A Push-Pull Inventory Optimization Strategy For Multi-Tier, Multi-Channel Supply Chains

Multi-tier, multi-channel supply chains are now common in many industries including aviation. Such supply chains provide high-value aviation parts to the Government, and many of these supply chains have been plagued recently by shortages. These shortages arise from demand volatility as well as supply uncertainties. In many commercial supply chains, a push-pull strategy is used to develop responsiveness to uncertainties in demand and supply. An optimization model is developed for an aviation supply chain to strategically place WIP inventory at specific suppliers, thus creating a push-pull boundary in the manufacturing supply chain. The optimum solutions are shown to substantially improve supply chain response and supply availability with reduced working capital. A system dynamics model is used to evaluate the performance of the supply chain over time when the optimal safety stocks were in place. The results indicate a significant improvement in the recoverability of the supply chain when subjected to a sudden increase in demand.

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Analysis of Global Food Market and Food-Energy Price Links: Based on System Dynamics Approach

The world food and energy prices are becoming increasingly linked. Food vs. fuel is the dilemma regarding the risk of diverting farmland or crops for biofuels production in detriment of the food supply on a global scale. One systemic cause for the price rise is held to be the diversion of food crops (maize in particular) for making first-generation biofuels. An estimated 100 million tonnes of grain per year are being redirected from food to fuel. The objectives of this study are firstly to build a simulation model, based on system dynamics approach, for not only analyzing the global food market but also forecasting the global food demand, production, and stock, and secondly to examine the food-energy links mechanism by analyzing biofuel related technology level and progress, expected biofuel demand and price, biofuel production capacity and

facilities, and petroleum market mechanism. a causal link from the oil price to the biofuel demand is positive, meaning that an increase in the oil price results in an increase in the biofuel demand. There are several more positive links: a link from the biofuel demand to the biofuel price, a link from the biofuel price to the oil demand, and a link from the oil demand to the oil price.

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Verifying Influence Diagrams using Dimensional Analysis

Developing a valid model is of primary importance in System Dynamics (SD) modelling process. To establish that a model produces the right behaviour for the right reasons it is essential to ensure that the structure of model represents the corresponding real world system. Amongst the verification procedures employed, dimensional analysis is used to verify the syntactical correctness of the equation. However, dimensional analysis is among the least prioritised procedures employed in the model building process. Therefore, a lack of dimensional consistency raises serious doubts about the validity of model behaviour. The aim of this paper is to summarise various problems and difficulties identified in the process of SD modelling and to suggest an alternative approach. Firstly, this paper discusses the problems faced by beginners. Secondly, the paper discusses alternative approaches suggested by researchers in SD. Thirdly this papers presents a novel approach to generate a mathematical model from influence diagrams. The two principle benefits this approach can offer are, a software tool based on this approach which can make the benefits of quantitative modelling of SD methodology more accessible to a wider range of users and an improved SD modelling experience, especially of those modellers who have limited mathematical experience.

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Exploratory strategies for simulation-based learning about national development

This study investigated an instructional strategy to improve learning a complex model in a sys-tem dynamics based learning environment. The instructional strategy required subjects to ex-plore key variables by manipulating dynamic graphs. Design of the strategy was posited upon principles of reducing cognitive load, facilitating mental models, enhancing transfer, and manag-ing risk. Eight students who received the exploration strategy subsequently made better policy decisions than nine subjects who did not receive the strategy. Furthermore, the former subjects exhibited better understanding of the model and how to manage it than did the latter subjects, based upon their verbal descriptions.

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Modeling Strategic Technology Management With a Hybrid Model

Abstract: In this study we will introduce a hybrid model to describe competition in a constantly developing market environment. A hybrid model referred here is a model that has both system dynamic and agent-based elements. Modeling effort begins from a literature review to strategic management and management of technology. From this background we build a model combining the theories from multiple theory tracks. The model is used to test the effects of more rapid strategy process to firm's profitability. To test the results we use statistical methods to analyze the data gathered from sensitivity runs. Our model founds support for the proposition that increasing agility increases also the competitive advantage of the firm. We also conclude that hybrid modeling is a strong research tool, but it comes with drawbacks of high hardware requirements and challenging more complex modeling tools.

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Human Resource Planning in a Shore-based Integrated Steel Plant: A SD Model

This paper elaborates a model of Human Resource supply and demand as it affects the productivity of a shore-based integrated steel plant using the System Dynamics method. The HR scenario at the plant is examined over a period of ten years, during which it successfully operated with one-third of the personnel in comparable steel plants in India. Also examined is the optimal level of human resources necessary to ensure enhanced efficiency and productivity levels, containing personnel, and redeploying surplus personnel through retraining and relocation. The key parameters taken up are non-executive/executive ratio, personnel productivity, and total workers. More precisely, it identifies policies related to (i) downsizing personnel (ii) to decreasing non-executive/executive ratio, and (iii) improving labour productivity and effectiveness.

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Fishing Industry Dynamics: Is fish farming sustainable? An Exploratory Study of the Salmon Industry

In recent years, there has been an increase in the interest for fishery dynamics in the System Dynamics field but most of the work has been related to the management of wild fish stocks. In this paper, we present an exploratory study of the effect of fish farming on the stock of wild fish stocks based on the case of the Salmon industry. Fish farming does not reduce the impact of fishing activities but it increases their effects since it is necessary almost 6 kilograms of wild fish for each kilogram of salmon produced.

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The Dynamics of Crisis Lifecycle for Emergency Management

Cascading disruptions and failures product of natural, industrial and man-made disasters can be avoided or minimized if the concept of Crisis Lifecycle is included and understood into emergency management. Research studies by Turner and also by Vaughan have shown that crisis often have long incubation times. There are numerous precursors or warnings that are ignored or not detected. As Coombs put it, "crisis does not just happen, it evolves". According to Coombs, a crisis lifecycle has three stages: precrisis, crisis event and postcrisis. With this lifecycle-view in mind, emergency managers could encompass asynchronous management of the incubation periods, the physical manifestations of the emergency, the restoration periods and beyond. Hence, emergency management needs a long term approach, resolution of different perspectives and improvement of emergency communication. We aim to define the characteristics of each phase by analyzing real cases developing reference modes.

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Learning Environment Simulator: A Tool for Local Decision Makers and First Responders

The National Infrastructure Simulation and Analysis Center (NISAC) has developed a prototype learning environment simulator (LES) based on the Critical Infrastructure Protection Decision Support System (CIPDSS) infrastructure and scenario models. The LES is designed to engage decision makers at the grass-roots level (local/city/state) to deepen their understanding of evolving crises, enhance their intuition and allow them to test their own strategies for events before they occur. An initial version is being developed, centered on a pandemic influenza outbreak and has been successfully tested with a group of hospital administrators and first responders. LES is not a predictive tool but rather a simulated environment allowing the user to experience the complexities of a crisis before it happens. Users can contrast various approaches to the crisis, competing with alternative strategies of their own or other participants. LES is designed to assist decision makers in making informed choices by functionally representing relevant scenarios before they occur, including impacts to critical infrastructures with their interdependencies and estimating human health & safety and economic impacts. In this paper a brief overview of the underlying models are given followed by a description of the LES, its interface, usage and testing experience.

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Dynamic Interrelationship between Administrative Consolidation and Segregation: Korean Example

This study aims at constructing dynamic models which would measure the direct and indirect impacts originating from the proposed administrative integration. Specifically, it compares two antithetical points of view, that of the existing and consolidation scenarios. Applying Cheongju and Cheongwon sample, it tries to set up causal and stock-flow models reflecting the above two scenarios. The simulation work focuses on dynamics changes of major urban indicators in the mother city of Cheongju and its vicinities, i.e. Cheongwon, respectively. It also analyzes whether the proposed consolidation scenario would exert meaningful positive impacts in enhancing regional attractiveness.

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The Change in Residents' Participative Behavior in Polluted Areas: A System Dynamics Perspective

This article explores the reasons for the declining public participation of residents in a severely polluted community from a system dynamics perspective by examining a set of communities polluted with dioxin in southern Taiwan. The study examines three aspects affecting participative behavior intention: residents' perception of the pollution, peer impact, and how residents perceive the impact of participation on government response. A face-to-face interview conducted from August to September 2008 revealed that the unintended side effect of the government's indemnity policy has created a balancing feedback loop that offsets the reinforcing feedback system suggested by the normative theory of participation. In addition, the unique nature of pollution victims mitigates the influence of an existing reinforcing feedback system. This article concludes with policy suggestions to increase public participation in a highly polluted community.

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From Waste to Value - A System Dynamics Model for Strategic Decision Making in Closed-Loop Supply Chains

The purpose of this paper is to develop a system dynamics model which allows an Original Equipment Manufacturer in the electronics industry to test different value recovery strategies in a Closed-Loop Supply Chain setting. Due to shortening product lifecycles and legislative regulations, companies face the challenge of handling products at their end-of-use or end-of-life. Accordingly, effective strategies for the collection and value recovery of these products have to be developed. The model presented in this paper is the preliminary result of an ongoing research project. First

simulation experiments conducted on the current model structure on the one hand show the economic potential of an engagement in value recovery activities and on the other hand highlight the high complexity and connectivity inherited with various value recovery processes.

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The Analysis and Simulation of the Materials Inflow and Outflow of Macao

The metabolism of a city can be seen as the process of transforming all the materials and commodities for sustaining the citys economic activity. The Macao Special Administrative Region (SAR) is a highly developed metropolitan region where prosperous tourism has made it possible to support a population of 0.54 million people on an area about 29.2 km2. This paper highlights the economic and environmental transformation of Macao by emphasizing the following aspects: the population trends, tourists changing trends, GDP, foreign investment trends, material resource consumption and waste generation, so as to forecast the trend of the Macao development and provide valuable reference to government policy makers. The result shows with the development of Macao, its area would increase, and population density would remain the same level, while its GDP and foreign investment might increase to the year of 2017.The imported materials would fluctuate with the equivalent population. The mineral and the potable water increased, while sewage would be influenced by the uncertain precipitation. This research was financially supported by the Science and Technology Development Fund of Macau (No.022/2007/A2), Macao SAR, China.

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Application of System Dynamics to Unsealed Road Maintenance Management

ABSTRACT: Most pavement maintenance management systems tend to be either non-analytical databases or statistical correlation models. However, pavement maintenance is part of a complex system comprising the road pavement, the environment, diverse users, the maintenance authority and Local/State/Federal Governments. This system has significant feedbacks, making it a suitable field for system dynamics enquiry. This paper discusses a system dynamics based pavement management model that was prototyped originally by engineering students at the Australian Defence Force Academy (Hyde 1996, Jackson 1997) and refined on contract with the Australian Government. The current model was rebuilt in Powersim Studio and refined in collaboration with a Victorian rural Shire Council. The model analyses the pavement deterioration over time of 530 individual segments of unsealed rural road, prioritising rehabilitation treatments based on user

preferences and budget constraints and identifies the consequences of different budgetary approaches. Feedback to the decision makers includes the number of households served by very rough roads, the number of user complaints and roughness related accident costs and vehicle operating costs. Keywords: Pavement maintenance management; pavement life cycle costing; unsealed road maintenance; transport economics; economic evaluation; system dynamics.

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The National Energy Dilemma: Models for Policy Evaluation

This study is about gaining a deeper and better understanding of the effects and implications of the current situation in the U.S. energy markets at a macro level. In order to test what macro-level theories might best explain the national situation, the research takes a system dynamics perspective to cope with the behavioral complexity of the problem. Questions to be addressed include what makes the energy markets so volatile? Can the U.S. Government help stabilize these markets by developing and selling some of its energy assets? How can the U.S. Gov. encourage more private investment in renewable forms of energy? System dynamics models are presented to study the U.S. energy situation with a view to gaining a better understanding and to providing useful suggestions for policy.

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Individual Versus Group Rationality: A Coevolutionary Approach to the Beer Game

In this paper, we examine the evolution of strategies in the Beer Distribution Game (BDG). This is a well known game which has many parallels with supply chain optimisation problems. This paper explores the strategies used by individuals participating in this game. The issue of bounded rationality is addressed in detail throughout our simulations. This paper presents a new and alternative approach to evolving strategies for the BDG. This includes a co-evolutionary architecture which provides a means of evolving strategies across the various sectors of the BDG. Our results identify the best performing or fittest strategies for the BDG when two alternative fitness approaches are used. We show the significant implications for individual strategies in the BDG when agents are influenced by greater levels of bounded rationality. Our conclusions indicate the implications of individual and group rationality on the BDG.

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Minimize Out of Stock Through Optimizing Store Operations: An analysis of restocking policies

Out of stock (OOS) has long been a plaguing problem for both manufacturers and retailers. It not only leads to lost sales in the short term, but also may lose customers in the long run. OOS could be caused by many factors, such as manufacturer production shortage, distribution center delay, consumer demand surge, and sub-optimal store operations, etc. In this paper, we focus on OOS caused by sub-optimal store operations, which is responsible for between two-thirds and three-fourths of OOS occurrences. We use system dynamics model to study the interactions of various factors in play at store level that may lead to OOS. We hypothesize that shelf space allocation and restocking practices are the two most critical store operation decisions. We propose a modeling effort and a set of experiments to determine where (which store) and when (what day) OOS is likely to happen. We expect our findings could be used to minimize OOS through dynamically guiding efficient inventory management, shelf space allocation, and store personnel deployment. A full report of the results from the modeling effort, our analysis, and the impact of the improved policies will be available by the time of the International System Dynamics Conference.
Keywords: Out of stock, System dynamics, Store operations..

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Implementing Irregular Warfare Policy Using Modeling and Simulation

Senior decision makers have few tools available when implementing policy in multidisciplinary domains like Counterinsurgency (COIN) and Irregular Warfare (IW). Modeling and simulation (M&S) is offered as an appropriate analysis methodology for its ability to 1) combine contributions from multiple subject matter experts, 2) generate and analyze complex policy consequences based on various initial conditions, and 3) provide useful results in the presence of pervasive missing data. This paper works through an example irregular warfare simulation problem based on The Quest for Viable Peace (Covey, Dziedzic, and Hawley, 2005) or "QVP" that combines political, economic, security, and rule of law strategies. Though the QVP model was originally formulated based on America's experience in Bosnia and Kosovo in the 1990s, here it is redirected and extended based on current IW concerns in Afghanistan. Used in this way, M&S combines the best aspects of well established and recently published work bolstered by current experience and expertise.

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Judicial Process Dynamics

Becker (1968) posits the notion that criminals respond, like any other rational agent, to the benefits and costs of their activities. From this notion follows the deterrence hypothesis, the idea that judicial policies can help reduce crime through an increase in the expected costs of illegal

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activities. Yet, despite implementing the suggestions implied by such models, more and more countries undergo a large escalation of criminal activities. We explore this issue using a longitudinal data set of relevant judicial figures for one country. The data are used to calibrate a System Dynamics model. We find that, contrary to what would be ordinarily expected, criminals tend to be punished not exclusively on the basis of their behavior, but in terms of other institutional variables. Our data show that judges and prosecutors are prone to dismiss cases when the backlog to be processed exceeds a threshold, in a manner that much corresponds to the archetype "Shifting the Burden To." The effect of judges' decision rules which results in potential criminals who are acquitted without apparent reason is that of creating incentives for criminals and others to engage in criminal activities, thus causing crime rates, and the backlog of cases, to increase even further.

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Visualizing Spatial and Temporal Dynamics in Google Earth Using Powersim

At its genesis, system dynamics (SD) modeling was developed to examine the temporal behavior of interrelated systems. This ability has made SD modeling and analysis the choice for decision and policy makers to do scenario testing and risk analysis. In addition to the conceptual advantages of SD modeling in this realm, are the many SD modeling platforms that have been developed that greatly simplify model creation and more importantly, provide an environment for visualizing the output. However, when making decisions that involve urban planning, electrical and/or water infrastructure, and the like, or for examining impacts of resource development on the environment, the spatial aspects of the decision becomes just as important as the temporal dynamics. To properly support these decisions, simultaneous visualization of the temporal and spatial dynamics is needed. This paper presents a methodology for utilizing vbscript from within the SD development platform Powersim to dynamically link Powersim simulations with Google Earth to visualize, in real time, spatial data that change over time. The presentation will describe the logic behind the approach, its capabilities and limitations, and areas for improvement that should be addressed.

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Proposed Method for Stakeholder-Centric Simulation of Social Cognition and Social Influence

It is hard to study problems where boundedly rational stakeholders determine important decisions in the system. This is because the dynamics of boundedly rational social cognition and social influence are complex and because data about stakeholder mental models and social networks are difficult to elicit, organize, and test. The proposed method

to study these kinds of problems combines data elicitation techniques from stakeholder management, theories of boundedly rational social cognition and social influence, and a system dynamics simulation model. This method takes rough qualitative stakeholder data, organizes it into stakeholder diagrams, and uses it to parametrically populate existing system dynamics structure. This allows the researcher to quantitatively simulate complex stakeholder-centric problems where data quality is poor.

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Exploring Alternatives for Sustainable Development in Tamiahua Wetlands

This paper presents a preliminary System Dynamics model developed to analyze sustainability of a natural reserve in Mexico: the Tamiahua wetlands. Wetlands are often referred to as nature's kidney because they filter contaminants from water. In spite of their importance, wetlands are endangered areas around the world. The preliminary model presented in this paper suggests that fishing activity in the Tamiahua wetlands, together with contaminants from human activity, have the potential to damage the diversity of species in the ecosystem, endangering the sustainability of the system. Continued work on the model is intended to explore appropriate ways of preserving Tamiahua, providing inhabitants with economic activities that promote the sustainability of the region.

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Using Institutional Theory and Dynamic Simulation to Understand Complex E-Government Phenomena

Governments around the world have developed e-government programs hoping to obtain important benefits. However, many e-government projects fail to deliver their promises. Some of such failures are the result of a lack of understanding about the relationships among technologies, information use, organizational factors, institutional arrangements, and socio-economic contexts involved in the selection, implementation, and use of information and communication technologies (ICT), producing mismatches and unintended consequences. The paper proposes the use of institutional theory and dynamic simulation, particularly System Dynamics, as an integrated and comprehensive approach to understand e-government phenomena. The paper draws on the case of the e-Mexico program, particularly in the strategy to create web-based content to the citizen in the areas of education, health, economy and government. Using the same technological infrastructure and under the leadership of the same Federal Ministry, four different networks of government and

non-government organizations engaged in the creation of Internet portals to create relevant content in these areas. Differences in institutional arrangements and organizational factors resulted on different technology enactments.

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Green, Simple, and Profitable: The Paradox of Failed Best Practices in University Building Maintenance

Many green practices are widely understood and known to bring benefits beyond reduced energy use. Yet, organizations often fail to implement them. What explains these failures? Past theory suggests that adoption and implementation will be most likely to fail when practices are difficult to recognize given current competencies or organizational structures, require complex knowledge, or when the organization faces short term pressures that force it to abandon implementation early. Here, we present a case study of an organization that fails to adopt an important best practice despite the fact that the benefits and steps toward implementation are well understood and external short term pressures are minimal. We find that instead, short term pressures are created entirely internally by the structure of relations across organizational boundaries, causing individuals to misperceive the best practice as a cost that can be put off rather than an investment with positive future returns. Thus, even the simplest of innovations and improvements can be stymied by dynamics internal to an organization.

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Simulation modeling of regions' social and economic development in decision support systems

In the report many methodological and technological approaches for creating Decision Support Systems for regional and federal authorities are presented. They are based on using new information technologies such as Data Warehousing, On-Line Analytical Processing, simulation modeling and others. The general structure of model complex for region social-economic development and its realization based on methods of system dynamics and modern technologies of simulation modeling are described.

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A System Dynamics Perspective of the New York State's Aggravated DWI Law

This paper examines the implications of an Aggravated DWI law passed in November 2006 in New York State. To examine the system-wide implications of the Aggravated DWI Law, a system dynamics computer simulation model was developed to capture the flow of drunk drivers through the criminal justice system in New York State. This system captures people from the time of arrest, through adjudication and sanctions, and then tracks these people for 10 years to capture recidivism. The goal of this project was to provide insight about the implications of the Aggravated DWI law on other parts of the system. For example, how would the law influence the police, DAs, courts, the drinking driver program (DDP), probation, and alcoholism treatment providers, and would drunk driving be reduced? The Aggravated DWI law allows for a felony DWI charge for any individual arrested for drunk driving with a BAC at or above 0.18%, regardless of previous alcohol convictions. In addition, the sanctions for an Aggravated DWI conviction are severe and require mandatory ignition interlock, license revocation and screening for alcoholism.

