PROCEEDINGS OF THE

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SYstem Dynamics Italian Chapter (SYDIC)

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Navigating the Conference Proceedings

For portability and ease of use, the 2002 System Dynamics Conference Proceedings are being distributed in Adobe Acrobat (PDF) version 5.0 format. You can view the files using Adobe Acrobat Reader version 5.0. available for free from http://www.adobe.com/acrobat/. Please download the most recent version of Acrobat for optimum viewing.

These instructions tell you how to:

- Use Acrobat's basic tools to explore the Proceedings
- Navigate the Proceedings using bookmarks and links
- Search for authors, abstracts, and papers, and access supplementary files.

If you are familiar with Acrobat Reader, you will recognize the common navigational features, including bookmarks, links, and menu icons. If you are unfamiliar with Acrobat, you may want to print this page for reference. (For information about printing, see the section "Print a PDF Document" below.)

Using general tools

Page tool

The built-in Page Tool (figure 1) allows easy navigation within multi-page PDF documents.

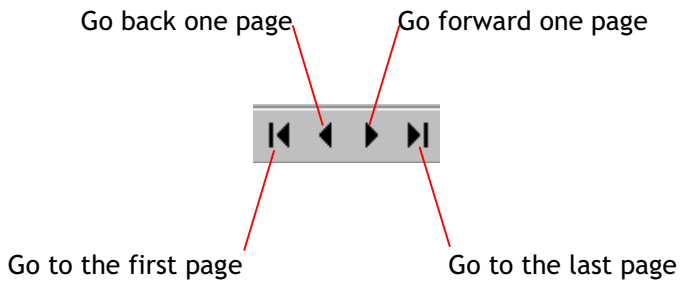

Figure 1. The built-in Page Tool lets you move between and across pages.

Browsing

The built-in Browser Arrows (figure 2) allow you to move through Acrobat in much the same way that an Internet browser allows you to surf the web:

- The back arrow returns you to the page you visited last
- The forward arrow reverses the action of the back arrow (and thus only works if you have used the back arrow)

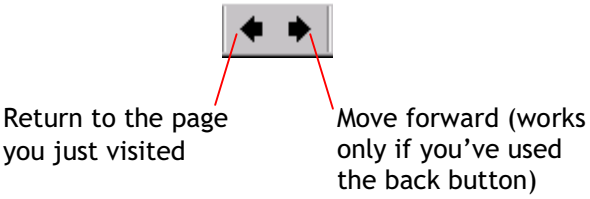

Figure 2. The Browsing Arrows give you greater flexibility to explore the Proceedings.

Printing

You can print a PDF document in two ways:

- Use the Print icon on the Acrobat tool bar. 
- Select File > Print

Note: Both of these actions will display the print dialog box with your default printer set to print. You can then set any specific options necessary to printing.

Links, buttons, and icons

Links and buttons allow you to easily search and access the Proceedings. Links take you from the Author Index to a particular abstract, and from an abstract to a particular paper. Any text or image surrounded by a blue rectangle is a link (figure 3).

All links are surrounded by a blue rectangle.

Figure 3. A sample link

Buttons allow you to move quickly between the Author Index, the Abstracts, and individual papers. The "Author Index" button (figure 4) returns you to the top of the Index, and the "Go Back" button (figure 5) returns you from a paper to its abstract. The "Table of Contents" button (figure 6) returns you to the Table of Contents.

Figure 4. The Author Index button takes you to the first page of the index.

Figure 5. The Go Back button takes you from a paper to its abstract.

Figure 6. The Table of Contents button returns you to the table of contents.

Using Bookmarks

Bookmarks, which appear in the left pane of the Acrobat Reader (figure 7), display the main sections of the Proceedings document. To display Bookmarks, select Window > Show Bookmarks. Clicking on a bookmark will take you to a main section of the document.

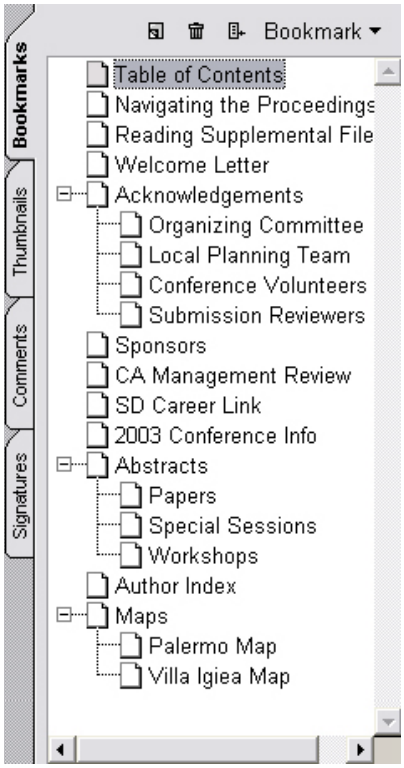

Figure 7. The Bookmarks pane

Finding abstracts

You can locate abstracts in two ways:

1. Locate the author's name in the Author Index
    a. Click the "Author Index" link in the Bookmarks panel
    b. Find the author's name in the alphabetical index
    c. Click the page number after the author's name

    Note: authors may be involved in more than one paper or presentation, which is indicated by multiple page numbers in the index.

2. Use the Acrobat "Find" function

a. Click the Find Icon. 

b. Enter the appropriate title, author name, phrase, or keyword in the "Find What" input box.

c. Click the Find button. The first instance of the search text will be highlighted if found by the search.

d. Repeat step c to find other instances of your search criteria in the current document.

Finding papers

You can locate papers in two ways:

1. Link from an abstract
   - A blue rectangle will surround the title of any abstract with an associated paper. Click inside the rectangle to access the paper.
   - Some abstracts do not have an associated paper.

2. Use the Acrobat "Search" function:
   a. Click the Search icon 

   b. Enter the appropriate title, author name, phrase, or keyword in the "Find What" input box.

      Note: do not include articles (a, an, the) in the search.

   c. Click the Search button. The title of any documents that include your search criteria will appear in the "Search Results" dialogue box.

   d. Repeat step c to find other instances of your search criteria in the current document.

After accessing a paper from its abstract, click "Go Back" to return to the Abstract or "Table of Contents" to return to the beginning of the proceedings.

****Note:** Some papers have been withdrawn from the 2002 Proceedings, and their abstracts have been deleted from the CD-ROM. Areas of white space in the "Abstracts" section indicate a deleted abstract.

Reading Supplementary Files

This year's Conference CD has a new feature - Supplementary files - for some papers.

- **Identifying Supplementary Files:**

  In the Abstracts Section and at the beginning of some papers, Ⓢ indicates there are supplementary files for that work. There is also a list of papers, alphabetical by first author, with the associated supplementary file names, at the end of these instructions.

- **Finding the Supplementary Files Folder:**

  1. Using the list on the following pages, identify the supplementary file(s) that you would like to access
  2. Explore the System Dynamics 2002 Proceedings CD-ROM using the utility appropriate for your computer (Windows Explorer for Windows, Finder for Mac)
  3. Once you have opened the CD-ROM, open the "Extras" folder
  4. In the "Extras" folder, locate the supplementary file that you identified in step 1
  5. Double-click to open or launch the file
  6. You may need to download software to open some files. Below, there is a list of the different websites where you can download the necessary software.

- **Viewing/Opening/Reading the Supplementary Files:**

  While some of these files are regular texts or presentations in widely accessible formats such as .doc, .ppt, .pdf, etc., others are model files, which must be viewed using the appropriate system dynamics modeling software. Please find below information on how to access freeware/demo/trial versions from several system dynamics software manufacturers. Please follow the links to the software needed to view the files.

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

File Name Extension	Software Needed
.itm	ithink*
.stm	STELLA*
.sip	Powersim Studio
.sim	Powersim
.vmf	Vensim

*ithink and STELLA can each be used to open both .itm and .stm files.

STELLA/ithink by High Performance Systems:
http://www.hps-inc.com/STELLAdemo.htm
http://www.hps-inc.com/ithinkDemo.htm

These links will navigate you to a STELLA and ithink Demo Kit, respectively. Each kit includes a free save-disabled version of the respective software which you may use to run STELLA and ithink

models. The kits also contain many additional models that you may find interesting, as well as several Flash-based tutorials that will walk you through how to use the software.