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Integration in cross-border mergers and acquisitions

Despite the increasing frequency of cross-border mergers and acquisitions, it is accepted that the rate of success in the post-merger phase remains poor; the main reason for this is widely accepted to be the unsuccessful cultural integration of the two firms involved. Driven by limited time to obtain results, managers from the headquarters (of the acquiring firm) seek to change the culture of the subsidiary (of the acquired firm); the imperatives of a 'strong culture' lead them to persevere with the same narrow strategies and objectives. Though organizational culture has been widely studied in the M&A literature, there has been insufficient attention to important dynamic aspects of the process of integration. This paper, with the help of appropriate concepts of culture dynamics from anthropologists, formulates a description of the integration process. Subsequently, by simulating a mathematical model of this process (which explores the impact of two exogenous variables that characterize the context) we bring out the role of endogenous dynamics in determining the success of typical narrow strategies. Specifically, we explain how the nature and strength of the constituent feedback loops shape the non-uniform evolution of relevant constructs in the integration process. We conclude with implications for managers and researchers.

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Improving Performance in Detection Systems: Exploring a Parallel-judgment Structure

In this paper, we describe a model of two judges acting in parallel. We expand work related to the identification of threats by analyzing the

effectiveness of including a second judge in the process and identifying its effects on performance and error rates. In addition, we explore the implications for learning under uncertainty.

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Modeling Airport Security Operations

Airport security operations such as those conducted by the US Transportation Security Administration (TSA) are complex and dynamic in nature. As part of a multi-year effort to improve security at airports, a system dynamics model of security operations is developed. The model was developed to investigate strategic-level issues with a broad scope and a multi-year time horizon. The model includes issues such as human resources management, security system testing, operations, compliance with standard operating procedures, and resource allocation. In the paper, the model is described and used for policy analysis.

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Real Estate Cycles: A Theory Based on Stock-Flow Structure of Durable Goods Markets

In this paper by means of a simple system dynamics model, we have addressed a cycle-producing mechanism in the owner-occupied real estate market which has not been discussed in the real estate economics literature before. This mechanism is based on accumulation of supply and demand which arises from specific stock-flow structure of a durable goods market like the owner-occupied market. Comparison between our model and a famous model of rental market (Wheaton, 1999) shows that despite the rental market, in the owner-occupied market an increase in durability of buildings leads to more intensive oscillations. Also the effect of price elasticity of supply on the cycles in the owner-occupied market is much more complex than that of the rental market. Furthermore a model integrating the two markets is developed. Model analysis reveals that the interrelations between the two markets make the effect of some parameters on the rental market cycles different from what is suggested by the rental market model. Our work uncovers the rich dynamic complexity of the real estate system and can serve as a good example of applying systems thinking principles to complex real world problems. Keywords: Real Estate Cycles; Owner Occupied Market; Durable Goods; Cycle-Producing Mechanism (CPM); Dynamic Complexity; System Dynamics Modeling.

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Business Dynamics Model for Market Acceptance Considering Individual Adoption Barriers

The technological developments of our time provide the basis for a continuous flow of new applications and services. But even when allowing for significant improvements in everyday life, some of these innovations need an incredibly long time to be broadly – if at all – accepted in the market. Marketing and technical implementation are often only partially responsible. Consumers additionally need to overcome personal barriers to adopt an innovation. The height of this barrier is determined by manifold aspects like: Financials, required infrastructure, technical affinity, expected learning efforts, and safety concerns. In this article we introduce a market diffusion model that explicitly takes individual adoption barriers into account, while maintaining the top down approach of Business Dynamics. The model includes a feedback loop between the number of existing adopters and the number of consumers prepared to adopt the innovation. It explicitly allows for the adoption by only a portion of the potential customers. Furthermore, the model can reproduce tipping points and visually explain slow market developments or unexpected late successes.

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A Land-Use/Transport interaction model for Austria

This paper presents the attempt to set up the dynamic land-use transport interaction (LUTI) model MARS (Metropolitan Activity Relocation Simulator) for a nation wide case study of Austria. To this end we adapted the existing urban MARS model. The purpose of the model is to capture the most important interactions and feedback mechanisms between the land-use- and the transport system. Particular attention was paid to the structural changes of the model and the estimation of the transport model parameters as well as the land-use model parameters, which are modelled with a gravity model approach. For this purpose we used the build-in optimizer of the modelling software Vensim by minimizing the sum of squared deviations between observed and predicted data. We present the model fit, estimated parameters and results of a first model run (30 years).

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Is Group Model Building worthwhile? Considering the effectiveness of GMB

Many field studies are available that describe successful applications of model-driven group decision support methodologies. However, these studies might suffer from a potential bias of contextual factors. Recently, there has been a call for a more rigorous testing of the effectiveness of

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model-driven methodologies. The purpose of our research is to determine the effectiveness of a particular model-driven approach, Group Model Building (GMB), on decision-making in a controlled research situation. In this paper, we first clarify 'effectiveness' as a construct. Then, we describe the present study. We compared groups supported by GMB (13 groups) and not being supported (13 groups) on perceptions of the quality of decision-making and on the quality of their decisions. Preliminary results show that there are no winners. However, some differences in the perceptions of the members of decision-making groups call for further testing in the future.

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Understanding the Role of Victims' Non-Discretionary Factors in Hurricane Evacuation Dynamics

Determining in advance emergency supplies and personnel required for a disaster relief operation is crucial for mitigating the societal impacts of such events. Prompt and effective response to either natural or man-made emergencies requires the analysis of key information where the role of disaster relief organizations is multiple. DROs approve the assistance requested by victims and coordinate supplies and personnel collected and transported to the disaster site. They provide mental health services and shelter while more long-term government aid is decided. The dynamic framework presented here was formulated to understand the complex multi-factor dynamic processes evolving over time during a hurricane emergency. It maps the process of interdependence between resource availability and satisfaction with human services and the influence of the media reacting to victims' complaints. It hypothesizes key mechanisms governing these relationships. Exogenous factors such as customer reactions to the category event; training level of response personnel; race, social stratum, home/pet ownership and education are all taken into account. The model was built with the analysis of data collected from victims of the 2005 Katrina Hurricane and paired with real operational data provided by the American Red Cross and then calibrated/validated by real data from the 2005 Rita Hurricane.

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Improving Military Strategy using Predictive Agents with Embedded Mental Simulation Models

Air strategy planners have the difficult task of providing commanders with campaign plans prior to commencing operations, and recommending options during the campaign. BAE Systems has developed the Commander's Model Integration and Simulation Toolkit (CMIST), a tool for creating and using simulation models appropriate for

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high-level strategic decision-making. CMIST provides a unified graphical interface for a variety of methodologies appropriate for systems modeling, including System Dynamics, Bayesian cause-effect, individual agents, Coloured Petri Nets, and other families. Recent development on CMIST enables an agent to run an embedded simulation model representing its own internal, usually simplified, model of the outside world. This proactive intent model allows the agent to project the future state of the world in order to make decisions and take appropriate preventative measures before those future states occur. We discuss comparative results using reactive vs. proactive intent models in the context of our notional Insurgent Growth model.

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Objective Analysis of Subjective Feedback Structures: The Problem of Consistency in Explaining Model Behavior

Real-world concepts can be operationalized into variety of feedback structures which may be mathematically identical but diverse in the number of feedback loops. Factors including model purpose, the modelers perspective and the intended audience all influence the final layout of a feedback rich model. One challenge in the analysis of model behavior is to account for the variations in the appearance of its structure and the feedback loops. This paper focuses on consistency in explaining model behavior illustrates some of the issues related to the cancellation problem and figure-8 loops. Both conditions can potentially lead to poor and even contradictory explanations of model behavior based on its idiosyncratic feedback structure. The paper concludes by illustrating how the pathway participation approach addresses these two issues and calls for comparative studies to using alternative approaches to model analysis to better understand the general principles and subtleties in connecting the structure to the behavior and explaining observed dynamics. Different methods in formal analysis can learn from one another and expedite the development of user-friendly tools to aid model analysis that serve a wider audience.

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Combination of Econometric Methods and System Dynamics Approach to Improve the Iranian Agricultural Policies

Agriculture is an important economic sector and a strategic component for the rural development in Iran. However, the sector has been beset by a labour surplus situation. This situation, together with inappropriate combination of labour with other factors of production, has caused a low growth rate in the agricultural production. The main objective of this study was to determine the optimal employment and production policies in the Iranian agricultural sector. Then, production, export-import, demand for labour and agricultural products, as well as the wage functions were estimated using the data collected during 35 years, and substituted in the economic component of the System Dynamics (SD) model to simulate the outcomes. The results indicate that a downward turn for the labour surplus problem will happen in 2008. Afterwards, the agricultural employment will gradually decline. Consequently, the

cityward migration will increase, and the unemployment problem shifts from the rural to the urban areas. The average annual production growth rate in the 2007-2021 period is estimated at 1.8%. Furthermore, higher production is commensurate needed with substantial investment and adoption of appropriate technology. This study further demonstrates that combination of the SD approach and econometrics methods is highly effective in arriving at logical answer. Keywords: System Dynamics Simulation, Econometrics Methods, Socio-Economic Model, Agricultural Labour, Agricultural Sector Polices.

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The Problem with Workarounds is that They Work

Resource shortages are a fact of life in most organizations and in the currently challenging economic climate will be even more common. There is little doubt that resource shortages are widespread and that they lead to undesirable outcomes, yet there has been surprisingly little attention to questions about why they occur and even more insidiously why they persist despite the apparently clear adverse consequences. This paper develops a grounded theory that helps to understand chronic resource shortages, drawing on data from field work at a manufacturing firm adopting lean manufacturing. The paper examines how the actions of various groups (e.g., managers, production workers, and other shop floor workers) interact with each other and with the physical characteristics of the workplace to sustain problematic resource shortages. The paper uses a causal loop diagram and a stylized system dynamics model to highlight some important features of the dynamics.

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Peak oil, biofuels, and long-term food security

Recent oil prices escalations, current production of biofuels from food, and rising food prices have caused an awareness of a potential conflict between biofuel production and food availability. Biofuels could help countries reduce their dependence on imported oil and biofuels could lead to some reductions in CO2 emissions. For such reasons governments have stimulated research and development and subsidized biofuel production. In this study we use a simulation model to study how markets for oil, biofuel, and food may interact and develop in the long run as world oil production peaks and starts to decline due to resource depletion. We hypothesize that a shortage of oil will make biofuels highly profitable, lead to a take-off for the biofuel industry, and lead to food shortages and starvation. We do not reject this hypothesis. A number of policies all tend to delay rather than cure the problem of food shortage. Therefore it seems urgent to start discussing and building support for a ban on biofuel production from food.

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South African Energy Model: A System Dynamics Approach

This paper provides a South African energy model that was developed as a first step towards a comprehensive Threshold 21 model for South

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Africa. The energy sector consists of five sub-models, which are structured around the supply and demand of electricity, coal, oil, and natural gas in the sector. The model was used to examine a set of policies that the South African government is currently considering, e.g. expansion of nuclear energy production and implementation of more stringent energy efficiency measures. The analyses show that energy efficiency measures are indeed the best option to curb the supply and demand constraints, which the energy sector faces, in the short term. In general, the paper demonstrates how a system dynamics approach can be utilized effectively to support understanding of energy-related issues and clarify the advantages and disadvantages related to the options available to government and the private sector. The paper also highlights potential pitfalls that may be encountered when building such a model. Future developments include extending the model to incorporate the linkages between the energy sector and the economy, society and environment, which would complete the T21 framework for South Africa, and extending the model, with models for other countries in the region, to the Southern African Development Community.

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The Long Runs Effects of Competitive Undervaluation of Dong Currency on the Economic Growth of Vietnam

After joining the World Trade Organization, Vietnam attracts more and more foreign investment. Large increase in foreign capital has been led to an overheating economy. Vietnam has been depreciating its currency over the last several years compared to the dollar, making Vietnam's exports to the U.S. lower-priced. In short run, it helps Vietnam to increase the exports and boost national income. However, in the long run, it is expected to negatively affect the economic growth. Since imports become expensive because of undervalued currency, Vietnam can not afford to update the technology improvements. With the lack of updating on technology improvements, it is impossible to maintain per capita growth. The impacts on technological growth in Vietnam, measured as Total Factor Productivity, can affect the per capita growth of Vietnam. This paper investigates what long term effects on the economy of Vietnam when the Dong currency is undervalued.

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Exploring the Dynamics of Music Piracy

Recently sales of physical music media have declined along with music industry revenues – the reasons are complex and poorly understood. We present three models exploring claims made in the conversation over piracy and the music industry's future. We model stakeholder perspectives rather than the full industry to identify their assumptions and the implications of their views, including: (1) Music industry labels claim music piracy directly supplants music sales; (2) Artists claim free music distribution can increase artist revenue through concert sales; and (3) Some academics claim reduced music sales revenue is attributable to other market changes (e.g., increased entertainment competition) rather

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than piracy. Modeled results suggest that, for each claim respectively: (1) Music labels' mental models are simplistic and do not reflect current research findings; (2) Artists can enhance their concert revenues through piracy as free marketing; and (3) competition with other media explains part of declining music industry revenues.

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SILVER: Software in Support of the System Dynamics Modeling Process

While the System Dynamics modeling process can yield 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. Failure to adequately manage such complexity can reduce the transparency, reliability, and credibility of the modeling process. While adherence to good modeling practices can aid this process, it often falls prey to corner-cutting or human error. This paper describes software that helps manage such complexity, by permitting modelers to easily access and succinctly compare historic versions of a model, by making explicit linkages between scenarios, the model versions and assumptions underlying them, and the motivations for and external files associated with model artifacts.

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Representing Progression and Interactions of Comorbidities in Aggregate and Individual-Based Systems Models

Health policy models have attracted significant offered important insights in to health trends and policy selection. More complete accounting for the cost and health implications of upstream interventions is hindered by the need to consider impact on, and interactions between, multiple comorbidities. Within this paper, we explore several distinct approaches for representing comorbidities, some of them at the aggregate level, and some of them at the individual level. All of these representations have the virtue of being declarative, in that they allow the user to focus on what is to be characterized, rather than how it is to be implemented. Our exploration suggests that while several aggregate representations of comorbidities are possible, they suffer from a variety of shortcomings, ranging from low fidelity to combinatorial blowup. While individual-level representations impose a heavy performance load, greater difficulties in calibration and less rapid analysis, such representations do offer greater transparency, modifiability, scalability, and modularity, and ease of representing transmission and influence networks. With much to recommend each approach, further research is needed to shed additional light on the tradeoffs and identify situations where one representation is preferable to another.

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Coordinating quality care: A policy model to simulate adoption of electronic health records

This article reports on a theoretical simulation model to investigate effects from policy interventions in the adoption of electronic health records among hospitals, physicians, and patients. The project draws on established system dynamics diffusion theories and provides a conceptual framework to develop and test interventions to promote adoption of electronic medical records. Using data from the Greater Capital Region, Northern New York State, the findings from the simulation experiments suggests that there is no single right intervention but a combination of measures to promote the use of electronic health records not only on the provider side but also among patients.

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Re-conceptualisation of Participative Modelling Process Design Effectiveness and Outcomes

Research into improvement of the design of system dynamics modelling process has attracted little attention probably because system dynamicists find existing designs adequate. However, participative modelling which involves clients/participants without prior modelling knowledge requires methodological details that show how a real-life situation translates into a simulation model. This paper calls for renewed attention on the critical requirements that make participative modelling process design more effective. Such requirements have been found to include: suitability of system dynamics for client's problem; purpose of modelling effort; clarity of client's problem; number of participants and whom to involve in the modelling process; the phase in the model building process and type of task performed; time available from participants. In addition, a rigorous design emphasises modelling process outcomes arising from iterations in problem articulation cycle, modelling proficiency cycle and solution refinement cycle. In harmonising these two streams of design considerations, this paper investigates two research questions at the interface of modelling design effectiveness and modelling outcomes.

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Discrete vs. Continuous Simulation: When Does It Matter?

The purpose of this study is to illustrate the similarities and differences between discrete event simulation and continuous simulation modeling. A simple M/M/2 queuing system with crowd-dependent arrival rate is used. In the first part, the arrival rate decreases immediately as the number of customers in the system increases. The system is modeled using discrete event and continuous simulation. The results of two simulations are compared with each other and with their analytical solutions. In the second part, the number of customers in the system affects the arrival rate first with a continuous information delay, then with a discrete delay. Discrete and continuous simulations give very similar results in terms of dynamic behaviors of system variables. There

are some minor differences in terms of the steady-state values of the variables, particularly the average time spent in system. Finally, increasing proportionately all parameters of the system (arrival rate and number of servers), reduces the discreteness of the system, bringing the discrete and continuous simulation results much closer.

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Dynamics of Escalation of Commitment

Escalation of commitment refers to the tendency of decision-makers to invest in failing courses of action. Research has shown that there are various causes of escalation, ranging from economic to psychological, social, and organizational factors. Even though the existence of the escalation bias is well established through experimental and case research the dynamics of escalation is not very clear. There are two possible explanations to how commitment evolves to generate escalation. The first one is the temporal model which suggests that initially economic factors will be determined and in time behavioral factors will gain dominance. The second one is the aggregate model which suggests that the relative importance of behavioral variables versus economic factors leads to escalation or withdrawal. This paper reports on a System Dynamics model that was used to test these two explanations to see which generates the escalation prototype.

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System Dynamics Modeling of Emigration and Brain Drain

Net migration rate of -3.28 migrants/1000 population ranked Iran 145th in the world. Popular discourse about Iranian immigration focuses on the social and political freedoms associated with relocation. In the current research, the focus is on the authority of the educated people, their impacts on the society, their access to the power and the wealth which seems far negligible. The elites of Iran are no longer the educated people. Based on this assumption, a system dynamics approach is presented to study the long term effects of the emigration on Iranian society. Each emigrant develops themselves in the target country and attracts more emigrants. The success and satisfaction in the target country motivates the young generation to move than to change. The emigrants, when their number increases to millions, form a basement to attract more talented ones from the source country. Emigration of elites is more than a move of people; it has important negative effects on the country to produce wealth, to become industrialized, and to produce more talented generations.

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Systems modeling and analysis for commercial pathways assessment of oil crop based biofuels in Hawaii

A systems-level analysis was conducted to assess the commercialization potential for growing oilseeds and refining the oil into advanced biofuels. A system dynamics model was constructed to be the primary

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analysis tool employed to evaluate the economic potential for growing oilseeds at a commercial scale and refining the oil into renewable jet fuel and green diesel. Focus was placed on initial penetration into niche markets – ones thought to offer the most favorable economic conditions. Here we use Hawaii as an exemplar of our commercialization analysis approach. If a case for commercialization can be made for one (or several) niche markets, they could serve as nucleation sites for improving production efficiencies and serve as the "jumping-off point" for much more widespread commercialization. Conversely, if it proves difficult to make the case for commercialization within these most-favorable market niches, we will have learned that commercialization is unlikely to be economically viable anywhere at present – and importantly, the analysis will have helped identify the chief obstacles to commercialization and what conditions will be required to change for commercialization to become economically viable in the future.

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Modeling the Cyclical Nature of Aggregate Airline Industry Profits

The aggregate profits of the airline industry have been dominated by a cyclical mode since before deregulation in the 1970s. In this paper we discuss several dynamics that combine to cause profit cycles: The misperception of the delay around capacity acquisition, the pro-cyclical ticket price setting policy and the countercyclical effect of industry congestion on passenger demand. By adding numerous endogenous feedbacks, extensions of previously used standard structures and wholly new structures we quantify the strength of these feedbacks, replicate the past behavior of the industry, and prescribe policies that can help to mitigate the cycle in airline industry earnings.

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Inventory Control in Closed Loop Supply Chain using System Dynamics

Inventory control is a fundamental activity in closed loop supply chains, particularly for remanufacturing processes. Several models have been developed in the literature where the aim is mostly to optimize cost or profit and to find the optimal order quantity for an integrated production and remanufacturing system. In this study, we explore a System Dynamics approach in order to model an inventory control system for a remanufacturing process in the context of a Closed Loop Supply Chain. Particularly, the return process is modelled through the influences relationships which several factors have on such process. The factors considered are residence time of the product with customer, service agreement with customers and customer behaviour in returning used products. The findings suggest that a reduction of residence time and an increase in the level of service agreement with customers, which in turn increases customer behaviour in returning used product, can lead to efficiency in inventory management for companies involved in remanufacturing process. In addition, we provide two simple case studies in support of these findings.

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The Soft Drugs Debate in the Netherlands: A Qualitative System Dynamics Analysis

The Dutch Soft Drugs policy will soon be under review. Regarding Dutch Soft Drugs policy, the Dutch population and political arena could be divided into three groups: those who do not really care, those strongly in favor of legalizing cultivation and use of soft drugs, and those strongly in favor of banning soft drugs. The points of view of the two latter groups are analyzed in this paper using a qualitative System Dynamics perspective.

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Cholera in Zimbabwe

By the end of December 2008, alarming reports and articles concerning the cholera outbreak in Zimbabwe received plenty of international media coverage. By that time 30000 cases of cholera infections and 1600 cholera deaths had been reported. In the first week of January 2009, a System Dynamics simulation model related to this cholera epidemic was created which was turned into a 'hot' testing/teaching case. Although the model contains some bold assumptions, the dynamics of the model is sufficiently interesting for to be presented. This case is a System Dynamics study under uncertainty focused on exploring the general dynamics over time.

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Saving a Bank? Cracking the Case of the Fortis Bank

This paper presents a simple experimental System Dynamics model of the underlying value and market values of a bank to analyze the loss of trust in the bank. The System Dynamics model was developed on 28 September 2008 –the day the governments of the Benelux countries met in a great hurry to rescue the Fortis bank– in order to gain a better understanding of the potential dynamics of bank crises and to test policies for keeping banks from collapsing. The System Dynamics model –as well as the exam case based on it– is interesting because of the actuality and importance of the topic, the small size and simplicity of the model, its potential to generate different dynamic behaviors, and its usefulness for policy exploration.

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Making System Dynamics Cool? Using Hot Testing & Teaching Cases

This paper deals with the use of 'hot' real-world cases for both testing and teaching purposes such as in the Introductory System Dynamics course at Delft University of Technology in the Netherlands. The paper starts with a brief overview of the System Dynamics curriculum. Then the problem-oriented teaching and testing approach is explained, followed by a presentation and discussion of several examples of 'hot'

cases. The main goal of presenting the use of 'hot' testing/teaching cases is to spur other System Dynamics lecturers on to doing the same, and to start up a small network for exchanging the 'hottest' cases.

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Hop, Step, Step and Jump Towards Real-World Complexity @ Delft University of Technology

This paper deals with System Dynamics education at Delft University of Technology, the Netherlands. It focuses more specifically on the quadruple jump approach towards dealing with real-world dynamic complexity. The paper starts with an overview of the System Dynamics courses, situated within the broader curriculum. Then recent innovations in the Introductory System Dynamics course are discussed. Finally, some of the lessons learned are distilled. The rationale behind this paper are the beliefs that (higher) education determines to a large extent the quality of (the next generation) professional System Dynamics modelers, and hence, the field of System Dynamics as a whole, and that sharing (innovative and/or proven) educational practices, and exchanging actual and challenging (teaching and testing) cases may lead to further improving the quality of System Dynamics education.

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The Economics of Education: is it Profitable to be Ignorant?

In the UK, formal tertiary education comes at monetary cost to those who choose to participate. Currently 43% of young people enter universities in the belief that they will recoup the initial expense in higher salaries, later in life. Whilst this is a historically true model for the majority of graduates, many analysts believe that the Government's push for a 50% participation rate, coupled with rising costs to attend university, could affect the profitability of higher education and lead to a situation where ignorance is not only bliss but also an economically sound decision. This paper explores the current situation concerning the economic benefit of higher education: building a model to represent subject areas that do and do not offer long-term economic benefits. A stock-and-flow model is built, as a policy tool, to articulate where the delays appear in the system and reasons behind cyclical supply-demand employment gaps.

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A Quest for a Framework to Improve Software Security: Vulnerability Black Markets Scenario

There are numerous discussions on possible leverage points in improving software quality and they have been placed in various context--from technical approach, improving user education to economic approach. One of central points of the discussions is on the best policy to handle vulnerability discoveries. Various approaches have been developed: from secret reporting, full-disclosure, responsible disclosure to a market approach. The dominant aspect of the latter is about the Vulnerability Black Market (VBM), which emerged due to the latter development, as an alternative for malicious hackers to sell exploits and malware that take advantage of the flaws in the software. The model in this paper draws on empirical observation on black markets and market-based approach for vulnerability discovery to generate a simple model of VBM. The model results suggest that efficient legal markets may attract malicious hackers to enter the legal markets and may reduce their likelihood to be involved in vulnerability black markets. However, better patching management may mitigate the abuse of software vulnerabilities.

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A Simulation Modelling of Property Markets: A Case of the UK Housing Market

This paper provides a system approach to the analysis of the property markets by first setting out a high level model of the market. The imperfections in information and distortions in such markets are widely acknowledged and accounted for while the role of legal, financial and social institutions being emphasised. The rate of production in the property markets in most advanced economies is a function of institutional factors as developed over time representing unique and path-dependent characteristics. The paper describes the main factors that have gone into the production of a general System Dynamics simulation model of the property markets which further focuses on the characteristics of the UK housing market as a case study and provides an analysis of its current structure. The paper indicates how in the absence of reliable and sufficient information simulation modelling can aid decision making in the real estate. As an imperfect market the role and potential areas of impact of governmental policy are outlined. The effects of tightening worldwide credit regimes on the UK construction industry are included in the model. The relationships between the credit crunch and the behaviour of the construction industry are identified and are explored. The analysis presented in the paper concludes with potential scenarios for determining the future behaviour of the market.

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Butterflies and Buffers

This paper presents a brief discourse on chaotic behaviour and provides an implementation of a classical example from existing chaos theory; the Lorenz strange attractor. The implementation is carried out using standard System Dynamics software and techniques. The paper then

goes on to describe a classical buffered feedback system; the Ktesibios clock. The implementation of this feedback system is again carried out using standard System Dynamics software and techniques. Both systems are then amalgamated to unite the butterfly effect of the Lorenz attractor with the buffered nature of the water clock. It is postulated that the resultant taming of the chaotic behaviour generated by the Lorenz attractor through the feedback buffer of the Ktesibios machine is common to many systems; brief examples are given. It is concluded that, in some cases at least, it is the overwhelming of the buffer that leads to a tipping point returning the whole system to a state of chaotic behaviour. Implementing a model of a natural buffered system with chaotic input is identified as an area for further work.

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Gasoline Rationing Plan in Iran: A Symptomatic Solution

Iran is a resource-based country and these resources have brought advantages and disadvantages for the country. It seems that disadvantages are results of mismanagement of the resources and not the existence of resources. Fuel subsidy is an example of such mismanagements. Actually while fuel subsidies are common in the Middle East, the oil-richest place of the world, Iranian domestic fuel prices are among the lowest in the world. The low fuel prices, population and urbanization growth caused growth of fuel consumption and consequently growth of subsidies. But because nothing can grow forever, two years ago the government had to start rationing plan to reduce the growth of consumption due to budget and gasoline stock limitations. In this paper we are going to model the dynamics of the problem and answer why the government had to execute the rationing plan. In addition, we try to show that this solution is not a fundamental solution. It is a symptomatic solution and after a while ration of each car will decrease. In the end, we offer two policies to limit the demand naturally, not by force of rationing plan, and try to offer a fundamental solution to manage the fuel consumption.

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Analyzing the Effect of Global Steel Price Fluctuation on Iran's Steel-Maker Stock Prices: A System Dynamics Approach

Steel making is an energy intensive industry and for this reason, energy prices, especially oil and natural gas prices, have an important effect on this industry. In 2008, the sharp rise of crude oil as well as iron ore price caused the sharp rise of steel price because of the rise in prices of key production factors. But Iran's producers experienced almost no rise in their production factor prices especially key factors of energy and iron ore prices. As a matter of fact, inexpensive energy and iron ore are competitive advantages of steel makers in Iran because the huge natural resources of the country let the government to provide inexpensive production factors for the industry. But these inexpensive factors have some side effects that one of them is on the stock price of steel makers in stock market. In this paper we are to model the effects of fluctuations in

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world steel price on stock price of one of Iranian steel producers. In the end, we will offer some policies to mitigate the fluctuations of stock prices.

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Deciding on Software Pricing and Openness Under Competition

The success of many open source applications has motivated commercial firms to explore how they can benefit from opening their software platforms in hope of getting free high quality contributors and more complementary products. Yet the openness decision is tightly coupled with the pricing of the software (e.g. openness limits the price that can be charged) and the reinforcing feedback loops of network effects and complementary products. In this paper we explore how there interconnections impact the optimum pricing and openness decision for two firms in competition. Reinforcing loops increase the value of early market lead and put pressure on the competing firms to seek such advantage. We show that the competitive equilibrium under strong reinforcing loops calls for highly open software products with deep early discounts, which may significantly compromise the profitability of the players in the market. Proprietary platforms and higher prices are favored in the absence of these loops.

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A Model for Technology Life Cycle (TLC) from System Dynamics View point

Technology life cycle (TLC) is what leads to product and process life cycles. Understanding the complexities and dynamical behavior of TLC is the key concept for managing the technology, policy making and strategies such as pricing or marketing. Some major works has been done on modeling PLC (Product life cycle), pricing strategies and marketing within an industry or among some competitor organizations. Although many there are a lot of works on TLC almost all of which declare its complexity and dynamical behavior, little effort is given to study TLC from a dynamical view point. In this work, a system dynamics model is presented for TLC based on major casual loops which drive the essence of dynamic behavior of TLC in order to have a base for simulation of unique phenomena, such as multi-generation technology, and performing an analysis on some of key parameters controlling TLC.

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System Dynamics simulation based hybrid approach for reliability analysis

System reliability is considered as an important performance index. Repairable standby system's study and analysis is an important topic in reliability. Analytical techniques become very complicated and unrealistic especially for modern complex systems. There have been attempts in the literature to evolve more realistic techniques using simulation approach for reliability analysis of systems. This paper

proposes a hybrid approach called as Markov System Dynamics (MSD) approach which combines the Markov approach with system dynamics simulation approach for reliability analysis and to study the dynamic behavior of systems. This approach will have the advantages of both Markov as well as System dynamics methodologies. The proposed framework is illustrated for a standby system with repair with a numerical example. The results of the simulation when compared with that obtained by traditional Markov analysis clearly validate the Markov System Dynamics (MSD) approach as an alternative approach for reliability analysis.

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Renewable Energy: A Framework to Model a Brazilian Case of Success (Part I)

In 1973, the first oil crisis leaded most countries to experience economic problems due to sudden unbalance in their trade balance. This leads to reactions, limited at the beginning due to short term inelasticity of petroleum demand, but relevant in long term. Brazil started the Proalcool program, which extended from 1979 to 1990, with the use of ethanol cars (E-100). In 1990 this program was ended, due to economic problems. A decline in international petroleum prices and an increase in international sugar prices, leaded to shortage of ethanol. This shortage made the users confidence to decline. From that point on, ethanol cars acquisitions almost dropped to zero. In 2003 a technological innovation, the flex fuel electronic injection, was launched and was a huge success. In approximately three years, about 85% of all cars sold in Brazil were using this technology. It caused a boom in ethanol industry which competes in terms of resources with sugar industry. This paper presents a framework to simulate the first period of the overall program which lasts from 1970 to 2003.

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Decision Rules and Organziational Dynamics

What forces shape the dynamics of individual organizations and the dynamics of organizational populations? We look at how much difference exists in firms' decision rules and how those differences help explain differences in the patterns of growth and decline among competing firms. Using a large data set of German consumer magazines - observed quarterly from 1972 to 2006 - we estimate and compare magazines' decision rules on a few key dimensions: pricing to advertisers; pricing to readers; and the number of editorial pages to be included in the magazine. We then embed these rules into a system dynamics model of magazine operations developed by Hall (1976) to evaluate how fully differences in decision rules explain differences in firm dynamics. Our hope is that this style of research, taking rich models based on case studies of individual organizations and generalizing them to explain the varied dynamics of entire populations of organizations, will have two contributions. First, it will show the extent to which differences in rules in organizations explain differences in organizational dynamics. Second, it will allow us to leverage the body of existing carefully executed SD case studies into a broader and still richer basis for understanding firm dynamics.

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Applying didactics for the creation of a cooperative, non-competitive environment: a study case in entrepreneurship and team

This research was carried out with the aim of suggesting a new approach to the concept of entrepreneurship as boosting the skills of economic self-sufficiency and team work among the students of the branches for technical and commercial training at the "Aquileo Parra" and "Rafel Uribe Uribe"- educational complexes. We formulated a comprehensive methodological, conceptual and adaptable framework, introducing its contents as well as its practical and future implications. The main feature is a tight relation to the socio-economic context. In order to obtain a clear profile of the subjects we measured the latent entrepreneurial potential among the students by means of questionnaires and sensibilization workshops which created a non-competitive environment through interaction activities and systems dynamics.

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Financial Performance Appraisal of a Steel Plant: An SD Model

Proper analysis of the financial statements of a company provides valuable insights into financial performance. Financial ratio analysis, a principal tool of financial analysis, determines a company's ability to raise external financing. In the present work, detailed System Dynamics (SD) modeling and analysis of the financial performance of a shore based integrated steel plant is undertaken. The key financial ratios used for simulation and analysis are (i) Liquidity ratios (ii) Turnover ratios and (iii) Profitability ratios over a period of 20 years from 1994. SD model is successfully applied to portray the dynamic behaviour of the financial system of the plant.

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A System Dynamics View of the Phillips Machine

Although system dynamics practitioners appeal to a bathtub analogy to explain the basic concepts of system dynamics, few physical water based models have been used for this purpose. The celebrated Phillips machine, a hydraulic macroeconomics model built in 1949, illustrates how this was done for a serious model of a macroeconomic system. This paper reviews the physical modeling constructs exemplified by the Phillips machine, relates them to standard system dynamics notation, and proposes two similar machines to represent basic structures in system dynamics instruction.

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Sustainable Organizational Change - Can you make the change happen with Large Teams alone?

The article presents some insights from ongoing research on sustainable organizational change. It focuses on a concept of improvements actions conducted by teams within manufacturing organization. There are considered two types of approaches, namely bottom-up - example of which are empowered, small, cross-functional teams; and top-down - large teams following rigorous problem solving methodologies. In order to investigate impact of small teams and large teams on the organizational system structure a System Dynamics model was developed. The model investigates the effectiveness of both kinds of approaches from the perspective of sustainable organizational change effort. The analysis of the model and simulation results is supported by example of successful organizational change in Lima Refinery. In the conclusion section the implications for sustainable organizational change efforts are presented.

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A System Dynamics Design of the US Economy Exit from the Stern Crisis

This paper re-defines two hypothetical laws of capital accumulation by including endogenous profit investment share and establishing an explicit inverse relation between this share and capital-output ratio. Other main state variables are labour productivity, employment ratio and unit value of labour force. A comprehensive Phillips equation, governing real labour compensation, is an element of a hypothetical law (HL-IR). Projecting future macroeconomic evolution takes into account structural changes in primary distribution of net value added. After the recent neo-conservative defeat there is no place for stabilising policy with the same or similar aggressiveness as in 2002-2007. Based on the US macroeconomic data mainly for 1969-2007, computer simulation runs for a later period (through 2060) exhibit how a postponed non-aggressive application of CL-IR in 2012 and afterwards could smooth out long waves of capital accumulation and shorten a period of fluctuations from 24-27 to 14-16 years in the restructured US economy compared to evolution based on HL-IR. The present stern crisis of the capital accumulation, probably deepest after the World War II, will last until 2018-2022 when the pre-crisis maximum of net output is restored and 2023-2026 when the pre-crisis maximum of employment is reached again.

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Stray dogs, street gangs and terrorists: manifestations of a latent capacity support system

Pests and other undesirable populations offer considerable resilience to interventions attempting to limit or eradicate them. These interventions often directly aim at reducing these populations through either by limiting their procreation or accelerating their demise. For example, stray dogs roam the streets of many major Asian cities in spite of the efforts to euthanize or castrate them. Street gangs and the violence associated with them continue in many North American cities in spite of considerable effort on part of law and order institutions to contain them. Suicide attacks menacing public continue in central Asian countries like Pakistan, Iraq and Afghanistan in spite of the concerted military offensives to eradicate their perpetrators. This poster will suggest that a latent capacity enablement structure that maintains the inflow into the undesirable population exists in all such cases. Interventions not cognizant of this structure may only address symptoms and not alleviate the root cause. The capacity enablement process as a generic metaphor may help to bring the latent root cause to fore.

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A System Dynamic Approach to Integrated Water Resources Management of West Jazmourian (Halil) Basin, Iran

Abstract: Water scarcity, growing demand, low productivity, and water and land-resources degradation are major threats to sustainability and equity principles are main water resources management challenges in arid and semi arid regions in general and in Iran in particular. The increasing demand for water in recent decade has put the water resource systems in instability. Moreover the future water demand will definitely bring critical condition for the sustainability of water management. The objective is to define a conflict resolution mechanism for present and future demands in a complex water resources system with the objective of system sustainability subject to uncertainty in natural phenomenon and management strategies. Results show that demand management as well as other management policies is essential for sustainability of the system. System Dynamic (SD) approach is employed and interactive user friendly media bring possibility to visualize the outcome of each management strategy, stakeholder behavior and probable hydro-climatic condition.

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Economic Origins of the Mafia and Patronage System in Sicily

Organized crime satisfies a demand for necessary social services in the absence of effective government institutions. This paper examines the

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rise of the Sicilian mafia. Using system dynamics, we model this system and test various policies to determine what factors have the greatest impact on mafia power. Based on the experiments, the most effective policies for reducing mafia power are those that decrease the demand for private protection services by reducing the threat of banditry in society, and not those policies that act against the mafia directly. We also examine historical examples of other mafia-type organizations and discover that our findings apply not just to Sicily, but also to other societies including present-day Iraq and Afghanistan.

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Evaluating the Effect of Integrated Health and Social Care Information Systems on Delayed Discharging of Patients

The integration between health and social care organisations in the UK is an acknowledged public policy problem. Despite government efforts at implementing 'joined up thinking', government have found this area frustratingly 'policy resistant'. The focus of this paper is to look at the effect that integrated health and social care information systems can have on delayed discharging of elderly patients in the UK National Health Service (NHS) and Social Services. A case study approach has been applied of the elderly care wards from hospitals at two NHS trusts and a social services department. System dynamics and Soft Systems Methodology are used to test the proposition that information systems can achieve a significant improvement in reducing delayed discharges. The conclusions are that these methodologies provide a sound test bed for the proposition and that integrated information systems can be useful. However, only if they stimulate action when there is limited health and social care capacity present. Integrated information systems should be used by managers to inform them of the capacity changes that need to be made throughout the patient process, helping to ensure there is a greater response and action in reducing delayed discharges.

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Towards the use of model structure analysis for designing flexible learning itineraries

Some large system dynamics models drive simulator interfaces used for teaching; this is the case of the MacroLab model. Such a model may be useful for making students with basic instruction in system dynamics explore the economy as a dynamic system, allowing for diverse inquiry itineraries. The question is if different exploration itineraries yield sufficiently similar learning outcomes. This has been tried with ten student groups. The results are encouraging, but also indicate that the inquiry scenario design should be based on systematic analysis of the model's structure: some variables may not be reachable from everywhere. An ad-hoc structure exploration found such isolated areas. The use of a reachability matrix is suggested and an initial example is shown. Also, students need systematic guidance in constructing a loop

set that will frame their exploration. Concluding, it is argued that this kind of instructional design may bring other large system dynamics models closer to instructional use.

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What's in a mental model of a dynamic system? On the conceptual structure and approaches to model comparison

This paper deals with the representation of mental models of dynamic systems (MMDS). The notion of mental model (MM) has always been fundamental in system dynamics, and 10 years ago, a specific definition was introduced. However, no conceptual model of MMDS content has been offered so far. Two assessment and comparison methods have been borrowed from general MM research:. Are these methods are equivalent in procedure and results, and do they satisfy specific needs of system dynamics? Two exemplary MMDAs are compared with both of the methods, which are found to be different in procedure and in results they produce. In addition, they ignore the feedback loop concept. Based on this finding, we propose a conceptual model for the structure of MMDS, a method for comparing MMDSs and a tentative revised definition of MMDS. The application to the exemplary models shows some alleged advantages. A preliminary conclusion is that more discussion and comparative work are needed.