Powersim Studio by Powersim Solutions:
http://www.powersimsolutions.com/sdconference2002

Powersim Studio Express is a 90-day trial version of Powersim Studio 2001. **Note that this installation will automatically replace any previous version of Studio 2000 or 2001 that is installed on the computer**. Studio 2001 can open Studio 2000 files, but Studio 2000 cannot open a file that has been updated or created in Studio 2001. Powersim Studio will convert and read .sim files. This trial version will not be able to open models that have more variables than the set limit.

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

The Vensim Model Reader is free software which allows you to publish models constructed with Vensim and distribute them to other people. Your model and the Vensim model reader can be copied and passed to as many people as you want, giving people access to your model without their needing to purchase Vensim.

- **Papers and their Associated Supplementary Files,** *alphabetically by first author:*

First Author Name and Paper Title	Supplementary File
Alonso Magdaleno, Ma Isabel, "Administrative Policies and MIR Vacancies: Impact on the Spanish Health System"	Alons1_S.ppt
Alonso Magdaleno, Ma Isabel, "Dynamic Analysis of Some Proposals for the Management of the Number of Physicians in Spain"	Alons2_S.ppt
Alonso Magdaleno, Ma Isabel, "Elaboration of a Model for the Management of the Number of Specialized Doctors in the Spanish Health System"	Alons3_S.ppt
Aly Abdel Aleem, Bahaa, "The War on Terrorism: Conditions for Success and Failure"	Aly1_S.jpg
Arquitt, Steven, "A Scoping and Consensus Building Model for Understanding the Dynamics of a Blue-Green Algae Bloom"	Arqui1_S.stm
Barnabe, Federico, "Group Model Building at a Chemical Company: System Dynamics for Knowledge Elicitation and Scenario Training"	Barna1_S.zip
Ciceri, Ivan, "Interreg EU Programme: A New Assessment Approach"	Cicer1_S.zip
Cooke, David, "A System Dynamics Analysis of the Westray Mine Disaster"	Cooke1_S.vmf
Dogan, Gokhan, "Long Term Consequences of Genetically Modified Crops in Agriculture"	Dogan1_S.stm
Dudley, Richard, "An Application of System Dynamics Modeling to the Question of a Log Export Ban for Indonesia"	Dudle1_S.zip
Fratesi, Ugo, "Regional Economies and Innovative Performance as the Source of Competitiveness and Agglomeration: A System Dynamics Representation"	Frate1_S.zip
Futami, Jun, "Data Quality Control and Improvement of Indirect Human Calorimeter by System Dynamics Approach"	Futam1_S.zip

First Author Name and Paper Title	Supplementary File
Gillespie, David, "Acceptable Risk and Mitigation Options: Dynamic Structure of Building Safety"	Gille1_S.itm
Goncalves, Paulo, "When Do Minor Shortages Inflate to Great Bubbles?"	Gonca1_S.zip
Grubenmann, Peter, "Economic Effects of Decentralization of Government with People Empowerment: An International Comparison of Four Asian and European Rural Localities"	Grube1_S.zip
Heffernan, Mark, "Business Transformation Success Dynamics: It's the Communication"	Heffe1_S.itm
Hennekam, Hans, "Making Complex Network Analysis in System Dynamics"	Henne1_S.zip
Johnson, Scott, "Alternative Modeling Approaches: A Case Study in the Oil and Gas Industry"	Johns1_S.zip
Koca, Deniz, "The Rubber Industry and Extended Producers' Responsibility Framework: Opportunities and Threats for Swedish Rubber Manufacturers"	Koca1_S.zip
Levine, Ralph, "Modeling Generic Structures and Patterns in Social Psychology"	Levin2_S.doc
Levine, Ralph, "Organizational Change at the Team Level: The Dynamics of High Performing Self-Directed Work Teams from a Learning Organizational Perspective"	Levin3_S.doc
Lounsbury, David, "Understanding the Psychosocial Dynamics of HIV/AIDS Prevention and Care in the Community: Base Case Model Findings and Implications"	Louns1_S.sim
Madachy, Raymond, "Software Process Concurrence"	Madac1_S.zip
Mandal, Abhijit, "Creating Competitive Advantage through Dynamic Resource Interactions"	Manda1_S.pdf
Newton, Paul, "Repeated Overshoot and Collapse Behavior: An Example from the Petroleum Industry"	Newto1_S.vmf
Ochoa, Catalina, "Simulation of a B2C E-Commerce Model of Durable Consumption Goods"	Ochoa1_S.zip
Pagel, Erica, "Structural Changes in US Dairy Farming and the Role of Government Policy"	Pagel1_S.zip
Pedercini, Matteo, "The Impact of the HIV/AIDS Epidemic on the Population Age Structure of Zimbabwe"	Peder1_S.zip
Petrides, Lazaros, "The Economics of a Biting Minimum Wage"	Petri1_S.txt
Pfeiffer, David, "Symphony of Eigenvalues: A Prototype for Sonification in System Dynamics"	Pfeif1_S.zip
Provenzano, Davide, "An Artificial Stock Market in a System Dynamics Approach"	Prove1_S.zip
Rahmandad, Hazhir, "Learning from Experience with Delayed Feedback"	Rahma1_S.zip

First Author Name and Paper Title	Supplementary File
Rai, Veerendra, "Dynamics of Schedule Pressure in Software Projects"	Rai2_S.ppt
Rees, David, "Use of Financial System Dynamics Models in Local Government"	Rees1_S.zip
Rockey, Samantha, "Information Systems Implementation"	Rocke1_S.doc
Salini, Patrice, "SIMTRANS (Freight Transportation Simulation Model)"	Salin1_S.doc
Schwarz, Rainer, "An Elementary Dynamic Model of a Small Start-Up Firm"	Schwa1_S.sip
Strohhecker, Jürgen, "Simulations for Planning Dresdner Bank's E-day"	Stroh1_S.zip
Sveiby, Karl-Eric, "Building a Knowledge-Based Strategy: A System Dynamics Model for Allocating Value-Adding Capacity"	Sveib1_S.zip
Svensson, Mats, "System Dynamics of Learning Processes: Comparing Apples with Pears"	Svens1_S.stm
Sverdrup, Harald, "System Dynamics Applied to Reconstruct the Dispersal of Modern Man on Earth and Language Patterns During the Last 120,000 Years"	Sverd1_S.pdf
Tengbe, Bonopha, "System Dynamics Modeling in Resource Management: A Sustainable Development Approach to Resource Extraction in Sierra Leone"	Tengb1_S.pdf
Turbow, David, "A Dynamic Simulation Model of Beach Sand Replenishment: A Case Study of Santa Barbara"	Turbo1_S.zip
Vail, Edmond, "Causal Architecture: Aligning Enterprise Strategy and Operational Dynamics with the Enabling Information Technology"	Vail1_S.html
Weaver, Elise, "Threshold Setting and The Cycling of a Decision Threshold"	Weave1_S.vmf
White, Anthony, "Control Strategies for Inventory Management"	White1_S.zip
Wilson, Martha, "Operational Improvements in the Supply Chain: Who Benefits? Who Loses?"	Wilso1_S.zip
Ziomek, Agnieszka, "The Performance of the Relationship Between Domestic Product and Unemployment"	Ziome1_S.pdf

Welcome

Dear Conference Participants:

Welcome to the 20th International Conference of the System Dynamics Society!

For many, many centuries, Sicily has been the meeting place of civilizations and empires. Its rich history is characterized by trade, exchange of information, and invasion upon invasions – not all as friendly as the one by the System Dynamics Society!

The multifaceted history of Sicily should be a source of inspiration to all participants taking part in this conference on complex, social systems.

As you can see from the presentation titles listed in our program, the field of system dynamics is thriving. Your fellow attendees come from over 30 countries and many different institutional settings. We hope that you will enjoy the program, make new acquaintances, and renew ties with old friends.

Over the next three and one-half days you will have a chance to sample system dynamics work by leading practitioners in a variety of application areas. Well over 300 scheduled presentations are broken down into parallel and convened sessions, poster sessions, workshops, and plenary and special sessions. We have grouped the presentations by topic to help you identify sessions of greatest interest.