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The Effectiveness of Force Directed Graphs vs. Causal Loop Diagrams: An experimental study

When it comes to making tough decisions in dynamic environments, decision makers usually do not make the optimal choices (Moxnes, 2004). In order to help decision makers understand the consequences of their decisions modelers usually reveal the structure of their models through Causal Loop Diagrams (CLD). Here I have run a small pilot experiment comparing an alternative method of model structure, model behavior visualization called Force Directed Graphs (FDG) in an attempt to determine which is the more effective aid to decision makers. Participants in this study were asked to make decisions in a dynamic system, and were given either a CLD of the underlying model, or a FDG as an aid. The results of this study were inconclusive as to which was more effective, but it appeared that FDG users had better strategy, but were on the whole unable to translate that into optimal decision making. This paper also discusses changes to be applied to its experimental design before this study can be run in full.

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A System Dynamics Perspective on Insurgency as a Business Enterprise

A system dynamics model is developed to describe how insurgency groups pursue funding for their operations and the choices they make in how they allocate these funds to maintain their operations and advance

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their causes. The model illustrates that the insurgent groups, under survival pressure, will seek necessary resources to continue their operations by any means necessary regardless of ideology or higher goals. This self-preservation hypothesis is predicated on evidence-based counter-insurgency research. The model focuses on four primary activities of the insurgency: force maintenance, public relations, commission of violent acts, and community outreach. The model shows how decisions to re-allocate resources among these four activities, affects the overall financial well-being of the insurgency. Indeed, the model can be used to determine the pressure points of an insurgency which may provide insight in how to financially damage such an organization.

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The Role of Proactive Strategic Planning in Punctuated Organizational Change: Revisiting Sastry's Model

Sastry's (1997) simulation model of Tushman and Romanelli's (1985) classic theory of punctuated organizational change supported the underlying causal theory and yielded several important insights regarding executive management's role in monitoring the strategic fit with the environment and allowing for a trial period directly after reorientation. However, Sastry's model focuses exclusively on reactive strategic reorientations triggered by sustained poor performance due to organization-environment misalignment, leaving no room for proactive strategic shifts in response to anticipated events. The extremely common process of strategic planning is geared toward just this type of change; routine planning attempts to manage uncertainty, anticipate future demands, and make targeted strategic changes before performance deficits make radical reorientation necessary. This paper explores the impact of adding a strategic planning routine to Sastry's model on organizational performance and change.

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The role of System Dynamic Simulations in Higher Education Management, a Systemic View

Under the assumption that there is a variety of meanings and purposes behind the use of System Dynamics in higher education management, this paper compiles a review and a systemic interpretation that will examine such variety. The Systems thinking research group (GPS), at the Universidad Autónoma de Bucaramanga, has developed a variety of projects which main purpose was to use System Dynamics modelling to support University management. A detailed revision of these projects, as well as other research documents developed by authors from the international community interested in this topic, is presented to

distinguish common objectives, strategies and organizational learning experiences. This revision provides the fundamentals that allow the identification of a variety of uses of System Dynamics in higher education to create a systemic perspective from which it is possible to discuss and reflect organizational complexities beyond mere management strategies and business projections in the University management field.

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The software life cycle spiral model: the dynamic approach

The process of developement of IT system is a set of activities and results connected with it, which lead to formation of the system. This process can be implemented in a variety of different ways. The abstractions of the course of creating an IT system are known as the manufacturing process model or software life cycle model. The spiral model, which is the subject hereof, as well as other existing models, have been developed on the basis of many years of experience of designers and programmers. The main goal of the models is indication of the sequence of steps crucial for the correct realisation of an IT project. However, they do not encompass the dynamics of the process and interaction between various factors connected with them, which include: human, time, economic and quality factors. The following article attempts to present the spiral model of software life cycle in the dynamic approach, on example of an ongoing project of a regional energy planning support system.

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A test of the relative effectiveness of using systems simulations to increase student understanding of environmental issues

This paper reports on an experimental study testing the relative effect of using simulation models on systems thinking in a college-level Introduction to Environmental Science class. The preliminary findings show mixed results. It is unclear whether this is a result on the systems simulations used in the interventions or the assessment techniques employed to study their effectiveness.

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Influence Of Labor Migration On Latvia's Labor Market

This paper shows system dynamic model of labor market and labor migration in Latvia. The hypothesis of the research is that: labor migration is determined primarily by the payment level in the countries under consideration and indicator derived from it – payment difference in compared countries; also employment level, unemployment level, number of work places (market capacity) and number of vacant work places. Secondary factors influencing migration may be costs connected

with labor migration, formal legal barriers of migration and personal propensity to migrate. Statistics on the Latvia's labor market are not complete; there is also no common view of experts about determinant processes. In such circumstances forecasting of market with quantitative methods is problematic. One approach is to simulate indicators and to estimate their influence on national economy. The model has three parts: labor force expansion, allocation and migration sub models. Labor force expansion sub model is based on allocation of population in various categories during transition to a working age population. Allocation by level of educational is further used in labor markets analysis, where, according to the education level, worker groups are formed. Mutual interaction of groups of workers together with labor migration is represented in paper. In results is shown model factors sensitivity from personal propensity to labor migration.

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Communicating model insights using interactive learning environments

Much attention is focused on the rational-style development and application of System Dynamics models. Even group model building focuses primarily on the formulation and understanding of the model by the group members themselves. There is a dearth of attention for communication of the insights derived during the model building process to those peripherally or (un)involved in this process. In this study, the multi-actor context of model implementation is addressed explicitly. The feedback loop connecting model-derived insights and results back to the problem owners, the client and stake-holders, is explored. A number of principles for use in the communication of models are derived and the rôle of interactive learning environments as a tool in communicating model results and insights in such a multi-actor context is discussed.

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Policy Planning to Improve Quality of Technical Education - A System dynamic Approach

In the present paper an attempt has been made to link various elements that affect the quality of technical education in the present era. A System Dynamic approach has been used to study the technical education system and a conclusion is drawn with the help of model by simulating it in powersim and the model is validated with hypothesis formed.

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Dynamics in domestic terrorist organizations

The number of incidents provoked by a domestic terrorist organization shows an oscillatory though irregular behaviour over time. There are periods of time where the organization carries out many incidents whereas during other periods, the activity diminishes or even is null. This paper attempts to explain the reasons of that behaviour considering a causal structure that picks up the interrelations between the actions of the organization and the government of the country where the organization focus mainly its activities. While the terrorist organization controls positive feedback loops, the governmental policies implemented to fight against it are led by negative feedback loops fraught with

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uncertainty. The dynamic emerging from the interrelations between the positive and the negative feedback loops would explain the evolution of the number of attacks carried by the organization. In order to check the strength of the causal structure a simulation exercise is proposed to characterize the number of incidents of a specific organization during a concrete temporal horizon. The aim is to check the degree of fit between the real data and those obtained by simulation, which includes specific features of the organization to study.

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Experimental Comparison of System Dynamics versus Traditional Facilitation

This paper reports on an experiment comparing the relative effectiveness of standard group facilitation techniques with system dynamics facilitation techniques in a real world stakeholder participation process. The experiment tested the hypothesis that the system dynamics approach would lead to: (1) better decisions; (2) greater participant focus on relevant materials; and (3) higher procedural satisfaction. The system dynamics approach yielded better decisions but lower procedural satisfaction among participants.

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Does formal system dynamics training improve people's understanding of accumulation?

Prior work shows widespread misunderstanding of the principles of accumulation (stocks and flows), even among highly educated adults trained in Science, Technology, Engineering, and Mathematics. People fail to grasp that the quantity of any stock rises (falls) when the inflow exceeds (is less than) the outflow. Rather, people often use the correlation heuristic, concluding that a system's output is positively correlated with its inputs. Here I ask whether formal system dynamics training is effective in overcoming people's poor understanding of accumulation. I report an experiment with graduate students at the MIT Sloan School of Management to assess the impact of an introductory system dynamics course on their intuitive understanding of accumulation. I use a pretest-treatment-posttest design, where the treatment consisted of the standard course content. Results show improvement in overall performance and a reduction in the prevalence of the correlation heuristic. Even relatively modest exposure to stocks and flows improves intuitive understanding of these concepts, at least among these highly educated adults. However, there is still evidence of correlational reasoning among a minority of students. I suggest additional experiments to deepen our knowledge of the education and training required to develop people's intuitive understanding of accumulation.

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Structural Racism and System Dynamics: A Theory and Methodology for Addressing Racial Disparities

Understanding how interactions between apparently race-neutral institutions and policies can produce racial disparities is essential to a Civil Rights Movement in the United States in the 21st Century. Moving from a discourse that focuses on intent as the determining factor in whether racism exists to a discourse that focuses on the existence of racial disparities and the structures that reproduce them requires a new language and vocabulary. Conceptualizing and operationalizing effective interventions that will reduce these disparities requires a new methodology. System dynamics can play a key role in providing both a language and a methodology to better understand the continuing presence of racial disparities across nearly every indicator of wellbeing. Most attempts to reduce racial disparities have met with considerable policy resistance, and modeling work must focus on identifying key leverage points. In this mostly qualitative work, causal-loop diagrams are pulled from relevant research and key reference modes are examined for insights into the structures perpetuating racial hierarchy. A dynamic hypothesis is proposed that the stock of African-Americans living in areas of concentrated poverty is one of the key drivers of racial disparities. Suggestions and opportunities for further modeling and next steps are also outlined.

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Healthcare Industry Incentive Structures Pressure System Operators to Operate in a High-risk State

The operation of hospitals in a low-risk state has become more a more challenging goal to meet as cost-of-care increases have forced hospitals to find alternative revenue sources. In particular, hospitals have compensated for increasing costs by expanding their ad hoc patient referral base and overloading their operation schedules without a corresponding increase in resources to treat the increased patient load. Without adequate resources to treat patients, proceduralists respond to throughput pressure by speeding up the pace of cases, thereby exposing the patient to greatly increased risk of an adverse event. The subsequent treatment of adverse events caused increases the cost-of-care as hospitals bill related treatment to insurance companies. Recent changes by third-party payers to the hospital reimbursement policy have attempted to address this issue by denying coverage of adverse event treatment. The policy is examined along with alternative solutions that seek to align the incentives of insurance companies, hospitals and surgeons in an effort to decrease the cost of care and encouraging the low-risk operation of hospitals.

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Does a Better Understanding of Accumulation Indeed Predict A Higher Performance in Stock and Flow Management?

The stock and flow management (SFM) 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, the phenomena of excess stock and shortages are omnipresent. One recent explanation for these observations is offered by a stream of research, which finds evidence for widespread and persistent deficits in stock-flow thinking (SFT) capabilities even among well-educated adults. Building on this explanation, an attempt is made to test the hypothesis, that the better people understand accumulation, the higher will be their performance in SFM tasks. The results of a small sample pilot study indicate that the hypothesis of a one-dimensional cause-and-effect relationship between SFT and SFM performance has to be rejected. Therefore, Ackerman's PPIK theory is introduced and used to formulate an elaborate causal model, which could be tested in future research.

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America Disrupted: Dynamics of the Technical Capability Crisis

This study investigates the cause of a nearly twenty-five year decline in the percentage of U.S. born undergraduates earning engineering degrees. This dramatic decline has occurred despite incredibly high pay and low unemployment among engineers. On the surface this situation appears to violate the laws of supply and demand. A system dynamics model was created to represent the institutional forces and feedback loops present in the real-world system. This model internally represents the economic forces governing the choice to pursue science, technology, engineering, and mathematics (STEM) education, distinguishing features of quantitative knowledge that constrain its transmission, and factors determining the quality of STEM education in our schools. It is shown that high industry pay for STEM workers and low pay for STEM teachers can cause long-term self perpetuating labor shortages. The fact that mathematics performance has strong dependencies on past-knowledge exacerbates the situation. Policy proposals are simulated to test their ability to positively influence the system. The model is shown to exhibit tipping point behavior. Small reforms will have negligible impact while significant reforms could make the system move into a fundamentally better pattern of behavior, but only after considerable delays.

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Supporting Small Medium Enterprises planning through the use of a step-by-step System Dynamics model building process

This paper aims to support small medium enterprises (SMEs) in business planning through the use of system dynamics models. In particular, it has been hypothesized that through the use of a step-by-step system dynamics model building process SMEs' entrepreneurs can better understand the net of cause-and-effect relationships underlying company financial and non-financial results. Such an approach also enables decision makers to improve their understanding about the figures portrayed in a balance sheet. In order to reach such a goal, this study has been carried out through the use of a case-study. The small company investigated is a leather handcraft operating in Indonesia. The paper makes explicit main feedback mechanisms underlying company customer base dynamics adoption process, production and inventory management policies, human resource management practice and machineries production capacity acquisition policy.

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Using Conceptual System Dynamics Simulation Models to Initiate Exploration of and Discussion about Incident Reporting Systems

Ongoing research collaboration between Tecnun, University of Agder, Gjøvik University College and mnemonic AS (a Managed Security Services provider), investigates how to improve the operation of information security incident reporting systems. A large part of the research effort is collaborative workshops and a significant issue is how to engage the participants in an objective discussion. We have successfully employed small System Dynamics computer simulation models for this purpose. These models leave out many details and make a number of assumptions that are often wrong. However, that is precisely why they work so well. When experts are confronted with a "wrong" model of a system they know very well, they seem to have an urge to immediately correct the modeler, thus initiating discussion. Used correctly, these small conceptual models can "kick start" a collaborative modeling workshop, engaging the participants and immediately extracting useful information. This paper presents one such model and our experiences with using it.

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The Role of Incident Reporting in Reducing Information Security Risks

This paper examines the role of information security incident reporting systems in the wider context of an information security management system. This work is based on four group model building workshops with participants from mnemonic AS, a Norwegian Managed Security Services Provider. We found that incident reporting is a crucial component in creating information security awareness among

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information system users. Our research indicates that increasing incident reporting rates does not necessarily mean poor security, but rather that the organisation is becoming more security aware, and, arguably, less exposed to information security risks. However, in an organisation with poor awareness, it is possible that incident reporting rates and risk increases simultaneously. Analogous results are known about industrial safety reporting systems and risk of organisational accidents.

Sustainability and System dynamics: some case studies

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While Being Green may be in fashion, sustainability has yet to gain such traction. Meanwhile, sustainability challenges are prevailing in many sectors and across wide ranging disciplines. The climate change threat is just one component of this challenge, together with sustaining global health and development without jeopardising intergenerational equity. This paper scrutinizes the concept of sustainability with specific focus on understanding its system boundary conditions. Case studies are presented to illustrate the value of a system dynamics view in formulating sustainability strategies. Each of the cases presented, from metals to fertilizers and ICT to forestry, offer unique challenges, yet share common threads: finite non-renewable resources, losses in renewable resource loops, and an economic system incapable of managing them sustainably. Each study reinforces the need for better understanding of integrated systems for adaptive management, societal learning, and policies to manage transitions towards a more sustainable society.

On root-causes of unsustainability: phosphate consumption investigated using systems analysis and dynamic assessment modelling

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The roots of unsustainability on the highest systems level, can only be determined by looking at the system from a birds perspective. We argue that real sustainability must be able to span at least 20,000 years to the inception of the next ice age. We can show that the population size and the consumption rate per person are both at work to let us collectively outpace the supply rate of the planet. So far, humans have addressed end of pipe solution like pollution cleanup, progressed to cleaner production and efficient resource use. The next level is also being studied and initiated, less unsustainable consumption rates, better efficiencies and closing of cycles. However, these are still at the systems level below the real root causes. The models predict that the available minable resources will finally run out 1300 years from now. After that only phosphorus gained from agricultural capture will be available. For scenarios leading to populations in the size range of 1-2 billion people on earth, the general supply situation will be much improved. The shortage of phosphorus may have food shortage as a result, leading to predicted significant social stresses, potentially leading to conflict. Key words, sustainable population, phosphate reserves, phosphate consumption, social sustainability.

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How can we assess whether our simulation models improve the system understanding for the ones interacting with them?

Most of the system dynamics studies that evaluate decision making in complex dynamic task focus on the evaluation of performance over repeated trials and on the effectiveness of different instructional strategies as far as performance is concerned. Especially when a strategy seems to yield promising results in terms of performance, it becomes essential to know whether improved performance is due to improved system understanding, i.e. to correct rules or due to other rea-sons such as trial and error. This paper contributes to the emerging literature in system dynamics about assessing system understanding. Based on the way experts make decisions we develop a step by step guide to evaluate how the understanding of the system develops in the course of subjects interacting with the system through a simulation model. We apply our guide to the rein-deer management task and analyze data from previous experiments with the task. This applica-tion provides important insights for the further development of the questionnaires that are ap-plied for assessing understanding.

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Using Binomial Decision Trees and Real Options Theory to Evaluate System Dynamics Models of Risky Projects

Many important risky projects are characterized by stochastic processes embedded in non-linear, feedback structures with delays. System dynamics models may be used to estimate the cash flow resulting from these projects. If these projects include managerial flexibility (real options), a correct financial evaluation of these cash flow requires the use of real options methodology. We adapt prior work on real options valuation in the decision analysis literature to develop a methodology that avoids the need to estimate a risk-adjusted discount rate for the project with options. We illustrate this approach with a model drawn from the wind power industry, which is characterized by numerous uncertainties and high managerial flexibility. We conclude with a discussion comparing this methodology to the previous methods and describe under what conditions each one might be a more appropriate choice.

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Investigation of depression among university students: A Case Study of Sharif University of Technology

Lately, students' depression has become a great concern among prominent universities. Increase in severe psychological problems (Kitzrow, 2003) has compelled these universities to think of an effective policy to improve the deteriorating conditions. Inspecting the students' lifestyle in eminent universities such as M.I.T, Michigan, Cambridge and Sharif University of Technology (which is considered as the best university in Iran and has found international fame) manifested noticeable similarities in causes of students' depression among aforesaid universities. In this paper, we have investigated the students' lifestyle at Sharif University of Technology as a case study, using a System Dynamics approach. Also, depression as a vague and intuitive concept is defined clearly in terms of explicit variables using "Alderfer's ERG Theory" and the dynamic behavior of the students, is carefully modeled within last 20 years. At the end we have come to conclusion that teachers can play a significant role in improving the conditions by choosing the apt evaluation policy.

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Science, engineering, and technology in the policy process for natural systems

Natural systems and society share a symbiotic relationship with each affecting the health and welfare of the other. More importantly, society's impacts on natural systems can lead to negative side effects on society such as increased respiratory illness from air pollution, contaminated drinking water from industrial runoff, and increased skin cancer risk from stratospheric ozone depletion. Mitigating the risks of these side effects often requires the development and implementation of public policy. But policy makers may have a limited understanding of complex natural and societal systems and their interactions. Scientists and engineers can help policy makers by offering their knowledge of these systems as well as technological solutions to mitigate the impacts of societal behavior. However, the expertise of scientists and engineers may not be fully utilized by policy makers for many reasons including scientists and engineers inability to provide the appropriate knowledge, scientists and engineers inability to effectively communicate with policy makers, or policy makers inability to incorporate scientific and engineering knowledge into policy development. The current work develops improved understanding of the interaction of scientists, engineers, and policy makers in the policy process for natural systems. This understanding is developed by constructing, testing, and analyzing a system dynamics model of stratospheric ozone depletion.

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Cluster Formation and Government Policy: System Dynamics Approach

This paper studies the effect of particular government policies on a cluster formation using a system dynamics modeling approach. A conceptual cluster dynamic model includes the interaction of the cluster with resources, workers, jobs, unemployment, salary, market demand, and production capacity. The considered government policies are raising the cluster's attractiveness, lowering the failure rate of new firms and enlarging the amount of resources. The results show that the cluster will be developed faster and grown larger if the cluster is attractive and/or when the failure rate of new firms is low. Increase in resources also enlarges the cluster but it takes a longer time to develop.

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A simple model to study the MNP impact on dynamic behavior of a two-competitor mobile market: Stability versus Oscillations

The mobile market in Iran is experimenting a transition period from monopoly by the incumbent service provider to a relatively competitive market by introducing the third operator. This paper describes the result of a research concerning the dynamisms of helping the churn in the mobile network by the Number Portability service. The feature adds to the attractiveness of the whole market and potentially stimulates the players to increase their individual attractiveness by either increasing their service quality or reducing prices or both. This dynamism is illustrated by a causal diagram, and a flow diagram has been constructed. The simple proposed model suffices to explore the consequences of different scenarios provided by the policy makers, and helps developing suitable policies to launch this new service. It is shown that improper settings for the service, including the costs, the time to port and the flexibility of porting can cause undamped oscillations in the system.

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Agile Project Management

Agile Project Management reviews literature of the agile software development domain relevant to System Dynamics.

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Systems Engineering: Have we lost our Competitive Edge? A Consideration of the Dynamics of Systems Engineering Projects

Recent media reports include several large systems engineering failures. These failures are especially alarming given that they span different

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sectors (i.e., shipbuilding and space systems), and are not isolated to one firm. Therefore we need to ask: Have we lost our systems engineering competitive edge? What can the systems engineering discipline do to correct the apparent discrepancies that appear to be at the root cause of these failures? A systematic framework that represents current system engineering practices and integrates different factors that impact its performance into a unified view is not currently available. We introduce some of the key concepts of this integrative framework by borrowing from the management and system dynamics literature. This framework facilitates the modeling of the systems engineering process for the purpose of understanding, assessing, and potentially improving its performance. Our framework brings together the basic mechanics (e.g., task completion, testing, scheduling, and costing) and the human elements (e.g., skills, incentives, and employee turnover) inherent in system engineering projects. We highlight major feedback processes crossing multiple stages of the process and leading to cost and budget overruns. We demonstrate how this framework can organize and connect multiple sources of failure in the systems engineering process.

Complementing System Dynamics with Object-Role Modeling

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In this paper we use Object-Role Modeling (ORM) to complement System Dynamics (SD). The art of SD modeling lies in discovering and representing feedback processes and other elements that determine the dynamics of the system. However, SD shows a lack of instruments for discovering and expressing precise, language-based concepts in domains. At the same time, the field of conceptual modeling has long since focused on deriving models from natural expressions. We therefore turn to ORM as a prime example to integrate a strong natural language based conceptual modeling approach into the creation of SD models. ORM is a formal fact-oriented approach for modeling information at a conceptual level. In this study we investigate the basic building blocks of these methods using examples. Investigating the foundation of the two methods helps us to better understand their underlying concepts and their differences in update behavior due to state and decision changes. We use SD to capture the dynamic, and ORM to capture the static aspect of a system.

Modeling Knowledge Reuse in Technical Support Operations

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There is an increasing concern on the part of corporate sector of the importance to harness knowledge as their most valuable resource. The purpose of this work is to identify the effects of knowledge reuse in

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service systems. In order to achieve this, a system dynamics model of a software-house's technical support service in Brazil is developed, emphasizing on the use of knowledge bases and its effects over the service system. It concludes that i) the model aids the designer in evaluating several aspects of the system as well as its performance, including the effects of knowledge reuse and ii) based on the simulation results, knowledge management enhances service system performance.

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Multi-scale Integrated Modelling for Sustainable Adaptive Systems

This paper presents a theoretical expansion of the 3-step modelling approach (Costanza & Ruth, 1998), which proposes an incremental progress from "scoping "models to "research" and "management" models. The trade off for increased detail and resolution in model building is a decrease in transparency. This paper aims to provide a context for Mediated Modelling (which happens at the "scoping" level) and similar system dynamics based participatory modelling approaches, as a missing link toward Adaptive Management. An emphasis is placed on reflective capacity among relevant stakeholders to evaluate the behaviour of systems at various scales and integrated dimensions. A theoretical Multi-Scale Integrated Modelling for Sustainable Adaptive Systems (MIMSAS) framework is discussed as a foundation for three, 6-year research programmes on (1) urban systems, (2) energy systems and (3) watershed and coastal ecosystem services.

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Dynamics of Agile Software Development

Software projects have traditionally been problematic in terms of quality, cost and time. Researchers and practitioners have focused on agile software development as an alternative to overcome these problems. Agile methods employ iterative development cycles (typically 20 working-days), interspersed by user feedback. The key to agile projects is the sense of urgency created by the need to deliver at regular intervals. This paper examines this construct, i.e., schedule pressure. We investigate the relationship between the level of agility (length of the iterative cycle) and project outcomes. We argue that project outcomes may suffer either from a team being too inactive, e.g., in sequential or low levels of agility, or from a team being over-active over too long, a situation likely to occur in high levels of agility. We hypothesize that moderate levels of agility are likely to result in the best project outcomes. We test our hypothesis through simulation, and find a U-shaped pattern: performance is better when iteration lengths are 50 working-days, as opposed to 20 working-day cycles widely used in practice. Our analysis provides both theoretical insights into the dynamics of agile software development and practical suggestions for managing these projects.

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The rise and fall of product innovation strategy: a simulation model

The benefits of a strategically balanced product portfolio, as a key driver of long-term business success, are well documented. In this respect, many firms have been unable to achieve a balanced product portfolio. An important cause is the failure to develop dynamic capabilities, that is, the capabilities to reconfigure internal and external competences to address dynamic business environments. In times of environmental instability and financial decay, top managers are facing difficulties in adapting their strategy to changes in market and competitive conditions. Firms can thus become seriously trapped in a reinforcing negative loop, where the changing environment is counteracted with inadequate strategic actions, which in turn results in further decreasing financial performance. This so-called suppression mechanism serves to explain why so many firms fail at building dynamic capabilities. We draw on system dynamics modeling to build and simulate a model of the causes, consequences, and potential solutions of the suppression mechanism. This model is derived from the literature on dynamic capability and, more broadly, strategy and innovation studies. The main contribution of this paper to the literature on dynamic capabilities is the definition and codification of the suppression mechanism.

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A Dynamic Simulation Analysis of Urban Ecotourism in Yangmingshan National Park and Taipei City

The concept of ecotourism has been promoted by the public in decades, and it is expected to push local development forward while conserves the ecological resources. However, the practical process is full of confliction and contradiction, and makes the development of ecotourism have its argument. Considering the concept of urban ecotourism is still obscure, this study introduces the method of Fuzzy number construction, to construct the index of urban ecotourism. Yangmingshan National Park and Taipei city are applied to examine the relationship between both of them through system dynamic method. The result reveals that the ecotourism destination has not destructed obviously while the tourists have been increasing in the early period. But if the policy of recreation carrying capacity has not been built up, the biodiversity will decay soon while the tourists keep on growing. In addition, the number of urban tourists is also increasing while urban ecotourism has been ripe, and that will result more carbon dioxide emissive while economy vigorous. The ecological green lands could reduce the speed of carbon dioxide emission. It is clear that urban ecotourism may provide an alternative choice of urban tourism, and correspond to the direction of ecological city. Keyword: Urban Ecotourism, Fuzzy number construction, System Dynamic, Yangmingshan National Park.

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A SD-Based Reflective Strategy Development Process

This paper aims to support growth management for firms that have no stable growth logic. Based on Schns reflective management perspective (Schn, 1983), we propose an iterative system dynamics-based reflective strategy development process to facilitate managers to organize and develop firm growth logic. Different from typical system dynamics modeling which is based on existing dynamic structures, in this paper, an iterative system dynamics modeling process is designed to develop models that evolve with managers ideal designs towards the implementation of expected growth patterns. An action science research is conducted with a case to illustrate the iterative SD model-based growth management process. How the case under discussion enhanced its understanding of the confronted growth problem and developed its growth logic to guide the formulation of relevant growth strategies are clearly described.

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A Dynamic Model Of Teacher's Adoption Of E-learning System By Integration Of Environment Variables and Teacher Characteristics

In this study we develop a system dynamics model of teachers adoption of e-learning system. We identify that environment variables and teachers individual characteristics are the two main factors affecting teachers adoption. Consequently we integrate well-known technology acceptance model into our dynamic model. This study also proposes three policies to enhance teachers adoption. Each policy will be analyzed individually, and policy comparison will also be performed.

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Exercises: The test for the Needham Puzzle Solutions via Systems thinking

China is a world-renowned ancient civilization, but why was capitalism and modern science originated in Western Europe rather than in China? We studied the commodity economy and natural economic development, as well as the impact of science and technology, culture (mainly about Confucian thought), and bureaucracy. Then we made the model of the situation of the Song Dynasty and work out the productivity curve of the Chinese feudal dynasty. After the process of our study, we learn that the consolidated centralized feudal dynasties are able to control the whole country, but its over-centralization has already decided that every dynasty is bound to eclipse. During the continuous wars, the protection and development of the productivity seems to be impractical, and so does the capitalism-it can not attain the suitable environment it lives by.

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Exercises: The Analog Prediction of the Discharge Process of the Barrier Lake at Tangjiashang

14:28 on May 12, Tangjiashang Mountain experienced a terrible crack in the Wenchuan earthquake. A 'barrier lake' was formed. The water level has been rising rapidly. Experts of the Ministry of Water Conservancy planned to take advantage of the artificial drainage and form a new watercourse. But we did not know if the water can be ensured to drain at a higher speed than the intake, otherwise the dam will collapse. Moreover, when the flow accumulates to an uncontrollable level rapidly, it may also lead to a calamity of collapse and flood. For such a complicated, dynamic, developing and volatile task, we can consider a system thinking method to try to answer these two questions. We studied water storage capacity, rainwater convergence, discharge flow, water level, and water erosion. Then we set the starting point of time for May 26 and run the model. We can draw the conclusion by modeling that the method of eroding earth by water is applicable.

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The Effects of Changed Work on Original Scope and Rework Using System Thinking

Discreetly identifying the resulting causal effects of change in construction have been a topic of discussion and debate for several years, especially those changes that disrupt contractor productivity. Managing projects consists of a complex and integrated array of decisions, actions, and communications necessary to complete projects successfully. A project is a system requiring fully functioning processes and procedures, tools and resources, and when any of these aspects are not working efficiently, problems can and do occur. The purpose of this paper is to discuss the possibility of identifying and quantifying the synergistic effects of changes on project performance, and the cause and effect relationships that are created when change is introduced prior, during and after work has been executed.

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The Role of Influence Operations in a Counterinsurgency Battle

The aim of this paper is to extend a recent "war of attrition" model for counterinsurgency (Kress & Szechtman, 2008) to include the impact on war of the use of influence operations for popular support and defections from the insurgency. The model has the following five sectors: (1) Competitive Contagion for Popular Support; (2) Recruitment and

Defections; (3) Quality of Intelligence; (4) War of Attrition; and (5) Collateral Damage. Two messaging policies were compared, but the results of such comparisons will depend heavily on model parameterization and the formulation of effect functions. Still, a model such as this one can be used in principle to inform policy development by making assumptions transparent and by clarifying causal links. For instance, popular support messaging can reduce the effectiveness of insurgent fighters and their ability to recruit. Alternatively, defection messaging can help to recruit defectors and glean intelligence for targeting that could limit civilian casualties and reduce insurgent recruitment, thus bringing the war to an earlier close. This effort was completed, in part, for the U.S. Air Force Research Laboratory at Wright-Patterson Air Force Base (Contract No. FA8650-04-D-6405 TO 25 and TO 33).

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Radical innovations from a dynamic capabilities point of view - A Hybrid-Modeling Approach to Generate Pseudo-Empirical Data

Sustained competitive advantage is a major issue in the field of management research. A growing number of scholars utilize the Dynamic Capabilities View as a reason for over average performance and adaptability of a firm, especially to radical innovations that threaten a firm's survival. Due to the abstract character of the concept, the nature and impact of dynamic capabilities is still vague and empirical evidence is rare. This paper presents a formal simulation model that builds on previous work on the accumulation of dynamic capabilities to explore the micro foundations of the concept. To generate pseudo empirical data, a mixed agent based and system dynamics modeling approach is developed. Judging preliminary results further development of the method promises to be fruitful to understand of the micro foundations of dynamic capabilities.

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The Simulation of Idea Propagation in Organizations

The healthy exchange of ideas within an organization leads to faster problem solving, mitigates short and long term risk, and opens the possibility for disruptive technological change. We introduce a new tool (GYRUS) for the simulation and optimization of idea propagation within an organization. This tool treats the organizational topology, internal processes, and implements an individual knowledge model to examine idea propagation. The topology represents both the formal and informal networks of idea movement within an organization. The processes include all activities resulting in the exchange or introduction of ideas to the organization. The knowledge model concerns how individuals store and propagate ideas. We apply this tool to a simple organizational topology to understand the propagation characteristics of ideas and the coupling of ideas between entities in the structure.

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Workforce Modeling for the National Institutes of Health (NIH)

The National Institutes of Health (NIH) and the research community has been concerned for decades about the increasing periods of training and the rate of entry of new investigators into its pool of funded Principal Investigators (PIs). Since 1970, newly trained investigators have experienced longer periods of training prior to application for NIH research grant support. Longer periods of training are reflected in the average age at which investigators receive their first independent research grant, which has increased from 34.3 to 42.4 over the period from 1970 to 2006. Because of the concern about sustaining the enterprise and assuring a continuing supply of new investigators, the NIH launched a collaboration with viaSim to model the biomedical PI workforce and to estimate the rate of replenishment necessary to balance the age of the entire pool and to test policies that could be employed to encourage reductions in the duration of training. This paper provides an overview of the model developed for the project, as well as some initial simulations of policies related to the duration of training and entry of new investigators. The final section addresses how the NIH-specific model could be applied to the national STEM workforce.

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Persistent Instabilities in the High-priority Incident Workload of CSIRTs

Since their inception Computer Security Incident Response Teams (CSIRTs) have been afflicted by chronic problems concerning workload, quality of service, and sustaining their constituency. We have cooperated with one of the oldest CSIRTs to model the most challenging issues. Low-priority and high-priority incident response cause distinct problems. In a previous paper we dealt with the impact of the exponential growth of low-priority incidents on the CSIRT workload. In this paper we deal with high-priority incident response and its impact on the CSIRT workload and quality of service. One observes long-term instabilities in workload and QoS and, ominously, oscillatory decreasing recognition of the CSIRT by its constituency. An improved communication of the service level provided by the CSIRT is the most effective policy to mitigate long-term instability in the workload and quality of service.

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Chronic Workload Problems in CSIRTs

Since their inception Computer Security Incident Response Teams (CSIRTs) have been afflicted by chronic problems concerning workload, quality of service, and sustaining their constituency. We have cooperated with one of the oldest CSIRTs to model the most challenging issues. Low-priority and high-priority incident response cause distinct problems. Low-priority reports grow exponentially, which overwhelms the limited CISRT resources. For high-priority incident response, one observes long-term instabilities in workload and QoS and, ominously, oscillatory decreasing recognition of the CSIRT by its constituency. In this paper we focus on low-priority incident response, leaving high-priority response for two companion papers. For low-priority response, the CSIRT tends to handle the workload by adjusting the productivity of manually handled incidents, a futile task owing to exponential growth in incidents. A more fundamental solution is automated incident response, but its implementation requires careful planning of timing and resources.

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Preserving a balanced CSIRT constituency

Since their inception Computer Security Incident Response Teams (CSIRTs) have been afflicted by chronic problems concerning workload, QoS and sustaining their constituency. We have cooperated with one of the oldest CSIRTs to model the most challenging issues. Low- and high-priority incident response cause different problems. In companion papers we dealt with the impact of the exponential growth of low-priority incidents on the CSIRT workload and the effect of high-priority incident response on the CSIRT workload and QoS. Here, we focus on a severe consequence of instabilities in high-priority incident response: problems to retain the internal constituency, i.e, the customer base or community who by its funding enable the existence of the CSIRT. Such an external constituency (people and organizations outside the internal constituency) that are provided with limited services, is unavoidable and even desirable, since security incidents often involve sites outside the internal constituency. But our model indicates that the instabilities in high-priority incident reporting create an imbalance that -- if it persists -- could threaten the very existence of the CSIRT. Our model suggests that a management strategy that reduces the turnover of the most frequent reporters is much better than any attempt to attract a higher number of frequent reporters.

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Simulating Pollution from Urban Stormwater in Project Twin Streams Catchment, Auckland, New Zealand

A system dynamics simulation is presented that models the accumulation of the urban non-point source pollutant zinc from stormwater run-off into an estuary in West Auckland, New Zealand. The boundary and resolution of the model is restricted by available data to a simple structure containing combined inflows and one stock, with no outflow. This is a realistic approximation of system behaviour and mirrors results from other studies in principle. We question the usefulness of such a simulation in its lack to address any socio-ecological processes and concerns. Qualitative modelling is deemed more useful for systemic understanding mandated as part of the transition towards sustainable urban environments.

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Mental Models in Urban Stormwater Management

Environmental problems and solutions are often conceptualised in many different ways by different stakeholders. In order to address behaviour change and move towards more sustainable approaches in stormwater management, there needs to be understanding of and engagement with these differing perspectives. This case study uses cognitive mapping to elicit and transparently capture perceptions on stormwater problems and solution strategies in stormwater management techniques of 31 diverse stakeholders of stormwater management in Twin Streams catchment, Auckland, New Zealand. Three perspectives have been discovered and are synthesized in causal loop diagrams: conventional fixes, low impact solutions and community development. Analysis confirms that these perspectives are diverse and potentially conflicting. Moreover, each perspective has shortcomings in providing solutions that can address effectively the challenges posed by stormwater. As a result, the integration of the perspectives in a wider move of all stakeholders towards a culture of transition is proposed. The implementation of low impact solutions is essential in addressing existing environmental degradation and achieving restoration efforts in the short term. In order to realise sustainable stormwater management, however, the long term focus must be on social learning, behaviour change, the creation of effective partnerships with local authorities and community ownership.

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Logical vs Historical Time in A Price Adjustment Mechanism

Recent global financial crisis seems to be re-kindling the battle of economic thoughts which has been dominated by the neoclassical doctrine as free market fundamentalism. This paper first examines the neoclassical foundation of price adjustment mechanism built on logical time, using system dynamics modeling. Then it is argued that similar workings could be done in a real market economy running on historical

time by the interplay of price, inventory and their interdependent feedback relations. This implies that off-equilibrium analysis built on historical time without neoclassical concept of auctioneer is a better way of representing market activities. This approach can be made possible by system dynamics modeling.

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The Market Competitive Behavior in the Project-based Industries

Project-based industries are among the largest industries in the global economy and project-based organizations are also becoming prevalent in the emerging industries. In a project-based industry, a contract is usually awarded before the goods or services are completely provided by the contractor and contractors routinely compete for contracts under specific project awarding systems. The characteristic of the transactions and contractors reactions to project awarding systems forms unique pattern of market competitive behavior of the project-based industry. This paper demonstrates the market competitive behavior and the problems of the ineffective competition under price-based and qualification-based project awarding systems. Several unanticipated adverse feedback behavioral loops generated from contractors opportunistic bidding are discovered and analyzed. Managerial policy implications to project owners are also discussed and tested through a simulation model.

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Inductive Modelling of an Entrepreneurial System

In this paper we present a model that represents a novel approach to generating a theory of the behaviour of an entrepreneurial or start-up system. The system around the cities of Bath and Bristol in the UK was analysed using an inductive ethnographic approach that hybridises grounded theory with system dynamics, an approach we have called grounded systems modelling. The model consists of three main causal loops that represent the stages of development of an idea through to successful exploitation – i) Spotting opportunity, testing and validation, ii) Realistic equity position, and iii) Scale up and exit. The results are discussed within the context of entrepreneurial research and a critique of the methodology is offered.

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The Impact of Aggregation Assumptions and Social Network Structure on Diffusion Dynamics

Diffusion problems in general, and innovation diffusion problems in specific, are one of the most frequently revisited issues in system dynamics domain. Although the models used for analyzing specific diffusion problems differ in details, in most cases a set of assumptions is recognized to be common. In this study, we aim to conduct a set of experiments in order to question the validity and potential impact of fundamental assumptions regarding the aggregation and social network

structure. First, a generic model focuses on the impact of information dynamics that accompany the diffusion process of an innovation is introduced. The experiments conducted on the aggregate and individual-level versions of the model reveal that the behavior of the system converges to the aggregate model assuming perfect mixing as the network gets denser. Secondly, the change in diffusion levels as a consequence of changing network densities was monotonic. However, direction of change was different for different groups of scenarios tested. In other words, in some cases diffusion level increases as the network gets denser, while in some other cases the opposite is observed.

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A System Dynamics Model for Analyzing the Effects of Government Policies: A Case Study of Iran's Cell Phone Market

In 2005 Mr. Mahmoud Ahmadinezhad won the presidential election campaign and became the new president of Iran. He desired to change deeply most of the usual social and economical rules and policies in Iran's society. For example, he decided to change the rate of tariff in many kinds of products such as cell phones. Since he has wanted to make Iran an independent country in producing cell phone and also to create some job opportunity, he increased the rate of tariff for imported cell phones and at the other hand many contracts was established with cell phone companies to achieve the high technology of producing or assembling cell phone. So a huge investment was done to make the first Iranian National cell phone. But the cell phone market was shocked by this hasty decision and little by little all of the cell phones in the market were became contraband. In this research we are going to analyze the effect of changing the rate of imported cell phone and also we explain some policies for setting the rate of tariff.