To increase your enjoyment of the conference, we have scheduled several special events including a wine tasting welcome reception, a conference banquet with live music, and tours of the historic Palazzo Steri, where the University of Palermo has its headquarters. We 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, feel at home in the conference center facilities, and enjoy the attractions of Palermo, a grand and remarkable place to match culture with relaxation.

This year over 220 reviewers screened and commented on submissions – this is more than double the number from last year. Dozens more volunteers put in many hours to ensure a successful conference. Without their commitment our conference would be impossible. A special thanks goes to all who helped.

We hope you find the conference rewarding and the facilities accommodating, and ask that you bring to our attention anything that may help us to both ensure the success of this conference and gain experience to better approach future conferences.

Thank you for joining us.

Best wishes from the Conference Organizing Committee

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Our strong focus on best practice is illustrated by the development of a methodology for the verification and validation of System Dynamics based models. This includes validation with mental models, ensuring that the problem has been well understood with a suitable boundary; verification of the simulation model to be certain that the influence diagram has been correctly translated into a quantitative simulation model; and finally, tests designed to validate the simulation model, comparing the model's behaviour with that of the real world.

Defence Focus

Our focus on the defence sector means that we bring unparalleled knowledge of the market place and the issues that face our clients to all our assignments. As part of our professional development programme, our consultants receive training in these issues from retired senior civil servants to ensure that we continue to provide solutions focused on our clients' precise needs.

Research and Development

The company has an extensive internal research and development programme and maintains links with the leading universities in its core competencies. This ensures that we maintain awareness of and access to the latest thinking in those fields.

How We Work

As one of the UK's leading providers of System Dynamics consultancy, our reputation for professionalism is second to none.

We work with our clients to deliver solutions precisely tailored to their needs. HVR believes very strongly in the need to transfer its technology to clients, many of whom now have the capability to undertake entire projects on their own.

Our process of model verification and validation ensures that our clients receive recommendations and conclusions that they can have total confidence in.

HVR's team of consultants is also proficient in a wide variety of other methodologies so we know when, and when not to apply System Dynamics.

Model Integration

In the course of our work, we have developed a number of tools for integrating System Dynamics models with other applications.

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Career Opportunities

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Comune di Palermo

PALERMO, the capital of Sicily, is located on a gulf at the foot of Mt. Pellegrino. Inhabited even in prehistoric times, it was known as "Panormus" (all port) due to its wide bay that offers strategically excellent mooring for ships.

The city was founded around 800-700 BC, in the centre of the fertile, verdant Conca d'Oro, flanked by two rivers, the Papireto and the Kemonia.

The site of great revolutions as it fell under the domination of different cultures, including Punic, Roman, Byzantine, Saracen, Norman, Angevin, Spanish, Austrian and Bourbon, Palermo' s history and art contains abundant traces of the heritage left by foreign peoples.

A Byzantine possession until the 9th century, under Arab-Norman domination (9th-12th centuries), Palermo was transformed into a splendid city and the regional seat. In 1130 it became the capital of the realm and the commercial link between Europe and Asia. Following the Angevin period, it once again flourished under the Aragonese (13th-15th centuries), and then fell under a long Spanish domination from the 15th to 16th centuries. Austrian from 1720 to 1735, then Bourbon in the 18th-19th centuries, Palermo was finally liberated by Garibaldi during the historic Expedition of the Thousand.

As testimony to the passage of these civilisations, whose influence has marked the culture and life of its approximately 700,000 inhabitants, Palermo offers its artistic and historic legacy to citizens and tourists from all over the world.

Located in northwest Sicily, Palermo includes all the beauty of the Mediterranean Sea: its climate, nature, coasts and water. Sicily's fortunate geographic location at the crossroads of three continents, Europe, Africa and Asia, and the passage of different people, civilisations and traditions, make Palermo a cultural and tourist centre of attraction in the heart of the Mediterranean.

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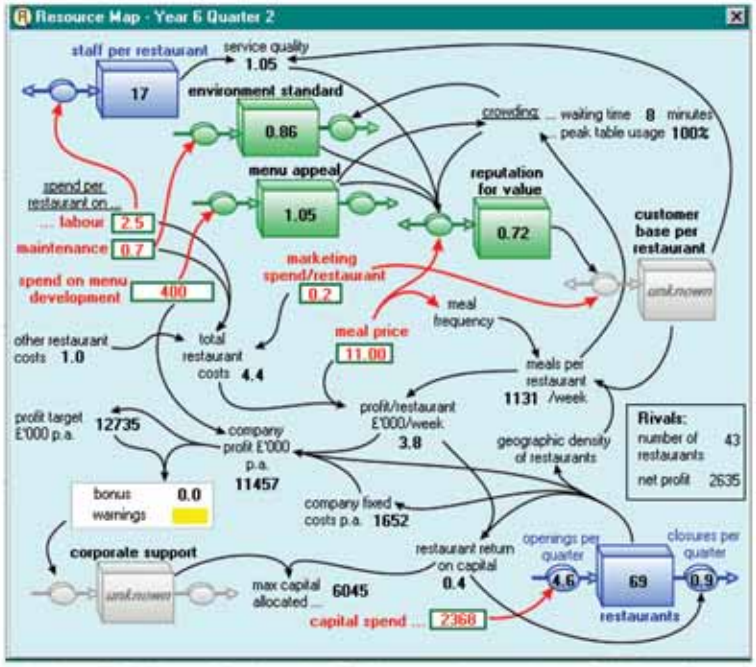

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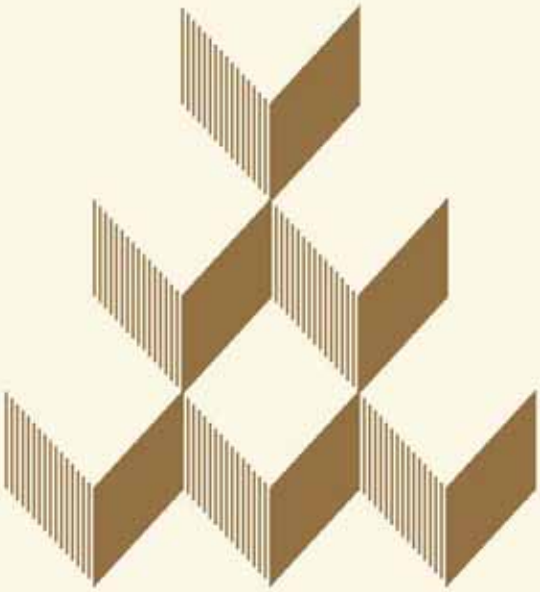

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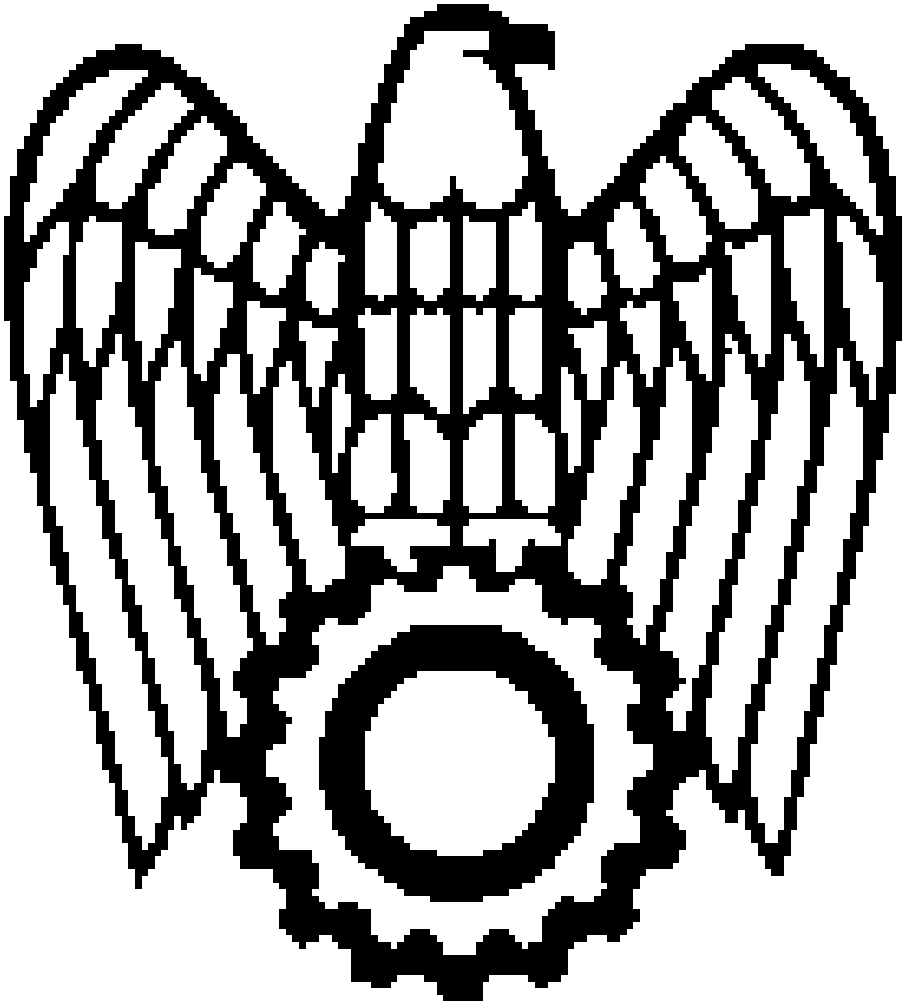