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Local Analysis of Individual-based Viral Dynamic Models with Eigenspace and Eigenvalue Elasticity Analysis

Eigenvalue elasticity methods have been widely applied in analyzing linear and simple nonlinear systems. In this study, we applied this approach to gain insight into the leverage offered by parameter changes in individual-based viral dynamic models for studying and controlling infectious disease spread. We found that such eigenspace based methods encounter severe limitations when applied to nonlinear systems with a relatively large number of state variables. Although eigenvalue elasticity offers some insight into the short-term impact of parameter changes, eigenvalue elasticity method can be complicated and even unwieldy for understanding the impacts of parameter changes for models with a relatively large number of state variables because of eigenvalue multiplicity, co-effects of eigenvalues, eigenvectors and coefficients. In terms of disease control, while such analysis methods could be helpful for identifying policy levers with high short-term impact, it is inefficient. In addition, we found that parameter changes guided by such local

techniques are usually insufficient to alter system behaviors in the long-term, such as in the phase of endemic spread in the infectious disease spread. We argue that further work should be focused on refining eigenspace techniques and developing global analysis method to understand the impact of parameter changes on long-term behavior.

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Dynamics of Organizational Adaptation, Inertia, and Routines: Generic Contributions from a Study of Change

Inertia and routines are important organizational characteristics affecting organizations' evolution. Empirical research has found mixed results concerning the question whether change establishes change routines that make organizations more malleable or whether transformations inhibit further alterations. Reasons for these results are analyzed in this paper by means of a case study of organizational change at the New York Stock Exchange and respective system dynamics modeling. The analysis reveals that there are multiple effects in the explanation of organizational transformations which dynamically interact and become important determinants of change and adaptation. The simultaneous consideration of balancing and reinforcing effects of adaptation, inertia, change routines, and reactions to threat sheds light on the ambiguous empirical results.

Plenary Session Papers

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A History of Making Energy Policy

For more than 30 years, system dynamics has played a noteworthy role in the making of energy policy for many states, provinces, corporations, and countries. This work has covered the spectrum from predictive forecasting, to strategic planning, to assessing policy options, to negotiating policy, to shaping policy, to defending policy, to swaying policy. While The FOSSIL1 model appears to have begun this process, the ENERGY2020 model continues to influence the policy process in functional, but possibly ambiguous, ways.

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Personal versus Situational Dynamics: Implications of Barry Richmond's Models of Classic Experiments in Social Psychology

There is a long-standing debate in the field of social psychology as to which is the primary determinant of behavior, the situation or system in which people act or the personalities of the role players. Psychologists have long studied this problem with controlled experiments on human subjects, and have now come to a general resolution of the debate. However, the field of psychology still lacks an efficient method for teasing apart the relative contributions of personal and situational variables in applied domains. An alternative to human subjects experiments is to employ system dynamics models of role systems, as was demonstrated by Barry Richmond when he attempted to model two classic experiments in social psychology: the Milgram and Stanford Prison experiments. In this paper, we replicate and discuss Barry Richmond's models to present them to a new audience. In addition, we use the models as a springboard to explore the relationship between social psychology and system dynamics and the potential for useful collaboration between the two fields.

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Why and How Small System Dynamics Models Can Help Policymakers: A Review of Two Public Policy Models

Public policies often fail to achieve their intended result due to the complexity of both the environment and the policy making process. In this article, we review the benefits of using small system dynamics models to address public policy questions. First we discuss the main difficulties inherent in the public policymaking process. Then, we discuss how small system dynamics models can address policymaking difficulties by examining two promising examples: the first in the domain of urban planning and the second in the domain of social welfare. These examples show how we can get insightful and important lessons for policy making that are exclusive to the endogenous and aggregate perspective in modeling and simulation.

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Pandemic Influenza and Complex Adaptive Systems of Systems (CASoS) Engineering

We present the story of our involvement in the formulation of the US's policy for mitigating pandemic influenza. At the heart of this formulation was modeling but in its actualization was interaction, drive, serendipity, hard work and advocacy for the use of models to select robust policy in the face of great uncertainty. Reflecting on this entire process and others where high impact influence has been achieved has led us to a recognition that nearly all the systems that we wish to influence can be categorized as Complex Adaptive Systems of Systems or CASoS and that our field of endeavor is CASoS Engineering.

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Four Grand Challenges for System Dynamics

In 2007 Jay Forrester challenged the field of system dynamics to address the big issues. This paper discusses four "big issues" as "Grand Challenges" in the DARPA sense, which meet the criteria of 1) impacting lives or livelihoods of millions or billions of people, 2) currently being governed by mental models that are seriously flawed, and 3) being addressable by system dynamics and seemingly few other disciplines. These are: 1. Insurgency, governance and political stability 2. Acting on global warming 3. Global financial stability 4. Harmonious Chinese growth For each of these, the paper discusses the flaws in governing mental models, briefly indicates the scope of analysis needed, and gives a representative causal diagram showing some of the loops that are complicating and obscuring a correct and widespread understanding of each issue.

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Using C-ROADS to Support Analysis of International Climate Change Proposals

We report the creation and initial use of the Climate-Rapid Overview And Decision Support Simulator (C-ROADS), a simple, fast, user-friendly simulation of climate change that conforms with accepted climate science while allowing decision makers to discover through interactive exploration the range of greenhouse gas emissions trajectories sufficient to achieve widely accepted goals for climate stabilization such as stabilizing CO2 levels at 350-450 parts per million (ppm) or limiting temperature increase to no more than 2 deg. Centigrade over pre-industrial temperatures. Our results show that these proposals--even if fully implemented--would be far from sufficient to meet the goals of stabilizing atmospheric CO2 levels at or below 450 ppm (reaching ~ 730 ppm by 2100) or limiting warming to 2 deg. C over pre-industrial temperatures (reaching ~4 deg. C by 2100).

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Model-based exploration of strategies for fostering adoption of improved seed in West Africa

Seed of improved varieties and other inputs are imperative to the transformation of the agricultural sector from subsistence farming to small-scale commercial agriculture in developing countries. This paper analyzes the adoption and diffusion process of improved seed by farmers in West Africa. The literature about farmers' adoption of new agricultural technology is abundant, yet it gives no inte-grated, process-oriented policy perspective that helps designing effective strategies for fostering the adoption of improved seed in West Africa. This paper develops a system dynamics model that integrates the findings from existing studies into a coherent framework. The model analyses the behav-ior patterns that are generated by such structure. With this approach we are able to identify parame-ter constellations that cause observed behavior patterns for different crops in different countries. On this basis we can derive policy implications for supporting adoption for specific crops (such as cotton and maize) and countries (such as Burkina Faso and Ghana) in West Africa.

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What Models Are Required To Understand Global Limits To Growth In The Next Two Decades?

The industrialized democracies will experience more change in the two decades, 2005-2025 than they did in the entire 20th century. The change will be driven in part by the exploding effects of physical limits to growth such as water scarcity, declining availability of fossil fuels, climate change, and soil erosion. These changes will confront society with an enormous challenge - finding ways that information about longer-term problems can be presented so that it has a constructive impact on political and corporate leaders, who typically have very short-term perspectives. There will be a new set of dynamic questions to explore. For example, how can an society continue to satisfy the needs of its people while experiencing an aging population and declining labor force? How can an economy adapt to rising energy prices without reducing the well-being of its citizens? How can research on temperature-tolerant food species be introduced into the agricultural system without disrupting existing food chains? Dennis Meadows will list several of the important limits, give data on their current and likely future impact, and describe some of the system dynamics modeling opportunities they will afford.

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The HealthBound Policy Simulation Game: An Adventure in US Health Reform

The U.S. Centers for Disease Control and Prevention developed the HealthBound game for those wanting to experience the possibility of transforming our troubled health system. Players are equipped with the power to navigate the country's health system toward greater levels of health, equity, and cost-effectiveness, if only they can discover how. The players' goals are difficult to achieve, in part, because the game includes resource constraints, time delays, and side effects of intervention similar to those of the actual health system. The game allows tests of single interventions, as well as a high degree of creativity in mixing them for better effects. There is also a transparent causal structure that allows players to identify the precise reasons for patterns observed in the game. Players learn by simulated experience and by tracing through the reasons for their successes or failures. Those who aspire to lead change on a national scale, or in their own sphere of influence, may benefit by first testing and refining their ideas in this realistic, but simplified version of the U.S. health system. The game teaches essential lessons about how the health system works and establishes a productive frame for finding a viable way forward.

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Are advice adhered to? Populist versus activist or expert advice.

Laboratory experiments of decision making have revealed widespread misperceptions of nonlinear dynamic systems. A possible criticism of these experiments is that participants do not get the advice they may receive in real situations. Here we repeat one previous experiment where we add two conflicting advice. A 'populist' advice reflects typical misperceptions while a second advice represents a near-to-optimal policy. The latter advice is in the wording of an 'activist' in Treatment 1 and in the wording of an 'expert' in systems analysis in Treatment 2. The results suggest that advice, including near-to-optimal ones, may have minor effects in complex systems. Activist wording seems more effective than expert wording, with the possible exception for participants with a certain background in stock and flow reasoning.

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STEM Pressures from Birth to Globalization: Five Related Models

In the U.S., there is progressively more concern about the impact that changes in science, technology, engineering, and math (STEM) skills might have on the future of U.S. prosperity. In parallel with their many STEM initiatives, industry, education, and government are engaged in multi-faceted STEM policy conversations, both among themselves and with the American public. We know of five system dynamics models that have been developed toward the objective of improving these STEM policy conversations. In this session, Boeing, as catalyst for development of three of these five models, will outline the STEM problem, summarize and lightly compare the five models, and present one of the models. The model presented here arose from a reading of the National Academies' report, "Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future." The model focuses on the reinforcing feedback between U.S. prosperity and the U.S. Science and Technology Enterprise, and concentrates attention on how education, R&D investment, and immigration policies might act to strengthen or weaken that feedback. Thus, this model provides a dynamic conceptual framework within which one can place the other four STEM models to be presented in other sessions at this conference.

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Using System Dynamics to Model Student Interest in Science, Technology, Engineering, and Mathematics

This paper presents preliminary results of a Raytheon project that uses systems dynamics to understand the intricacies of the U.S. educational system and to assist in exploring the effects of policies and programs, with a goal of doubling the numbers of science, technology, engineering and mathematics (STEM) college graduates by 2015. Specifically, a system dynamics model has been developed, the initial version of which

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targets increasing the number of students both capable and interested in pursuing careers in STEM disciplines. A few scenarios have been analyzed that examine changes for improving student capabilities. Initial results provide insight into the value and viability of a few proposed policies and indicate that with continued research, model development, and analysis it will be possible to further assess proposed improvements in the U.S education system.

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A Conversation with Peter Senge, Özge Pala, and Paul Newton

This event will entail a semi-structured dialogue with Peter Senge, the well-known author of *The Fifth Discipline,* Özge Pala, a promising young scholar, and Paul Newton, an entrepreneurial modeler. Together they will reflect on their experiences with fostering genuine systems awareness and wiser actions within education, civil society and business. The conversation will address themes, topics and questions of interest to the audience, both surveyed in advance and impromptu. This event is a special feature of the K-12 program thread which is open to all conference participants.

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Modeling the Cycles of Gang and Criminal Behavior

In a study done by Saeed and Pavlov a generic microstructure of resource competition was developed and stylized using the dynastic cycles that occurred throughout Chinese history. The result was a model that demonstrated how economic drivers contribute to the cycles observed in the rise and fall of dynasties and lawlessness. Using their structure, with only a few substitutions of names, the same model suitably describes numerous systems where similar cycles in resource levels can be observed. Yet, in some systems, such as gangs, the economic motivations alone do not adequately describe the social factors clearly evident in rise and fall of criminal behavior attributed to gangs. This paper explores the social influence gaps in the purely economic model, identifies a social structure that can be used instead of the economic mechanisms, and then examines implications of a model that combines both aspects of the system. The result of this research indicates that both economic and social influences are capable of producing cycles and when combined, only further exacerbate the problem. These findings have import implications on policy design, suggesting that solutions will need to simultaneously consider both aspects.

To Be Announced

Presentation by the System Dynamics Applications Award Winner

The System Dynamics Applications Award is presented by the System Dynamics Society 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 relating work to existing system dynamics literature and/or other disciplines. The winner will be announced during this session, followed by a presentation by this year's winner.

Meetings, Special & Convened Sessions

Listed alphabetically by Session name

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Australasia Chapter Annual Meeting

The Australasia Chapter will meet at the Conference to discuss progress in the past year, and also to develop a plan for the coming year.

Barry Richmond Scholarship Award Announcement (External Award)

The Barry Richmond Scholarship Award is presented annually to a deserving Systems Thinking or System Dynamics practitioner whose work demonstrates a desire to expand the field or to apply it to current social issues. The winner of this award will be announced at the banquet on Tuesday evening.

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Conference Debriefing and Program Debriefing Meetings

All are welcome to attend these meetings to talk about what worked and what needed improvements at the Albuquerque Conference. Also, please remember to complete and return the conference survey. Post-conference, please email the conference survey to Etiënne Rouwette <E.Rouwette@fm.ru.nl>. A link to an online version of the survey will be available via the conference website (http://www.systemdynamics.org/conferences/current/index.htm).

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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 of $500 as well as conference registration plus travel expenses (up to a combined maximum of $700).

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Economics Chapter Annual Meeting

The Economics Chapter will hold its annual meeting. All are welcome to attend.

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Education Roundtable and Education SIG Annual Meeting

This Roundtable is the place to come to discuss substantive education issues, whether you are part of the Education SIG or simply exploring possibilities. The Ed SIG is establishing an agenda which embraces both elementary and secondary education and high education. We also deal with both management and public policy issues. We will continue working on the intellectual and operational challenges to system dynamics of the PK-20+ concept of lifelong learning from prekindergarten to continuing adult education, reaching beyond the usual silos separating the domains. Come tell us what you are working on, or just ask questions.

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Energy Roundtable and Energy SIG Annual Meeting

The Energy Roundtable 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.

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Environmental Roundtable and Environmental SIG Annual Meeting

The environmental special interest group welcomes everyone to join us in this important discussion about the challenges surrounding the use of system dynamics for natural resource modeling. Issue for discussion: Natural resource modelers often need to use data to create model behavior; moreover our cliental often expect to see their data and how it fits into a model. What are the challenges of managing the data driven nature of environmental while still designing system dynamic models. Many people who are not trained in system dynamics pick up software such as Stella and Vensim, build models and assume they are doing system dynamics. When they do not get results that are insightful they think that system dynamics is not useful. What can we do as a community of practice to enlighten modelers that system dynamics is much more than software and encourage the (proper) use of system dynamics in this field?

Exhibitor Demonstrations

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

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Getting to Know the System Dynamics Society

This event gives newer conference attendees an opportunity to learn more about the Society and to 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

Health policy challenges in different countries often share similar structural features. Therefore it has been a longstanding goal of the HPSIG to foster international collaboration in studying health system dynamics. Previous efforts to pool insights and compare findings across countries have focused on approaches to national health reform as well as efforts to reduce health inequities. Anyone intersted exploring opportunities for future collaboration is welcome to attend this informal, organizational meeting. Please bring ideas about where your work may focus in the year ahead and which topics seem best suited for collaborative or comparative modeling.

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Health Policy Special Interest Group, Roundtable and Election (Sunday)

The Health Policy Special Interest Group formed more than six years ago and has grown to include nearly 300 members. We are an international SIG with worldwide membership and 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. This year's meeting will feature project summaries from some of the world's health policy modelers and we will award the second annual student prize in Health System dynamics (sponsored by the Lupina Foundation of Canada). 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.

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Information Science and Information Systems iSIG Annual Meeting

The Information Science and Information Systems Special Interest Group (iSIG)will meet at the Conference to discuss progress in the last year, and also to develop a plan for the coming year.

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Information Science and Information Systems iSIG Roundtable

The Information Science and Information Systems Special Interest Group (iSIG) is interested in supporting the promotion of quality system dynamics work in the areas of Information Science and Information Systems. System dynamics has a long history analyzing complex problems in a variety of application domains, ranging from environmental or public policy, corporate strategy, security, healthcare, and operations management, to change management. However, it has not seen extensive application in the Information Science and Systems literature. The iSIG seeks to discuss research initiatives in the field of Information Systems and Science as part of the International Conference in System Dynamics. The roundtable discussion aims to establish a roadmap for research topics and collaborative initiatives within the scope of the iSIG. We will facilitate a discussion and provide examples of research studies in the field and hope to agree on an agenda for future work.

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Inter- and Intranational Conflict Roundtable and SIG Annual Meeting

The Special Interest Group: Inter- and Intranational Conflict was approved by the Policy Council of the System Dynamics Society on 3 March 2008. The SIG is concerned with the application of systems dynamics to understanding inter- and intranational conflict, e.g. military and political conflict, terrorism, insurgency, etc. There is a wide range of interested individuals, both academics and practitioners, currently applying the system dynamics approach to this area. Much of this work has not been published or is difficult to obtain. The purpose of the roundtable is to attract more interest and to frame how the SIG can interact, for example, in paper reviews, attendance at non-system dynamics conflict conferences. etc.

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Introduction of the System Dynamics Applications Award Winner

The System Dynamics Applications Award is presented by the System Dynamics Society 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 relating work to existing system dynamics literature and/or other disciplines.

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Italian Chapter (SYDIC) Annual Meeting

This is the annual meeting of the Italian Chapter (SYDIC). All are welcome.

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K-12 Poster Session: What Is Happening in K-12 Systems Dynamics and Systems Thinking?

Come, enjoy, and learn from the wonderful and productive thinking that is happening with students ages 5-19! This session is designed to be informative and educational for both the participants at the International System Dynamics Conference and the students and teachers who are presenting examples of their system dynamics and systems thinking work in classrooms. It is a chance to inform professionals, as well as give the poster presenters a chance to interact positively with those conversant in system dynamics. Constructive and positive discussion is encouraged. This session is part of a special emphasis during this conference to be welcoming, inclusive, and collaborative with the K-12 community.

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Latin America Chapter Annual Meeting

During the 2008 Annual Meeting we met many Spanish-speaking members living outside the Spanish-speaking countries and the wider group continues to grow. This year's meeting is an opportunity to talk about sponsorships and future joint activities and also to welcome new members. Any topic members feel is relevant for the development of the Chapter (whose mission is to spread system dynamics in the Spanish speaking world) are welcome.

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Long Waves and Short Waves - How Should Business Simulations Ride the Wave? Roundtable & Business SIG Annual Meeting

Business activities have been described using system dynamics for more than fifty years. Planning and scheduling, product adoption, profitability, job satisfaction, and many other parameters have been simulated. But have the prevailing assumptions behind these models been complete, or have they reflected narrow experience observed over a relatively short period? How many of the business-related models reported within the past ten years, for example, examined the effects of a major recession? Are the resulting policies rational at this time? Can and should the models be adjusted to reflect the current situation? Or should new models be developed? In light of the significant downturn in the global economy, is it time to rethink the underlying paradigms of economic and market behaviors? Have system dynamics models been based on overly optimistic expectations for long-term performance, leading to policies that do not consider negative externalities? What is the need for including a long-term view, say fifty or sixty years, of external economic and political cycles when simulating behavior over ten or twenty years? This roundtable will be an open discussion of the value of including the effects of short-, medium-, and long-term economic cycles on the dynamic simulation of business activities.

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Canada

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 presented to the recipient (or recipients) during the HPSIG meeting on the Sunday afternoon meeting 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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Membership Forum on Diversity in the System Dynamics Society

The System Dynamics Society has been committed to increasing diversity in membership and field of system dynamics. This roundtable provides an open forum for conference attendees to discuss concerns, improvements, and new directions that the System Dynamics Society should to increase diversity of the membership and field of system dynamics. Everyone is welcome.

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Model Analysis Roundtable and SIG-MA Annual Meeting

At the 2008 System Dynamics Conference in Athens a survey of the understanding and expectations of conference participants regarding model analysis was conducted. Respondents included both those active in research on formal model analysis and those only vaguely familiar with the term. Results from the survey will be presented and discussed. The implications for the Special Interest Group on Model Analysis (SIG-MA) will be explored under the chairmanship of the newly elected co-chair of the SIG-MA.

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Newcomer Orientation

The Newcomer Orientation Session is a special event for newcomers, scheduled for a half hour on Sunday afternoon. Newcomers and veteran attendees (guides) will be brought together based on their topics of interest. The guides will provide information to help the newcomers maneuver through the conference resourcefully and get the most out of the conference experience. The Sunday afternoon session will "self-organize" into groups of newcomers and guides to cover general topics. Some examples of topics are Business, Education, Energy, Environment, Health Policy, Security, Military, 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 may match their interests.

AND

Newcomer Orientation: Scavenger Hunt

Newcomer Orientation Activity: Scavenger Hunt, to be done by participants throughout the conference. We would like some time on Wednesday to announce 1st, 2nd, 3rd places.

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Ninth Annual 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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Outstanding Service Award Presentation

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 established in 2009. It is awarded as often as once per year during the annual conference.

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Pakistan Chapter Annual Meeting

The Pakistan Chapter will hold its annual meeting. All are welcome to attend.

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Peer Review Dialog Meeting

Since 2005, there has been an opportunity for joint reflection about the quality of the peer review process at each conference. In the subsequent conferences, discussin became more structured and this year, a substantial effort has been made. Still there remains work to be done in order to arrive at a policy that would achieve a satisfactory balance between paper and presentation quality on one side and other goals of the conference on the other. This year's meeting is the opportunity to discuss a set of indicators to express the presentation and paper quality perceived by attendees; also we can assess up to which point the new policies have yielded improvements. Reviewers, chairs and organizers are specially invited to give their input.

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Prospective Conference Host Meeting

The annual conference is the most important activity of the Society, and therefore hosting it is a very important contribution to the Society. In addition, being a host for this event can bring fame (sorry, no fortune) to the hosting individuals and organization, and attract local interest in the field. In this meeting we will discuss the timetable and activities involved in preparing a bid to host the conference, the requirements for a successful bid, and the requirements for a successful conference. We will also discuss the Society's schedule for conference site rotation, and the role of SIGs and Chapters in conferences. Please attend this meeting if you have any interest in hosting a future conference.

AND

Conference Budgeting Workshop for Hosting a Society Conference

This workshop will show how the Society deals with budgeting for a conference, the budgeting timeline, and what is required financially. This event is open to anyone interested in our conferences.

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Psychology Roundtable

The Psychology Roundtable 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. To stimulate discussion, we will present a dynamics case study of Zimbardo's 'Standford Prison Experiment.' Modelers of all disciplines and backgrounds - including the social and behavioral sciences, health services research and policy, epidemiology, medicine, genomics, ethics, organizational theory and human resources, engineering, and beyond - are most welcome to participate.

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Psychology Special Interest Group Annual Meeting

The Psychology SIG is devoted to integrating psychological processes into system dynamic models and to use system dynamics principles in developing new psychological theories. We invite members and prospective members to assist us in conducting a general review of the state of the SIG, with particular attention given to identifying short-term and long-term goals and to nominating and conferring new leadership.

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Security Roundtable - The Challenges of Modeling Security Problems and Security SIG Annual Meeting

Modeling strategic and tactical problems in the information and infrastructure security domains presents special problems for the system dynamicist. Concerns about confidentiality, problem uncertainty, and inter-organizational conflicts all contribute to the modeling challenge. Once models are crafted, their distribution is often restricted and the dissemination of insights is limited to the particular sponsor. The Security SIG convenes a roundtable of modelers who will answer questions and discuss their experience in past and current projects concerning: Establishing the problem boundary and choice of modeling paradigm; Using SD to identify critical scenarios for expert examination; Eliciting and capturing expert insight from confidential data; Modeling problems that span the multiple organizations responsible for security; Creating and disseminating open models; Publishing opportunities in security research. Invited panelists include: Edo Cavaleri DOro, MIT Ignacio Martinez-Moyano, Argonne National Laboratory Tom Corbet, Sandia National Laboratory Finn Olav Sveen, University at Agder Jose Manuel Torres, TECNUN, University of Navarra.

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Student Chapter Annual Meeting

The Student Chapter brings together students who are involved in system dynamics research, and it gives them the opportunity to raise key questions and discuss concerns related to their research in a constructive and enjoyable atmosphere.

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Swiss Chapter Annual Meeting

The Swiss Chapter of the System Dynamics Society consists of researchers, educators, consultants, and practitioners in corporate and public sectors. Approximately 140 people receive our e-mails and about twenty of them are full members who pay the membership fee. The number of participants in chapter meetings is relatively constant at around ten. Additional activities involve enhancing consulting

competences and educational programs. Chapter meetings are organized where we usually combine a presentation about System Dynamics in action with the discussion of organizational, chapter-related issues. In addition, the Swiss Chapter organizes several PhD round tables each year at different locations. At these meetings, PhD students of Switzerland who apply System Dynamics and related disciplines in their research have the opportunity to present and discuss their projects and obtain feedback from senior researchers and peers. With such a structure, we try to maximize the benefits for our chapter members. The value added by the Chapter's activities lies in the provision of networking, learning and exchange opportunities.

System Dynamics Models Created by High School Students, Presented by the Students

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For those of us who work with students and who have introduced system dynamics modeling and systems thinking into our curriculum, the time has come to highlight that student work. We need to begin the process of changing the minds of other interested educators and parents. We will not have the statistical data needed to change opinions on a large scale for at least the next five to ten years. So what can be done now? Let the students make our point. We need to make student work public. The work should highlight the important components of the system dynamics method. It should highlight the study of important problems not usually addressed in typical classrooms. It should highlight the thought processes that students go through as they build models and/or analyze problems using feedback. It should show what policies students might recommend, or show what policies currently in place would not work, by using the feedback in the system. It should make a parent want their child to have an opportunity to learn this way. This paper will present some recent models created by students ages 15 to 18 in a system dynamics modeling course in the United States.

System Dynamics PhD Colloquium

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The PhD Colloquium is a whole day event for PhD-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. The forth-coming 10th PhD Colloquium will take place on Sunday, July 26, 2009 at the 27th International Conference of the System Dynamics Society in Albuquerque, New Mexico, USA. Plenary pres-entations by PhD-students at the Colloquium will identify common problems encountered by these researchers using system dynamics. Each presentation will be followed by an extensive discussion session, providing a unique opportunity for learning among all attendants, and particu-larly for young researchers. Combined with a poster session, we expect the all-day colloquium to be an exciting event. To conclude the day, attendants will be invited to join for an informal and friendly social event. More information is available at www.sdstudentchapter.org. Any questions about participating in the colloquium can be directed to phdcolloquium@systemdynamics.org.

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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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UK

United Kingdom Chapter Annual Meeting

The UK Chapter have regular meetings in the UK and annually at the international conference venue. (See www. systemdynamics.org.uk) This year we held our 11th Annual Gathering at London South Bank University. Co-hosted with the SD+ Study Group of the UK OR Society, it proved a great success (53 attendees). The theme was “System Dynamics: the client perspective”. The first afternoon consisted of presentations with clients there to offer their views on SD as a method of policy analysis. The organisations involved were the Refrigeration Corporation of Cleveland (Ohio), Bristol Water and the Ministry of Justice. A buffet dinner followed in the evening. We held our 2nd PhD Colloquium on the following morning with a number of student poster presentations. Our evening networking events have continued. These are an informal means of renewing acquaintances as well as meeting new faces. This Spring we are planning one outside of London in the NW of England. If you are based in the UK and not already on our membership list (membership is free) then please do join us 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 Albuquerque conference.

Chapter & Special Interest Group Poster Presentations

Listed alphabetically by Chapter or Special Interest Group name

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Business Special Interest Group Poster Presentation

Does your company use system dynamics modeling? Would you like to learn how other businesses are applying system dynamics tools? Would you like some help bringing these tools into your business? The Business Special Interest Group was formed in 2005 to provide a forum for the exchange of ideas, methods, and lessons learned in the use of system dynamics in the corporate world. The SIG has grown substantially in the number of interested members since then. Our members represent a cross-section of industrial, consulting, and academic organizations, offering tremendous depth and breadth in relevant expertise. Our goal is to encourage the sharing of system dynamics best practices in business. Our approach is three-fold: (1) Development of the system dynamics modeling competence of business users through training and consultancies, (2) Sharing recommendations around effective tools and methodologies with immediate applicability to policy and decision making in business, and (3) Encouraging and inviting presentation tracks and speakers to present applicable work and case studies at the annual International System Dynamics Conference.

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Economics Chapter Poster Presentation

The Economics Chapter promotes the use of system dynamics to study and improve economic systems. The chapter maintains a website (http://www.systemdynamics.org/chapters/economics/) and a mailing list with over 100 subscribers as of April 2009. Members of the chapter have organized system dynamics threads during annual meetings of the System Dynamics Society. Last year's Economics Roundtable discussion was on the "Global Economic Outlook". This year, the chapter plans to organize a full Bonus Day workshop on economic modeling. We encourage anyone interested in economics to visit our poster to learn about the activities of the chapter and its members. We also want to hear about your interests and invite you to join the chapter.

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Education Special Interest Group Poster Presentation

E-SIG Current and Planned Activities 1. Building a network of mutually helpful resource people interested in system dynamics approaches to any aspect of education. 2. Encouraging the generation of additional resources. 3. Developing a comprehensive taxonomy of published work in the field and making it available. 4. Supporting the training of teachers 5. Developing and updating an E-SIG website. 6. Reaching out to other professional education associations to acquaint them with the potential value to them of system dynamic approaches to their work. 7. Encouraging undergraduate and graduate students to undertake projects and dissertations to advance the theory and application of system dynamics to education, 8. Organizing the second international workshop on application of system dynamics to education. Please come to the E-SIG sessions to tell us about your work and find out what others are doing. See you there !!!

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Energy Special Interest Group Poster Presentation

The poster of the Energy SIG presents past and present activities of the group. Key energy issues will be highlighted, as well as relevant studies in the field.

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Environmental Special Interest Group Poster Presentation

The System Dynamics Society has partnered with Carbonfund.org as a means of offsetting the carbon emissions associated with the conference. International conferences have an especially high carbon footprint primarily due to people flying long distances. Other sources of emissions include hotel energy and food, and local transportation. Other than having a virtual conference one manner of reducing our carbon footprint is to purchase carbon offsets. Carbonfund, a 501(c)(3) nonprofit, has helped us estimate our conference emissions at 900.9 metric tons and is offering a website as a manner to pay for offsets and keep track of our total contributions. Carbonfund.org supports three types of carbon offset projects: Renewable Energy – supports clean energy development, such as wind, solar, and biomass. Energy Efficiency – reduces existing energy use, much of which comes from coal, oil, and natural gas. Reforestation

– absorbs existing CO2 emissions, which helps to reduce the excess greenhouse gases that humans have added to the atmosphere. The interactive poster presented by the Environmental Special Interest Group provides information about each of these offset projects. To offset your emissions: http://www.carbonfund.org/site/pages/land/sds_conference.

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German Chapter Poster Presentation

The Chapter advances networking and collaboration among system dynamicists in Germany with the frequent organisation of SD roundtables and other meetings in various German cities. The German Chapter currently has 86 paying members and is pleased to keep more than 200 interested researchers, managers, and students updated through its e-mail newsletter. On June 25th/26th, the 3nd German System Dynamics Workshop will be held in Stuttgart. The event will bring together modellers from the scientific community and corporate practice, offering a wide array of opportunities to exchange ideas and opinions, and combining talks, presentations, and modelling exercises. More information on the activities of the German Chapter is available from our website at http://www.systemdynamics.de.

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Health Policy Special Interest Group Poster Presentation

The HPSIG was formed in 2003 and now has more than 250 members. Its main role is to foster the application of system dynamics to the study of the dynamics of health systems and health-related areas. We hope to deploy useful models and education material that will assist SD, other computational modelers and health professionals to apply systems thinking and modeling to improve health decisions, at the design, planning, management, clinical and consumer level.
Our major activities are a Sunday Special Session at the ISD Conference, circulating Snippets and a wiki and new Discussion forum http://www.systemdynamics.org/forum/index.php as part of the SD Society activites. There is also the Lupina Prize for student papers about health dynamics.

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Information Science and Information Systems Special Interest Group Poster Presentation

The Information Science and Information Systems Special Interest Group (iSIG) was created with the objective of advancing the application of system dynamics to information science and information systems related problems. iSIG is oriented to encourage research, networking and advocacy within the system dynamics community and in other academic and professional communities that focus on information science and information systems research and practice. Members of iSIG have been involved in a virtual conversation about an interchange language definition (XMILE or Model Interchange Format) to be able to translate models between simulation software. This year the iSIG round table will promote a conversation about the current status of Information Science and Information Systems research supported by System Dynamics.

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Inter- and Intranational Conflict Special Interest Group Poster Presentation

Recent activities from the SIG: papers, conferences, presentations.

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SYstem Dynamics Italian Chapter (SYDIC) Poster Presentation

SYstem Dynamics Italian Chapter (SYDIC) Annual Report will describe the activities, both in accademic and consulting/enterprise area, developed from July 2008 to June 2009 by members of the Chapter.

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Japan Chapter Poster Presentation

System Dynamics history in Japan commenced in 1960s; several textbooks of Industrial Dynamics were published in those days. After that, many researchers used System Dynamics in their own field individually for about 30 years. Thereafter, System Dynamics researchers gathered and founded Japan Chapter of International System

Dynamics Society in 1990. Since then, Japan Chapter held The International System Dynamics Conference 1995 hosted by Gakushuin University in Tokyo. The chapter members assembled their best minds and finished it successfully. In 2006, Japan Chapter had over one hundred chapter members. As Research activities, Japan Chapter publishes an annual journal and holds regular research meetings and symposiums. In 2007, we held three research meetings including one conference. In particular, the conference was the most important events not only for the chapter but also for the public. The recent theme of the public symposium is "Internal Control and System Dynamics" The conference had many participants including public people. We always welcome System Dynamics members or users who visit Japan. Several System Dynamics researchers have already had meetings hosted by Japan Chapter. Contact with our office is greatly appreciated.

Latin America Chapter Poster Presentation

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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. Since 2005, the Spanish "Revista de Dinámica de Sistemas" publishes two numbers per year. The "sisTEMAS" newsletter and a mail list allow keeping in touch. During October, the 6th Latinamerican Conference took place in Santiago de Chile, organized by University of Talca, Adolfo Ibañez University, Diego Portales University and Andrés Bello University. The next Latinamerican conference will take place in Santa Marta Colombia during October 2009. If you would like to join us please contact Gloria Perez Salazar (gloria.perez@itesm.mx), Isaac Dyner (idyner@unalmed.edu.co) or Martin Schaffernicht (martin@utalca.cl).

Special Interest Group on Model Analysis (SIG-MA) Poster Presentation

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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, Ford's 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 include facilitating communication amongst model analysts by moderated listserve discussions. These focus on theoretical developments as well as improving the means of communication of analysis results. We are expanding our activities to 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. Please contact Jill Slinger (j.h.slinger@tudelft.nl) to join our listserve (sdsigma@listserv.tudelft.nl).

Pakistan Chapter Poster Presentation

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Pakistan Chapter is a small community comprising 15 members. It was founded in 2005 and since then it has been working to promote SD thinking and practice among the students, practitioners and the academia. An SD course was started at University of Management and Technology, Lahore, Pakistan, which had an enrolment of 20 students. Basics of System Dynamics methodology and simulation modeling were introduced to the students through the SD course. A meeting with the faculty was arranged with Dr. Khalid Saeed as he was visiting Pakistan. The purpose of the meeting was to 1) introduce concepts and applications of the System Dynamics; and 2) invite more faculty and academia to contribute to the development of a community of system dynamics researches and practitioners. Two papers were contributed in International conferences last year, one in Pakistan and the other in Dubai. The same is intended this year. In future the Pakistan Chapter looks forward to translate books in Urdu as well as publish some basic books to introduce system dynamics to students as well as the public. The publication will include contributions from Pak members of the System Dynamics international community. We also intend to develop website for System Dynamics.

Psychology Special Interest Group Poster Presentation

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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. Currently there are approximately 40 members. With respect to the development and application of system dynamics modeling, members share the following aims: (1) Include psychological and social constructs and processes in more classical system dynamics models, where such constructs and processes would help in understanding the underlying dynamic problem of interest; (2) Develop new molecules or mini-models of psychological processes to promote deeper understanding of existing psychosocial and behavioral theories and to generate new theories of psychosocial and behavioral dynamics; (3) Apply system dynamics modeling to a wide range of clinical problems to improve individual and family therapies, group interventions, dyadic interaction analyses. For more information about the Psychology SIG, please visit our WikiSD:Psychology: http://systemdynamics.org/wiki/index.php/WikiSD:Psychology.

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Russia

Russian Chapter Poster Presentation

This poster summarizes all SD-related activities held in Russia by Russian Chapter of SDS. The poster will consist of the following sections: 1. System dynamics in Education 2. Systems thinking and system dynamics application to solving real-world problems 3. What is planned for next year.

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Security Special Interest Group Poster Presentation

Security is a broad field that affects to several systems. However, Security presents some common features in all these systems: It is a system that evolves over time, including technical and social variables. These characteristics make System Dynamics a very powerful methodology for its analysis and research. The incipient Special Interest Group on Security is still immature, but has already provided its first promising results, through the edition of several collaborative papers and project proposals. Some researchers from this group will also develop a projecta about crisis in European energy sector during 2009 an 2010.

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Student Chapter Poster Presentation

The Student Chapter of the System Dynamics Society aims at building a network of Ph.D. students who are interested in system dynamics, and the chapter tries to enable fruitful discussions within this network. The objective is to foster the exchange of ideas among new and more advanced students and provide help with concerns and questions regarding students' research. During the past nine years, the Student Chapter organized the Ph.D. Colloquium at the International System Dynamics Conference. On the Sunday before the conference, students have the opportunity to present the current state of their work and receive feedback from other students, practitioners, and professors in a constructive and pleasant atmosphere.

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Swiss Chapter Poster Presentation

The Swiss Chapter of the System Dynamics Society consists of researchers, educators, consultants, and practitioners in corporate and public sectors. Approximately 140 people receive our e-mails and about twenty of them are full members who pay the membership fee. The number of participants in chapter meetings is relatively constant at around ten. Additional activities involve enhancing consulting competences and educational programs. Chapter meetings are organized where we usually combine a presentation about System Dynamics in action with the discussion of organizational, chapter-related issues. In addition, the Swiss Chapter organizes several PhD round tables each year at different locations. At these meetings, PhD students of Switzerland who apply System Dynamics and related disciplines in their research have the opportunity to present and discuss their projects and obtain feedback from senior researchers and peers. With such a structure, we try to maximize the benefits for our chapter members. The value added by the Chapter's activities lies in the provision of networking, learning and exchange opportunities.

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United Kingdom Chapter Poster Presentation

The UK Chapter have regular meetings in the UK and annually at the international conference venue. (See www. systemdynamics.org.uk) This year we held our 11th Annual Gathering at London South Bank University. Co-hosted with the SD+ Study Group of the UK OR Society, it proved a great success (53 attendees). The theme was “System Dynamics: the client perspective”. The first afternoon consisted of presentations with clients there to offer their views on SD as a method of policy analysis. The organisations involved were the Refrigeration Corporation of Cleveland (Ohio), Bristol Water and the Ministry of Justice. A buffet dinner followed in the evening. We held our 2nd PhD Colloquium on the following morning with a number of student poster presentations. Our evening networking events have continued. These are an informal means of renewing acquaintances as well as meeting new faces. This Spring we are planning one outside of London in the NW of England. If you are based in the UK and not already on our membership list (membership is free) then please do join us and see what we have to offer. There are between 80 and 100 members active in SD in the UK.

Workshops and Workshop Series

Individual Workshops

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Online Industry Case Simulations from the MIT Sloan School of Management

The MIT Sloan School of Management is launching a series of competitive web simulations game designed to be used at universities and by individuals around the world. The simulations will be provided by MIT Sloan at no charge to any universities, students, or faculty as part of MIT Sloan Teaching Innovation Resources (MSTIR) program. These industry evolution simulators portray the growth and competition of firms as industries evolve and can represent a variety of different industries. This workshop will provide participants who bring their wifi-enabled laptops with the opportunity to run two of the simulations in this series. Professor John Sterman of the MIT Sloan School of Management, assisted by Michael Bean from Forio Business Simulations facilitate the play of the simulators and discuss how these simulation and user interfaces were developed, what the design challenges were, and what the process for building the simulation was.

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How to Easily Get Your Vensim, Powersim, or iThink simulation on the Web using Forio

Forio has a new product that allows modelers to create simulations on the Web with no programming or HTML. These tools have made creating web interfaces to system dynamics models simpler and inexpensive. During this workshop, Michael Bean will demonstrate how to create web simulations, discuss commonly occurring web simulation design challenges and potential solutions, and show examples of web simulations that have been used by thousands of users. Michael will also provide a series of guidelines for creating simulations online. After the workshop, participants will have the tools and information they need to put there own simulations online.