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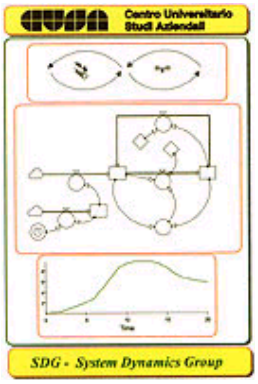

Research goals, which mainly concern the small business and public services fields, are pursued through a mutual relationship with firms, (entrepreneurs' education, seminars, workshops, etc.), an intensive collaboration with other international leading research institutions, international seminars on system dynamics applied to business growth management issues, and synergetic networking with professionals.

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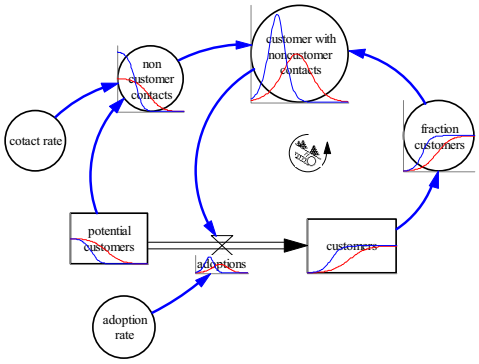

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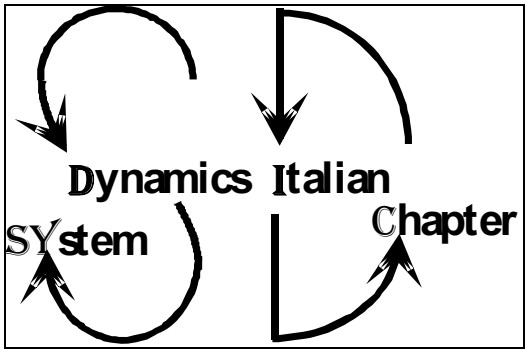

The chapter objectives are: to promote the development of the System Dynamics (S.D.) and the interchange of learning and research in related fields, to establish formal and operative links with other European S.D. communities (i.e. through common EU research projects), to promote and develop educational programs through S.D. methodology, and to create events and opportunities (seminars, meetings, work groups) so to exchange knowledge and experiences in S.D. between both components of the group and external world

Membership in the Chapter is open to all Italians (also living abroad) and people living or working in Italy who have interest in System Dynamics and activities of the Chapter.

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CALIFORNIA MANAGEMENT REVIEW

The California Management Review is pleased to provide the following articles for the System Dynamics Society Conference Proceedings. They originally appeared in a special issue of CMR on System Dynamics in the Summer of 2001.

"System Dynamics Modeling:
Tools for Learning in a Complex World"
John D. Sterman

"Tradeoffs in Responses to Work Pressure in the Service Industry"
Rogelio Oliva

"Past the Tipping Point:
The Persistence of Firefighting in Product Development"
Nelson P. Repenning, Paulo Gonçalves, and Laura J. Black

"Nobody Ever Gets Credit for Fixing Problems that Never Happened:
Creating and Sustaining Process Improvement"
Nelson P. Repenning and John D. Sterman

Copies of this special issue as well as reprints of the individual articles are available for purchase from *CMR*. Subscriptions are also available.

Our web site is: www.haas.berkeley.edu/cmr/

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We are also pleased to announce that Nelson P. Repenning and John D. Sterman have been selected as this year's winners of the California Management Review's annual Accenture Award for their article, "Nobody Ever Gets Credit for Fixing Problems that Never Happened."

THE *SYSTEM DYNAMICS CAREER LINK*

What is it? The *SD Career Lin*k, in its third year of operation, is hosted by the System Dynamics Society at the University at Albany. It includes on-line information and links to organizations seeking candidates specifically with system dynamics and systems thinking backgrounds. We hope that the *SD Career Link* will provide a valuable exchange of information about positions and people in the field of system dynamics. Please visit the *SD Career Link* bulletin board at the conference.

How to participate? Please refer to the System Dynamics Society website at www.systemdynamics.org/ or send an email message to the Society office at <system.dynamics@albany.edu>. All information about access to and use of the site will remain confidential. We look forward to your participation.

What's New? Career Link to Be Expanded and More Frequently Updated. The *SD Career Lin*k is about to undergo some changes. First, the Career Link section will be more regularly updated. Job postings and resumes will be monitored to assure that they remain current. Jim Lyneis of WPI has volunteered to manage this portion of the website. And second, the format of the Career Links section will be reorganized to include three subsections: career information; job postings; and resumes. In the career information section, employers will be able to provide general descriptive information about how system dynamics fits into the organization, typical jobs, career paths, and other aspects of employment with the company. This subsection will allow employers to provide information about system dynamics opportunities within their firms, to supplement the more general information contained on their corporate or academic websites. The subsection on job postings will allow employers to advertise specific and active openings. The listings will be organized into Academic/Research and Consulting/Industry sections. Finally, a subsection where those seeking employment may post their resumes will be provided. Information to populate the revised Career Links section will be solicited from Society sponsors over the next few months. Anyone with ideas, suggestions, job openings, or resumes please contact Jim at jmlyneis@wpi.edu.

Announcing the
Twenty-first International Conference of the System Dynamics Society
New York City July 20–24, 2003

Hosted by: Worcester Polytechnic Institute, Worcester, Massachusetts USA

The 21st International Conference of the System Dynamics Society will be held at the Roosevelt Hotel in New York City. The conference will bring together participants and practitioners interested in system dynamics and systems thinking. Presentations by practitioners and world leaders in the field will cover a wide variety of topics, including theory, methods, tools, techniques, pedagogy, case studies, and applications. Application areas will include business, economics, organizational change, public policy, engineering, K-12 education, and the social and natural sciences.

New York is the most exciting city in the world and the Roosevelt Hotel is in the heart of midtown Manhattan. The conference venue is within walking distance of Broadway, Central Park, Grand Central Station, Fifth Avenue shopping, the Metropolitan Museum of Art, the Empire State Building, Rockefeller Center, St. Patrick's Cathedral, the United Nations Building, and other well-know attractions. We have negotiated a special room rate at the Roosevelt to keep the cost of attending the conference affordable.

Key Dates:

January 2, 2003	Opening date for presentation submissions and workshop proposals.
February 14, 2003	Submission deadline for early decision.
March 20, 2003	Notification of acceptance for early submissions.
March 28, 2003	Final submission deadline.
May 9, 2003	Final notification of acceptance.
May 16, 2003	Deadline for materials to be included in the electronic proceedings. Presenter registration deadline.
June 20, 2003	Early conference registration deadline.
July 2, 2003	Hotel room reservation deadline.
July 20, 2003	Conference Opening New York City!

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The program will include plenary presentations on topics of interest to all. Parallel sessions will be organized by theme and will feature the full range of work being done in the field. Poster sessions will provide an opportunity for participants to engage authors directly on subjects of particular interest. In addition, there will be workshops, tutorials, panel discussions, special interest group sessions, student colloquia, vendor displays, and demonstrations. The conference schedule will provide time for relaxed social and professional interaction.

For updated details, please visit **http://www.systemdynamics.org** and click on the 2003 Conference.

Papers

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System Dynamics Model for Computer Virus Prevalence

A standard SIR epidemic model is used as the backbone of this study, capitalizing on the dual nature of the biological virus, and computer virus prevalence. The basic SIR model has been extended to account for the important concept of a "kill signal" which is generated as an infected machine is virus-cleared. The "kill signal" spreads through a "word of mouth contact rate" (WMCR) informing physically connected machines, or machines that have exchanged software with the infected one about the virus. As a policy design it is suggested that the kill signal level, represented by a WMCR, will be dynamically increasing as the infectious population level increases. This has been proven theoretically using the simulation model to push down the epidemic level significantly, thus suggesting a very cost effective organizational policy to control the computer virus spreading. On the prevention level policy, controlling infectivity as well as the contact rate will help decrease the infection rate of PC's.

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Impact of Marketing Mix on Exports of Egyptian Textiles Using a System Dynamics Approach

This paper is in quest of building a system dynamics model for the Egyptian textile industry which can be used for testing ideas to enhance the status of this industry, prepare it for expected local and international environmental changes, and boost exports. This paper concluded the high importance of investment in raw cotton development to increase exports of raw cotton and finished textile. It showed that early investment to increase fine raw cotton production is more effective in increasing exports than investment in textile manufacturing development, which would be more important after raw cotton production increase. It showed also that investment in distribution and promotion helps against competition with results better than quality and research and development for the Egyptian textile-manufacturing sector. Also, investment in quality of finished textiles should be sustainable at high levels to give a real positive effect on exports.

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A Comparative Study Among Policy and Decision Makers Through Their Mental Models

Cognitive map analysis has been widely used to understand the structure of decision-makers thought. It has been introduced as a proper tool to map the mental model of a decision-maker. Facilitators as agents who intervene and facilitate change in the mental models can use it to map the mental model of managers and assist them to change it or evaluate its changes over time. This paper introduces a framework of intervention, which has been implemented in three companies in order to change individuals' mental models toward shared mental models. Cognitive maps are used to measure the impact of intervention in different stages. Cognitive maps of three decision-makers, in three companies, have been used as a tool to measure the changes in the thought processes of decision-makers and to measure the rate of sharing among them after each intervention. Analysis and evaluation of the rate of sharing and the contents leads to some guidelines for more effective intervention.

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Traffic Deadlock Caused by Two Intersections

In this work, we discovered an important feedback structure in the traffic flow, which generates a threshold value that causes deadlock in the traffic flow. There is a two-way main artery, which is fed by two intersecting roads in reverse directions. When the traffic flow is congested, one of the main arteries may become full. Then the cars coming from the intersecting road that feeds this artery stop in the junction. By doing so, these cars cause the other main artery, which is in the reverse direction, to be blocked. Therefore the tail of the jam in this artery becomes longer and the cars entering the artery stop in the outflow junction of the first artery. Since the other road is also blocked, the outflow of this road becomes blocked and none can move anywhere. This work is evidence for the argument that individual movements – movements which do not care about the system structure – lead to system crash.

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Developing a Balanced Scorecard with System Dynamics

The Balanced Scorecard (BSC) is a popular concept for performance measurement, because it focuses attention of management on just a few measures and bridges different functional areas (both financial and non-financial measures are included in the BSC). But, the BSC has also received some criticism. In this paper five limitations of the use of the BSC are

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discussed: BSCs focus on unidirectional causality, are unable to distinguish delays between actions and their impact on performance, have a dearth of validation capabilities, integrate insufficiently strategy with operational measures and suffer from internal biases. We propose a system dynamics approach to develop a BSC in order to overcome these limitations. We present a case study from the insurance sector where this approach is applied. The results suggest that developing a BSC with system dynamics is a promising approach to supplement existing BSC frameworks.

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Reengineering the Furniture Industry in Egypt to Help Improve its Export Capability: A System Dynamics View

The furniture industry around the world is undergoing a period of rapid globalization. With the rapid globalization of the furniture industry and the competitive pressures of imports, a nation has to find a way to stay competitive. The furniture industry in Egypt experienced a lot of weaknesses and constraints that limited industry growth and hence its exports. Most important are the quality, delivery delays and others that are rooted fundamentally into the current structure of the industry. The objective of the paper is to propose group of policies that might help reengineer the Egyptian furniture industry. As outcomes of the research, the authors have suggested two group of policies based on the scale of the furniture manufacturer using a time framework approach. A system dynamic methodology has been used to conceptualize the dynamics of the furniture industry in Egypt, and hence propose macro solutions to the observed problems by the researchers.

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Optimal Neural Feedback Control for Carbon Tax Policy Gauging in Transportation

The effects of carbon emissions have been the objective of an investigation that was based on the model of the nation-wide transportation system with railway, waterway, and roadway. The dynamics of such a complex phenomenon depends on a set of control variables (i.e., the percentage of carbon tax on the fuel cost, the operational cost coverages, and growth rates of the various transportation modes) that can be chosen in a suitable way so as to minimize a given cost function (e.g., carbon emissions, public and private costs, fuel consumption, etc.). This problem has been addressed by searching for a feedback control law that can be approximated by means of the combination of both Dynamic Programming and neural networks. Preliminary simulation results with the afore-mentioned model are presented to demonstrate the effectiveness of the proposed method.

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Model Transparency in Educational System Dynamics

Model transparency is increasingly identified as a positive or even necessary characteristic of system-dynamics-based learning environments, where model transparency is usually identified as providing modified causal-loop diagrams, equations, or verbal descriptions of a model. The theses of this presentation are: (1) Model transparency may be beneficial for some educational goals and conditions, but model opacity may be beneficial for others. (2) Model transparency is a continuum (from transparent to opaque) and is multidimensional (for different aspects of a model, such as its variables, stock-flow combinations, and cause-effect relationships). (3) There are many methods of providing information about a model, and these too will depend on the goals and other characteristics of a learning environment. Rather than seeking to prove that model transparency is valuable, system dynamics researchers should be elaborating on how goals and other conditions determine optimal levels and methods of transparency.

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Administrative Policies and MIR Vacancies: Impact on the Spanish Health System

This work shows the impact over the Spanish health system of two policies that have been used, and still are used, in the allocation of MIR vacancies. These policies are the allocation of MIR vacancies according to the number of graduates and, the allocation MIR vacancies according to the historical "bag" of graduates without specialty. This comparison is based on the

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evolution of the historical "bag" of graduates without specialty. It is observed that this last policy benefits more to the community than the previous one. Both policies harm the evolution of the specialized doctors' "bag," although the allocations according to the historical "bag" harm it even more. By means of the simulation the interrelation is observed that exists among both "bags" (the improvement of one of them implies harm to the other one). The adoption of these proposals spreads to improve the situation of the medical community in the short term but it harms it in the long term.

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Dynamic Analysis of Some Proposals for the Management of the Number of Physicians in Spain

In this work the impact of some proposals formulated by several groups involved on the Spanish health system is analyzed. The purpose of these proposals is to solve the current imbalance problem among supply and demand of physicians. In this study, the impact over the Spanish health system of every proposed measure is shown; as well as its comparison with the evolution of the system according to the allocation policies that are currently used. According to the obtained results it is concluded that the proposal that offers better results in the long term is the one carried out by the Spanish Society of Primary Care Medicine. Nevertheless, none of them is appropriate to eliminate or to reduce the outlined problem, although they can improve certain collectives or groups in certain moments.

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Elaboration of a Model for the Management of the Number of Specialized Doctors in the Spanish Health System

The purpose of this study is to analyze the existence of an important imbalance between supply and demand of specialized doctors in the Spanish health system. The specific sequence followed in the supply of MIR vacancies, along the eighties and nineties, has generated this problem. The way of allocation of MIR vacancies, along the time, has created many problems. This fact has led the Spanish health system toward a situation of uncertainty and growing inefficiency. This work's objective is the elaboration of a model whose purpose is to identify the causes or origins of those imbalances, so that alternative policies are proposed and to learn of the system behavior rather than the realization of future forecasts. In this way, the factors that seem to interact generating the observed symptoms are identified. Lastly, the main feedback loops are shown and the causal diagram of departure is elaborated.