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Getting Started With AnyLogic Software

During this workshop we will introduce AnyLogic - a multi-method simulation tool supporting System Dynamics, Agent Based and Discrete Event modeling. We will build an agent based model, a system dynamics model and combine them into one. New features of AnyLogic 6.4 will also be demonstrated; SD array editor, full-featured converter form VenSim(TM), SD tools palette, view areas, and other. A CD with AnyLogic trial version will be given to everybody. You can bring your laptop and follow the presenter, or just watch. AnyLogic workshops usually include discussion on how Agent Based modeling is used in practice.

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Creating simulations for the web with iThink & STELLA

This workshop is intended for new or current iThink and STELLA users who want to share models online. Using iThink and STELLA, 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 STELLA or iThink Version 9.1 and isee NetSim installed or arrive 15 minutes early to install the software.

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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 STELLA or iThink Version 9.1 installed or arrive 15 minutes early to install the software.

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Modeling Dynamic Systems: Lessons for a First Course

Modeling Dynamics Systems: Lessons for a First Course 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. A new chapter dealing with material and information delays will be discussed. Developed for beginning modelers, the lessons contained in this book can be used for a core curriculum or for independent study. Systems thinking software like STELLA offers an opportunity to create visual models that actively engage students in the study of a wide variety of problems. Creating a model allows for real- time analysis of dynamic behavior and a more stimulating environment in which to glean insight. 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). Developed over 16 years, the lessons in this book provide an easy-to-use set of teaching materials that are paced gently enough for novice modelers. Students learn to create progressively more sophisticated models, testing their structures as they proceed. Feedback analysis is integral to the lessons.

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How to Write a Good SD Paper

A full afternoon of lecture, discussion and exercises, evenly divided between doing SD work that supports good papers, and paper-writing heuristics. The intend audience is student and consultants, and the material applies equally to thesis work and single paper publication. The material is based on everything it took for the presenter to make the transition from a not particularly gifted writer to someone with a reasonable publications record, and never having had an article submission turned down. (Except one, and we'll talk about it.) The workshop gives quantitative guidelines where feasible to tell the writer "what's likely to be good enough". The offering is a refinement of last year's well-received workshop.

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The Manufacturing Game

The Manufacturing Game is an interactive board game that stresses defect elimination as a means to attain reliability of equipment and processes. The game grew out of a System Dynamics model created at DuPont in the 1980's.

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Sharpening Soft Skills for Group Modeling Workshop

It has often been noted in publications and at conference that as a field, we could do more to increase our soft skills as modelers. Issues range from working effectively with groups and being better listeners to dealing more effectively with conflict and issues related to power differences within groups and human diversity. While these issues are arguably present in some way within every human interaction, they become more pronounced when we focus on persistent social problems and begin to work with more diverse and marginalized stakeholders. Drawing on the diversity of participants attending the session, this workshop aims to develop advanced skills for facilitating and managing group conflicts. The workshop will be highly interactive and focused on preparing and expanding the range of system dynamicists in working with groups.

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Getting Started with Goldsim

This workshop will be an introduction to building simulation models using GoldSim. GoldSim differs from traditional system dynamics approaches in that 1) it puts much greater emphasis on probabilistic simulation techniques to support representation of uncertain and/or stochastic systems; and 2) it provides a wide variety of specialized model

objects (beyond stocks, flows and converters) in order to make models less abstract (and hence more transparent) and help represent processes and events that cannot easily be represented using a traditional system dynamics approach. The workshop is intended for people who do not have experience using GoldSim. The session will be conducted as a hands-on workshop and will demonstrate basic techniques for building simple simulation models. The key differences between GoldSim and traditional SD tools will be illustrated. GoldSim's capabilities for modeling stochastic and uncertain systems, and for superimposing discrete events on continuous systems will be demonstrated. Participants should bring their own computers and are encouraged to download an evaluation version of GoldSim prior to the workshop. Otherwise, they must show up one half hour early to load the software. The workshop will be of value even if you only watch without a computer.

Getting Started with Powersim Studio Software

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The workshop will introduce beginners to Powersim Studio. It will begin with preparing the Studio model environment and end with a simple but working model. It will also introduce beginning modelers to sources of information within the Studio modeling community.

System Dynamics Model Documentation Tool (SDM-Doc)

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The System Dynamics Model Documentation Tool (SDM-Doc) developed at Argonne National Laboratory (ANL) creates HTML-based documentation of models created with Vensim. The model documentation created by the SDM-Doc tool allows modelers to navigate through model equations in a very efficient and practical way. This tool was created expanding on Oliva's (2002) work on HTML model documentation. The tool will be presented using several examples of how to use it.

Learning with Memorable Dynamic Experiments and Real Data

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This workshop teaches the art of creating dynamic experiments that involve an audience, and translating those experiments into working simulation models. The dynamic experiment is brief, exciting, memorable, and involves workshop participants. Behavior data is captured "real time" for later use. The audience discusses their observations of the experiment and their understanding of the data. A dynamic hypothesis is elicited from the audience and a simulation model created "on the spot" with help from participants to reproduce the

observed dynamics. The motivation is to remove the mystery of simulation from people who have not (themselves) created simulation models. We want to involve people in experimentation and simulation, instead of having "dry" uninvolving presentations about modeling.

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Optimization under uncertainty in SD models

People have difficulties making good decisions in the presence of uncertainty and in nonlinear dynamic systems. When these challenges are combined, decision problems get even worse. The workshop gives an introduction to optimization under uncertainty in such systems. This is normally a very complex undertaking. However, it has been greatly simplified by the new software SOPS from Powersim Software. After the introduction, participants get hands-on experience with SOPS.

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Modular Programming in System Dynamics

This workshop will lay the foundation for effective modular system dynamics model development and use. Programming in modules is standard practice for modern computer languages. System dynamics embraces the notion of molecules of exemplar code formulation, but such code fragments are fundamentally different from modules. Modules separate domains and encapsulate the module operations. They offer interfaces to other modules and promote code reuse, a powerful productivity multiplier. Conventional system dynamics models are typically complex, dense, with intertwined domain elements. They can be difficult to maintain and often hard to understand by any but the original developer. This workshop will provide methods and tools to alleviate these issues via adoption of modular software development practices. The workshop is presented in two sessions. In the first, participants will learn techniques for modularization, and the underlying prerequisites. In the second session, advanced applications that emphasize statistical analysis of models will be discussed and demonstrated. While the examples and tools demonstrated in the workshop are specific to Vensim®, the concepts are generic and can be applied to any system dynamics language. Participants will receive a courtesy copy of the "Conductor" tool, especially developed to automate this approach. This workshop is appropriate for experienced system developers familiar with Vensim®.

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Fun Learning with the World Football Challenge Team Game

Groups of 3-4 people compete in a new competitive paper-based game that gives a fun introduction to some system dynamics principles. Teams manage the strategy over 8-12 years of major football clubs, such as Manchester United and Real Madrid competing in a fantasy world league. Good strategy develops a team of the right size and experience, and with good morale and team cohesion, and this leads to both success in the competition and growing financial capital.

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The Beer Game on Steroids: Do You Have What It Takes to Fix This Mess?

We have a massive supply chain in a heap of trouble. Do you have what it takes to fix it? Participants will be broken into small teams, each with their own copy of the supply chain simulation to manipulate. Teams will compete against each other and against the "optimized" solution to see who has the best approach. So bring your A game. This is similar to the popular Beer Game, but greatly expanded. Knowledge of the lessons of the Beer Game is helpful, but not required. Plan to have fun. Don't come if you're a whiner.

Education Workshop Series

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Masterful Classes K- Graduate SUMMARY

The Masterful Classes K- Graduate is a series of six one-hour workshops. Morning workshops include the first three out of six workshops highlighting examples of good teachers presenting system dynamics lessons from early elementary school through high school school. The teachers in this session are all K-12 educators experienced in the use of system dynamics in the classroom. (1): How 6-year olds learn System Dynamics ABCs; (2): Stocks and Flows in the Middle School Classroom; (3): Models for Use in Advanced Algebra: Lessons on Drug Dynamics. Afternoon workshops include presentations by three professional system dynamicists who have thought a great deal about teaching in the field and who have been recognized by students and colleagues as master teachers. Topics will feature describing the power of interdisciplinary modeling using system dynamics; exploring the joys of tiny concept models; and focusing on urban dynamics. The aim of each of the three afternoon sessions is a self-contained class teaching something interesting and useful about the real world and something interesting and useful about modeling skills and the system dynamics approach.

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K-12 (1): How 6-year olds learn System Dynamics ABC's (Accumulations, Behavior-over-time, Circular Causality)

Workshop participants will experience primary school (ages 6 through 8) lessons designed to teach some of the basics of system dynamics. The lessons will be taught using hands-on techniques, visual tools and computer modeling. Student work, classroom video clips and testimonies from guest elementary teachers will be used to illustrate how students respond to the lesson. The workshop will conclude with a whole group discussion driven by lessons learned from teaching system dynamics to young children. The workshop will be one hour long.

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K-12 (2): Stocks and Flows in the Middle School Classroom

Workshop participants will engage in hands-on activities that the presenters use in fifth and eighth grade classrooms. The activities help students become familiar with system dynamics principles and applications through active and entertaining games and simulations. The presenters are co-authors of the two book series "The Shape of Change" and several articles available on the Creative Learning Exchange website. One hour long.

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K-12 (3): Models for Use in Advanced Algebra:

Advanced Algebra is a course ripe with topics for modeling experiments. Those functions that tend to work well using the STELLA software are linear, exponential, quadratic, and sinusoidal. Starting with just linear and exponential functions, which are usually covered in the first semester of an advanced algebra class, an interesting application, the study of drug dynamics, is easily within the reach of all students, by mid-year. The lessons start with just exponential functions but become more interesting when both linear and exponential model segments are combined to model different drug dynamics. I make it clear to the students from the beginning that we will study therapeutic drugs, such as antibiotics or aspirin, so they (and their parents) do not misinterpret the lessons. The set of models that will be presented have been used in a high school math class, but could easily apply to a health or biology class. Participants should bring a laptop computer, if possible, so they can build the models the students build, during the workshop. A CD with a workshop version of the STELLA software will be provided, as will the first lesson handout used with students. This workshop will be one hour long.

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Masterful Classes – Graduate (three one-hour workshops)

This workshop will be presented by three professional system dynamicists who have thought a great deal about teaching in the field and who have been recognized by students and colleagues as master teachers. The aim of each of the three sessions in this workshop is a self-contained class teaching something interesting and useful about the real world and something interesting and useful about modeling skills and the system dynamics approach. The teachers will strive to make these "masterful classes." Andy Ford from Washington State University will describe the power of interdisciplinary modeling using system dynamics. The talk begins with stories from the work on boom towns in the west and on electric utility problems during the 1970s-80s, and moves to a

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classroom example on salmon populations of the Columbia and Snake Rivers. Brad Morrison from Brandeis International Business School will explore the joys of tiny concept models. Beginning with conceptualization and continuing to formulation, we will interactively develop and then analyze a tiny model. George Richardson from the University at Albany will present a class focusing on urban dynamics, interactively developing a small model in which the classic urban dynamics pattern emerges naturally, almost magically.

STEM Workshop Series

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Creating an Open Innovation Network to Address Key STEM Education and Workforce Issues

Participants will learn about and provide feedback on a unique effort to create an open innovation network around system dynamics models of science, technology, engineering, and mathematics (STEM) education. Presenters will discuss ongoing activities to establish the STEM Research & Modeling Network (SRMN) a diverse group of researchers, modelers, policy makers, educators, and funders that has begun to coalesce around the use of modeling. The workshop will first offer participants and authors of the various models presented in the previous two workshops an opportunity to discuss how learnings from any one of the models might suggest improvements to any other of the models. At least one-third of the workshop will be devoted to engaging participants in a discussion of the challenges and opportunities related to creating and sustaining the SRMN as it works to improve and make its models more useful to the national policy debate. A critical aspect of this workshop will be a participatory discussion of the configuration management processes that will be implemented as members of the SRMN propose changes to the model. And finally, the participants will learn how they can become involved in the SRMN, and will be asked to suggest strategies for involving more members of the modeling community.

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Exploring Models of Science, Technology, Mathematics, and Engineering (STEM) Education in the United States - Part A

Participants in this workshop will engage in a guided exploration of two system dynamics models related to science, technology, engineering and mathematics (STEM) education in the United States. The first model, developed by Raytheon systems engineers, explores potential ways to increase the number of college graduates and teachers in the STEM disciplines. The second model, developed by Dan Sturtevant for his Master's thesis at MIT, explores the causes of the nearly twenty-five year decline in the percentage of U.S. born undergraduates earning degrees in engineering. After a brief intensive introduction to the two models, the participant will engage in exploring how these models can help to evaluate alternative policies for improving the US education system. At least one-third of the workshop will be devoted to interactive learning

activities where the modelers discuss the constraints and challenges modeling the U.S. education system and the participants share their experience, knowledge and ideas to improve the models.

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Exploring Models of Science, Technology, Mathematics, and Engineering (STEM) Education in the United States - Part B

Participants in this workshop will have the opportunity to engage in a guided exploration of three system dynamics models related to science, technology, engineering and mathematics (STEM) education in the United States. The purpose of the Sandia model is to explore the many feedback loops influencing the attractiveness of a STEM career. The purpose of the SimBlox model is to study the changing age demographics of the Principal Investigator pool funded by the National Institutes of Health. The purpose of the Boeing model is to represent the dynamic hypothesis for the feared decline of both prosperity and the engineering-scientific enterprise in the U.S., as discussed in the 2007 National Academies report Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future. At least one-third of the workshop will be devoted to interactive learning activities where the modelers discuss the constraints and challenges modeling the U.S. education system and the participants share their experience, knowledge and ideas to improve the models.

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STEM Education and Workforce Challenges: How Can System Dynamics Improve Key Outcomes?

This workshop will engage participants in an exploration of the potential use of system dynamics modeling to improve our understanding of key STEM education and workforce challenges and to explore potential policy solutions that can strengthen student outcomes in STEM disciplines and careers. This workshop will begin with a facilitated discussion among participants regarding the current state of STEM education, future employment needs in STEM occupations, and ways to improve student interest and proficiency in STEM disciplines and careers. A panel of experts in education will then engage participants in a discussion regarding how systems thinking and system dynamics modeling could assist policymakers, leaders from business and industry and educators in examining ways to increase the number of students who are interested and proficient in STEM disciplines and careers. Participants will be asked to identify a range of modeling approaches that might help address key challenges. At least one-third of the workshop will be devoted to audience participation.

Bonus Day Presentations

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SYDIC, SYstem Dynamics Italian Chapter

SYDIC started a new path since the Nijmegen ISDC, also thanks to innovative tools now available to members. A new website, newsletter, forum, all have contributed to spread knowledge over the net about SD, achieving the goal of raising new members. Practitioners, professionals and academics can now find a way to discuss about common interests and research. Moreover, being visible on the web with a sort of "georeferenced" system, has provided the capability to attract newbies close to our research or working areas. An SD-interested person can infact access the website and "browse" the territory looking for information on places where the SD-approach is used. The website has been also used as a tool for e-democracy. Infact, the last SYDIC policy council elections have been carried out by using a forum functionality (survey) which made it possible to vote. So, the SYDIC session at the ISDC09 bonus-day will have the goal to let italian members spend some time together to learn how to better use the new functionalities of the website, and share knowledge and experiences so to build a wider community. Also, it will be an occasion to discuss about the possibility to constitute the SYDIC into a law-recognised institution.

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Energy and Environmental Special Interest Groups Meeting

The Environmental Special Interest Group and the Energy Special Interest Group are hosting a semi- joint bonus day meeting. We will begin our bonus day activity with two simultaneous sections, one environmental, one energy. The format would include 1.5 hours for 6 presentations of people's current work, work they would like to do, or who are perhaps looking for collaborators or feedback on project development. The venue would be less formal than during the conference to allow for more discussion and only requires an abstract for consideration. We will then join the two SIGs together for a 1.5 hour meeting to foster new ideas and collaborations in areas common to both the environment and energy. Please send abstracts for the individual or joint sessions to Luc Van Den Durpel, energy SIG vddurpel@listo.be and Allyson Beall environmental SIG abeall@wsu.edu.

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Inculcating System Dynamics into a Corporate Environment

Although system dynamics is a powerful tool for understanding many aspects of business operations and strategy, anecdotal evidence suggests corporations have been slow to recognize this value and resistant to implementing it as part of their arsenal of problem-solving techniques. Reasons for this are manifold, ranging from a lack of experience to a perception that system dynamics is either "too technical" or "not technical enough." The purpose of this workshop is to discuss experiences and lessons learned from successful - or unsuccessful - integration of SD into a business. Presentations will address efforts at introducing system dynamics into the corporate environment. The processes used, the training, management expectations and follow-through, and other relevant parameters and behaviors will be explored. Follow-up discussions will be used to elucidate comparisons with the experiences of other attendees. The outcome of this workshop may be a summary of the lessons learned, which may be used to develop future presentation threads or papers within the System Dynamics Society.

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And Additional Team Members

Copenhagen Climate Exercise

The Copenhagen Climate Exercise is a half day simulation-based role-playing climate game that gives groups from 10-150 an experience of reaching a global agreement to mitigate climate change. Set up as a highly simplified "Copenhagen-2009-like" U.N. meeting, participants play the role of delegates from India, China, the US, the EU, Brazil, island nations, and others and work together to reach a global accord that meets the group's goal for CO2 levels. The UN Secretary General receives pledges from three different "blocs", asks his technical staff to simulate them in the "C-ROADS" climate simulation, and informs delegates of results, often sending them back for another round of debate, strategizing, and collaboration. Overall, we've seen the Copenhagen Climate Exercise help people quickly learn the policy-relevant science of climate change, viscerally experience the international dynamics, and succeed at crafting a solution to the challenges, while taking a realistic look at the scale of changes ahead as we shift to a low-carbon global economy. See a recent article in MIT's Technology Review - http://www.technologyreview.com/article/21190/.

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Powersim Studio User Group

The Powersim Studio User Group Conference will be an opportunity for the Studio user community and invited representatives from Powersim AS and their regional representatives in Europe, Oceania, South and North America, Asia and Africa to meet and share ideas and information. The goal of the meeting is to learn to be better system dynamicists, aided by Studio and to strengthen our user community. This opportunity will include tutorials for novices and experts, paper presentations focusing on Studio's unique capabilities and a chance to interact with Powersim AS representatives concerning the company's vision for Studio. The tentative agenda includes: a plenary presentation, novice and expert tutorials, papers on Studio techniques, and hopefully a presentation on the future of Studio. This is also an opportunity for the user community to interact with Powersim AS representatives to express user concerns and suggest new features.

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Participatory Approaches to Modeling and Simulation

In this workshop the organizers will address a number of issues with regard to participatory modeling. The meeting will start of with addresses by key contributors to the literature, highlighting the state of the art of participatory approaches and challenges for the future. The addresses will be followed by a joint discussion on a research strategy and collaborative research program.

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Modeling in Public Policy

In this workshop the organizers will address a number of issues with regard to participatory modeling. The meeting will start with addresses by key contributors to the literature, highlighting the state of the art of participatory approaches and challenges for the future. The addresses will be followed by a joint discussion on a research strategy and collaborative research program.

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Utilizing System Dynamics Expertise in K-12 Education

This morning session will focus on the coordination between system dynamics practitioners and K-12 schools. There will be an opportunity for practitioners to brainstorm with teachers and K-12 education professionals to devise plans to increase the availability of SD expertise for our K-12 schools. The outcome of the session will be a plan to go forward with specific tasks for the coming year to increase the contact between K-12 and SD professionals. In the two months before the ISDC, a small list will be set up to facilitate communication amongst the participants so that the groundwork will be laid and the four hours can be effectively utilized.

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Economic Crisis Roundtable: Sharing Models of Problems & Policies

We will have a full-day discussion of systemic explanations and policy options. The models presented during the morning session will focus on how the dynamic problem(s) developed, but will not include policy proposals for alleviating the problematic behavior. During the morning session, audience questions and discussion will be limited to clarifying everyone's understanding of what the presenters are saying. The afternoon session, in contrast, will have have a policy focus. It will be dominated by audience input, questions, and discussion aimed at generating a list of policies that might alleviate the problematic behavior. Of course, the morning presenters will have some new policy structure in mind for their respective models, and they will also be active participants in the afternoon session. The focus of the policy-oriented discussion will be on "where" various policy ideas might "plug in" to the respective models presented during the morning session; i.e., what kind of structural changes would be required in order to add the proposed policies to those models. It is expected that all participants will take away useful economic modeling ideas. Moreover, we expect the forum to generate a list of practical suggestions for economic policy-makers.

Index of Authors, Presenters and Facilitators

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