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Autoregressive Models and System Dynamics: A Case Study for the Labor Market in Spain

Autoregressive (AR) models explain, partially at least, the values of a variable or set of variables, based on the past values of this variable or set of variables. It has been found that this kind of simple model, with a small number of variables and parameters, can seriously compete, in terms of its prediction capabilities, with the large macroeconomic models with hundreds of variables and parameters developed during the fifties and sixties. This paper tries to show how system dynamics models may easily incorporate fundamental elements of AR models. As an illustration, we present a case study from the labor market in Spain. We explain the fundamentals of the problem and the formulation of the corresponding AR model. Finally, we develop the model within the framework of system dynamics. We believe this work is a good example of how system dynamics and econometric models can be considered as complementary analysis tools to deal effectively with complex problems.

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Coordination Between Monetary Policy and Fiscal Policy by Means of a Model of Dynamic Simulation

The end of all economic models is to elevate the level of life. Each government tries to find appropriate measures to improve the national economy, without being able to succeed because they refuse to understand that the whole economy is a system with subsystems that interact the one with the other. The current government is promulgating laws after a superficial debate in the congress of the republic or by means of ordinances of urgency. Such laws are experiments that use the country like a laboratory. In the investigation presented, fiscal politics and monetary politics are analyzed by means of a model of dynamic simulation. Effects are caused in multiple social variables and in the economic growth of the country. It is demonstrated that the decisions adopted by the current administration don't favor a real economic growth of the country

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The War on Terrorism: Conditions for Success and Failure

Though terrorism has been a problem for decades, now it has developed both in size and sophistication to a terrifying extent. The 11th of September attacks on various targets in the U.S.A. are living evidence of this. These radical developments raise

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serious questions about the effectiveness of the counterterrorism scenarios used until the 11th of September. This simulation-based study inspects the effectiveness of the American reaction to the 11th of September events. The model simulates the war from its beginning till the elapse of two months, a period in which major military operations took place. The model shows the behavior of the Americans during the war as well as various behaviors including those of the terrorists, western media coverage and the Arab and Islamic world. Analysis of the model reveals the reasons why the war has failed in achieving some of its major goals and suggests a more effective strategy.

System Dynamics Model for Forecasting Demand of Each Automobile Type in the Korean Automobile Market

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A system dynamics model is formulated to forecast the automobile demand in Korea. Until the present, managers have used rule-of-thumb methods based on salespersons' experience and past sales performances. However, as the Korean auto market has changed from a supply leading market into a demand leading market, managers need more logical tools. There have been also arguments that a pure statistical model is too robust and there is no room to incorporate the rich experiences of salespersons nor managers. The newly developed system dynamics model is an experiment to combine the statistical method and the system dynamics method. The model classifies automobiles into 11 types, and the demand is forecasted based upon the top-down approach spiced up with the bottom-up approach. The main structure of the model includes stocks and rates, a regression model, and many calibration models. Vensim DSS is used for the system dynamics model and the calibrations, and Stata is used for the regression model.

A System Dynamics Model to Analyze Investments in Power Generation in Colombia

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The Colombian electricity sector was restructured in 1994. Under the new legal framework, investment decisions for building new capacity need to incorporate elements of risk and uncertainty. In these circumstances it is advantageous for agents to learn about market risks for assessing the implications of their decisions. Microworlds or simulators, such as the one presented in this paper, intend to help investors for better understanding uncertainty and its implications over their decision-making processes. The authors developed a microworld, supported on a system dynamics model, in which it is possible for the decision maker to assess his/her investments in capacity under simulated

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conditions. The developed microworld for the Colombian electricity market is described in some detail and applications are presented.

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Quick and Rigorous, Strategic and Participative: 12 Ways to Improve on the Expected Tradeoffs

Lyneis (1980, 1999) describes a phased approach to modeling that has proven successful for large strategy consulting engagements. This process usually requires months of modeling effort and multiple iterations to achieve the level of detail required for specific answers. Strategic analyses are episodic, however, and managers expect faster turnarounds and more specific, trusted results than is possible without a detailed, calibrated model already in place. We present here a refinement to the phased approach, which might be called lean strategy modeling, that is able to deliver substantial value in just six weeks. It increases the scope of testing and validation on what would otherwise qualify as an insight model. The process is divided in three stages: Issues definition and prioritization; model development and analysis; model-based analysis and strategy exploration. The approach is illustrated with an example about a client's degree of control over new technology diffusion in an emerging market.

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A Scoping and Consensus Building Model for Understanding the Dynamics of a Blue-Green Algae Bloom

So-called nuisance blooms of Lyngbya majuscula have been occurring with increasing frequency in tropical coastal waters around the world. Outbreaks of this cyanobacterium (blue-green algae) threaten water quality, coastal ecosystems, and can be harmful in instances of human contact. While scientific and popular theories abound regarding lyngbya bloom initiation and growth, a clear research agenda has not emerged. In keeping with the modelling approach suggested by Costanza and Ruth (1997), this paper offers a scoping and consensus building model for the development of research directions. Development of this initial model is reported here as are simulation results that are instrumental in setting priorities for empirical investigations and future simulation-based research. It is expected that this preliminary model, after additional empirical work is completed, will lead to research and management models that will help set policy for community response to Lyngbya blooms.

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Making System Dynamics Accessible to SME's Through User-Parameterised Generic Models

System dynamics is a powerful strategic analysis approach, but it can also be a costly one, if all models must be constructed largely from scratch. This appears to preclude their widespread use in small-medium enterprise (SME) applications. Field research has shown that generic parameterisable simulations can challenge mental models and enhance confidence as a firm faces major change. We discuss whether such simulators could be the only viable option for SME's to benefit from system dynamics modelling and scenario planning.

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Integrating System Dynamics into a Course on Sustainability: A Model-Based Reasoning Approach

The Science of Engineering is an undergraduate course for non-science majors. The course combines environmental concepts with information technology concepts in a format designed for non-technical majors. This responds to a growing trend to integrate information technology principles and concepts into the broader higher education curriculum. Many institutions require not only basic computer literacy, but also that students have demonstrated competency with information technology in specific disciplinary contexts. In order for this type of course to be more than an academic exercise, however, students must find the curriculum to be relevant and applicable to their everyday experience. Toward this end, an undergraduate course was redesigned to provide opportunities for non-science majors to conceptualize global issues and environmental concepts in terms that can be comprehended on a more personal, experiential level. System dynamics modeling has been instrumental in the approach to redesign.

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System Dynamics Applied to Epidemics

This paper presents an approach to infectious disease analysis through system dynamics methodology, following the early works of Ritchie-Dunham. The case study concerns the Bovine Leukosis Virus (BLV), that exclusively strikes cattle. The infected animals, exposed to secondary infections, become less productive bringing about an economic loss. In order to avoid the spread of the infection among dairy farms an eradication national plan is operative in Italy since 1996, but points of infection are still being recorded. Hence deeper analyses are required to understand the causes of the endemic behavior of BLV. Analytical models of epidemic spread have been implemented

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since the first decades of the XXth century, but, their practical use is often difficult. System dynamics models allow epidemiologists to do a set of what-if analyses, with the purpose of assessing the system's behavior under various conditions, and afterwards, to compare and evaluate the results of alternative sanitary policies.

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The Dynamics of Law and Normative Structures

The methodology of system dynamics was applied to better understand why a large infrastructure projects in Sweden caused severe environmental and health damages. Environmental laws failed to prevent that detrimental actions were taken. In fact, they were neglected by the governmental agency in charge of the project. By specifically studying the dynamics of feedback systems during project implementation we found crucial aspects triggering a range of decisions that eventually led to the scandal. Several problems caused a prolonged delay that became costly for the company responsible. This together with political will and cultural aspects influenced the direction of the decisions taken. We conclude that the decisions taken can better be explained as placed in the intersection between rationality and normativity. We suggest that an analysis of the normative structure can be useful to better understand the underlying reason for action and strategies - legal or not - may therefore be developed to prevent similar events.

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Training to Improve Decision Making: System Dynamics Applied to Higher-Level Military Operations

This paper is concerned with how to improve the training of higher-level military officers, given that the conditions for learning in "conventional" exercises (with a high degree of realism and complexity) are suboptimal. From other applications (e.g., business and public management) we know that a key feature of effective decision training is high exercise frequency. Another requirement is for the decision-maker to see the full range of consequences resulting from his/her decisions. Both aspects require time compression in the training environment. We suggest applying the same principles when training military commanders, in a newly created concept termed Minimalist Decision Training (MDT). MDT is characterized by simplifying the commander's operating environment, radically compressing time and space. In MDT, a typical two-day exercise can cover several repetitions of a thirty-day conflict and at the same time provide continuous feedback about the unfolding of the conflict, consequential to decisions made.

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Modeling the Management of Clam (Ruditapes decussatus) Exploitation in the Plentzia Estuary (Basque Country, Northern Spain)

Some of the estuaries of the Basque Country (Northern Spain) have been areas of exploitation of clam populations, by both professional and illegal fishermen. The Department of Fisheries of the Basque Government needs to understand the situation relating to these populations; and provide a tool to establish adequate management for the exploitation of clams. In order to simulate different alternatives for the exploitation, based upon scientific data on the population, a system dynamics model was employed. This study improves previous experiences in modelling clam exploitation in the Plentzia and Mundaka estuaries. This analysis was undertaken in order to establish the effect of modifying the number of fishermen, the aperture-close season of captures, the minimum sustainable biomass, the exploitation area and the minimum legal length for shellfishing in millimetres. This approach tries to establish the sustainable exploitation of the clam populations in the Basque Country.

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Group Model Building at a Chemical Company: System Dynamics for Knowledge Elicitation and Scenario Training

The paper presents the outcomes of a group model building project at a Norwegian chemical company that produces calcium carbide. The project led to the creation of a system dynamics model describing the production process and of a computer-based interactive learning environment, a microworld, meant to reproduce most of the features of the operating and controlling software actually used in the company. The process of organizational learning, the gaining of a better common understanding about the production process and the development of the different mental models of the plant operators are some of the main goals of the project. Moreover, the method followed during the project can be considered as "general" and could be used in a variety of production processes, mainly in most of the manufacturing industrial firms, both for modeling production processes and for teaching and training the operators that manage those systems.

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Evaluating the Use of System Dynamics Models in Software Project Management

This paper presents an empirical study aiming to evaluate the application of system dynamics models in software project management. In this study, a project concerning the specification

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and implementation of part of an academic control system for a graduate department was proposed for several participants. Each participant was asked to act as the project manager. Participants should make decisions in order to finish the project in the smallest time possible. A software project emulator was developed, where participants analyzed the project status and enacted their decisions. Half of the eighteen participants managed the project based only on their personal knowledge and experience, while the second half were allowed to use system dynamics models to support their decisions. The results from the experimental study analysis show that, for the selected participants, managers using system dynamics models to support their decision perform better than managers who base their decisions only upon personal experience.

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Enhancing Metamodels with Scenarios: Plug-and-Simulate Extensions for Model Developers

In a previous work, we presented the concept of metamodels, an extension to system dynamics that allows the development and specialization of domain models. A domain model provides a high-level representation for the elements that compose a knowledge area. Specific models developed for the domain are based on these elements, inheriting their behavior from the domain model. Traditional system dynamics constructors (stocks, rates, and processes) describe the behavior of domain elements. Domain models are believed to simplify model development within a knowledge area. In this paper, we present scenario models, which act as "plug-&-simulate" extensions to domain models. A scenario model allows a developer to change the behavior of domain elements without direct and error-prone intervention in the domain model equations. While analyzing a model, a developer can select relevant scenarios and activate them upon the model components. We present the system dynamics metamodel, the structure of scenario models, and their integration with specific models.

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The New Era in Managing Supply Chains: Lessons from Industrial Dynamics

Developments in technology have led to a revolution in how we can conceive and manage supply chains. Despite the success of companies like Dell, and the availability of an extensive literature and of consulting services etc, the performance of many supply chains has not improved. System dynamics in its earlier guise as Industrial Dynamics has much to offer in understanding this apparent dilemma. Evidence suggests the lessons of the Beer Game are as relevant today as they were 40 or 50 years ago! This

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paper outlines recent developments in supply chain thinking and demonstrates the important contribution that system dynamics can make to resolve a number of current supply chain debates.

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Post-Hospital Intermediate Care: Examining Assumptions and Systemic Consequences of a Health Policy Prescription

The provision of health and social care for an increasing elderly population is a challenge facing many societies. The financial and social problems associated with long-term institutional care and the use of beds in acute hospitals by patients who are medically stable and do not necessarily require expensive hospital care have gained particular attention. UK policy makers advocate the establishment of intermediate care services as a partial solution to both of these problems. In this presentation system dynamics is used to examine the logic behind these policies and bring into focus the crucial role of (frequently overlooked) assumptions about costs and outcomes of intermediate care for their systemic consequences. This work shows how valuable and practically relevant insights can be gained from an analysis of the sensitivity of the behaviour of a relatively simple model to changes in underlying assumptions, even if the quality of the available data is poor.

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Advocating Ackoff's Interactive Planning Concepts and Principles for Software Project Management

This poster extends the use of Ackoff's interactive planning concepts and principles to the domain of software project management. His criticisms of traditional operational research are highlighted and applied to current algorithmic cost models and preparation methods used for software estimation. A review of selected models is provided. These are evaluated through examining their estimation performance and explanatory capability. A limited survey of independent empirical research on the estimation performance of specific models is presented. Next, an archetypal cost model is matched against the top ten software risks in order to examine its explanatory capability. The survey and comparative study together indicate that over the last two decades there has been no significant improvement in software cost estimation. We conclude by showing how Ackoff's reconceptualisation of operational research and its supporting principles could guide future directions in software project management, with reference to the general approach to developing and applying algorithmic cost models and key meta-characteristics underpinning them.

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Studying a Multi-Dimensional Problem Using System Dynamics: The Case of Sustainability in the Semi-Arid Argane Forest in Morocco

This paper studies the dynamics of the Argane forest system in the region of Taroudant, Morocco. The study attempts to define the main causes of the unsustainability of the system and to identify possible measures susceptible of achieving ecological, economic, and social sustainability in the Argane forest. Scenarios of the future development of the forest system are simulated under different conditions of rainfall. Based on conclusions from these scenarios, ideas for a more sustainable future are suggested and scenarios run to evaluate them. The study concludes that it is possible to achieve a sustainable future for the Argane forest system under three main conditions. First, dependence on irrigated agriculture has to be reduced. Second, the regeneration of the forest must be insured. Finally, population growth needs to be limited in order to avoid dependence on migration as an external outlet of the system.

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A Modular Dynamic Simulation Model of Infrastructure Interdependencies

Electric power supply in California depends on the successful interaction of a large number of processes, such as generator operation, power transmission and distribution, power marketing, and delivery of fuel to power generators. In the winter of 2000-2001, trends in power supply and demand, along with plausible load projections for a warm summer, were considered likely to cause widespread shortages in electric power supply in California. We developed a set of interconnected dynamic simulation models to evaluate the potential costs of power outages, and the effectiveness of increased natural gas storage in improving power supply conditions. Although observed natural gas prices do not show periodic spikes, the physical constraints that lead to price spikes in the model are a real feature of the infrastructures in California. These features have the potential to confer market power on the operators of gas storage facilities. As overall demand for gas increases, gas import and production capacities, rather than storage volumes, become limiting factors.

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Discerning the Inertial Effects of Current Decisions on Long-Term Performance in Family Firms: The Rise and Fall of Casa Florio

Investigating the rise and fall of a business is commonly viewed as a matter of searching single causes to be linked with corresponding effects. Such an atomistic and static picture of the

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driving forces of business success and decline often produces a superficial understanding of observed phenomena. This might be the case of Casa Florio, a family company successfully started in the beginning of the 800's. Within the space of two generations, it became a giant embracing different unrelated industries. Business success gradually gave rise to a strong image of Casa Florio in the Mediterranean area, which exponentially boosted entrepreneurial and political contacts and the Florios' quality of life. However, by the end of the 800's, in spite of the Florios' rising financial and social performance, both the firm and the family collapsed. This paper adopts a feedback approach focused on the analysis of dynamic relationships between Casa Florio's values and its local and extended environment's culture.

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Application of System Dynamics in Value Based Management: An Approach Based on a Real-Life Case

Value Based Management is a common management technique to support organisations to get in a good shape to meet competition in the current turbulent economic era. The complete concept of Value Based Management has a very broad scope and is designed to support an organisation in aligning the business strategy, business processes and decisions in order to create maximum value for its stakeholders. In order to get an understanding of the way the business is organized, to identify the most sensitive value drivers and to determine their impact on the creation of value, it is essential to qualitatively or quantitatively model the organization. In this article we describe the application of system dynamics in the Value Based Management context in order to support strategy development, based on experiences of PwC Consulting in The Netherlands. We identify the areas where system dynamics adds value to Value Based Management and describe a number of steps we take in client engagements.

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Engineer or Oracle?: SD/ST Viewed from the System-Thinking-Activity Approach

This paper distinguishes between system dynamics (SD) and systems thinking (ST). In order to discuss their similarities/differences and reciprocal functions, a meta-position is necessary. It is suggested that such a position exists in another-culture paradigm, i.e. in the System-Thinking-Activity (STA) approach, elaborated by the Moscow Methodological Circle (MMC). STA schemes are used to describe the sense of ST, as it is understood in SD. Using the STA approach, the problem solver is more an engineer than the SD analyst who could be described as an oracle. Indicating a number of basic

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methodological difficulties in the modern development of ST, the paper proposes a Thinking-Activity Theory as an ontological foundation for SD/ST. The Activity-Organisational Games (AOG) method is considered as a way of analysing problem situations and of problem solving. It is suggested that the assimilation of STA experience by SD/ST could have many other significant consequences.

The Time Machine: Game and Forecast, Play to Forecast

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The aim of this article is to present various tools useful to "play" with the concept of forecast for educational purpose, for discussion enactment and for decision-making processes. This "tool box" can reveal to be precious in various contexts, from game, plain and simple, to formation activities and real case-studies.

MaGA: Collective 'Knowledge Maps'

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MaGA (MAppe Globali di Apprendimento – "Global Maps of Learning") is a Web-based software designed for a collective construction of "knowledge maps." The founding working hypothesis of the software is the idea that it is possible to represent a collective "knowledge" on a particular topic through a network of concepts, each containing definitions and references of various types. The grounding idea is that at the basis of the definition of every single lemma there is not a "substitutive semiotics" where a concept corresponds to a term to be defined; rather, the former is just a limit area of a single term, beyond which we find the activity of a multitude of users that has contributed to the construction of that particular local knowledge. References to other terms and to external objects (bibliographies, web-biographies, etc.) constitute hence a Thesaurus that one can navigate through: it allows us to leave a single concept and to start a "hyper-textual" navigation within a "library."

Advancing the Frontiers of System Dynamics Through Higher Orders of Paradox

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In systems dynamics, certain archetypes, such as fixes that fail and shifting the burden, contain a combination of balancing and reinforcing loops that exacerbates the original cause. Such a paradox represents a shift from a mechanistic paradigm inherent in a balancing loop to a more holistic paradigm. However, there is a second order paradox that is generally neglected in the analysis of systems dynamics. It is characterized by mutual

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causality of elements, as observed in new science, chaos theory and mystical traditions. Furthermore, there is a third order paradox that belongs to the spiritual domain. As we advance from the first to the third order paradox, the causal relationships between the opposites become subtler, until the duality disappears. This paper presents a method of unveiling creative solutions—ranging from the material to the spiritual—of puzzles in complex living systems through the exploration of first, second and third order paradoxes.

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Collaborative Modeling in Group Learning Environments

In this paper we present an interactive tool for modeling and simulation as a basis for learning with models and learning by modeling. This tool, called Cool Modes, is capable of integrating several modeling languages in one workspace. There are language plug-ins, e.g., for system dynamics, Petri Nets, and argumentation graphs. Furthermore, features like handwritten notes or mathematical graphs are integrated. Collaboration and group learning is facilitated in the form of synchronous work with shared and private workspaces in a distributed computing environment.

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Qualitative Knowledge Acquisition Using Fuzzy Logic and System Dynamics

Research results are exposed on policy representation based on fuzzy logic and system dynamics. It is pretended to find a method for representing qualitative knowledge on dynamics of complex systems. Qualitative knowledge is considered the softest part in human organizations and the hardest part to manage. The set of fuzzy policies represented in the model pretends to carry out a hotel business administration. This research sustains an effort to integrate some of the benefits that fuzzy logic has brought to the area of control systems by representing qualitative knowledge of human operators to the discipline of system dynamics by representing policies of decision-makers. The set of policies and the hotel models have been implemented using the "ithink" software. Results show the useful of the method in the learning process of managers when the attention is explicitly paid on the rules that transforms information into action.

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The Dynamics of Venture Capital Companies

The existence of a strong venture capital industry is crucial for the development of new, innovative companies and for maintaining a high level of flexibility and innovation of an

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economic system. The study of the development of the venture capital industry and of venture capital companies has shown that there are: 1. some key factors crucial for the start-up and development of venture capital companies; 2. some positive loops pushing their development; 3. some loops limting their growth. After presenting a strategic analysis of the venture capital industry and of venture capital companies, the paper utilizes a "resource based" approach identifying: 1. the critical "stocks" (resources) on which a venture capital company can base its development; 2. the critical loops feeding these stocks of resources; 3. the typical loops limiting the development of the company. The paper can be useful for top managers of v.c. companies and to senior managers of companies of any industry.

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Entrepreneurial Personal Drive Becoming a Limit to the Company Potential: An Organizational Dynamics Perspective from a UK Technology Start-up Case

A British technology start-up was failing to achieve sales targets and suffering high attrition rates compared to a market physiological rate. During a consulting assignment, the organisational dynamics in a UK technology start-up were observed. Issues affecting growth and commercial viability of the company were found originating from an over-entrepreneurial attitude in the founders that ignited some dangerous dynamics within the organisation. Missing alignment of leadership and entrepreneurial personalities within stakeholders' interests resulted in a situation in which even positive market potential was failing to deliver. The organisational dynamics resulted in causal loops that were reinforcing, with different delay times, in a negative manner and impeding growth and business development activities. By changing the leadership style with the introduction of a new management, it has been possible to alter the situation by enabling positive personnel expectations, attitudes and behaviours.

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Banking Back Office Processing Behavior: Considerations on a Process Activity Managed by Capacity Saturation Policies

This speech proposal describes an example taken from a work-in-progress in which systems dynamics is used to reproduce and simulate some back office activities within a financial organization. The model does not support an initial hypothesis on its own but is meant for the estimation of potential financial losses originating from process behaviour dependent from volumes of items in processing as part of a wider Operational Risk Management exercise. By sampling and reproducing a key

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process activity, it has been possible to observe how a processing behaviour, optimised on capacity saturation by a traditional BPR approach, presents inefficiencies that are not otherwise intuitively evident. The value of this application is in the modelling of personnel behaviour at changing work pressure and its dynamics and it present some observation regarding the personnel allocated to the activity and the overtime policy.

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Shareowner Value Creation and the Management of Intangible Assets

More than 50% of the Enterprise Value for the most important North American companies is tied to their Future Growth ValueTM. Statistical data is provided that shows the extent and importance of this capital market reality. Importantly, the size and sustainability of the Future Growth ValueTM component of Enterprise Value is mainly tied to the management of intangibles. Managing for value in a knowledge-based economy therefore requires new insights into managing all strategic assets, including all intangible strategic assets. This paper describes a new approach to building "total" shareholder value driver models based on system dynamic modeling principles. In so doing the implications for comprehensive strategic asset recognition, strategic asset valuation and management information system requirements are explored. A case study, based on Sun Microsystems, is presented that illustrates the comparative benefits of employing system dynamics as a tool for gaining the strategic insights necessary for "managing for value".

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A Matrix Architecture for Development of System Dynamics Models

A matrix architecture for development of system dynamics models is described. The approach concentrates on the formulation of the Forrester stock and flow diagram, and incorporates the concept of an interaction matrix to assist in the formulation of such models. The interaction matrix is formally derived. Set and graph-theoretic concepts are utilized in the derivation. The rules (primitives) of system dynamics are expressed in the form of definitions and axioms. From these primitives, theorems are proven. The theorems describe whether interaction between certain pairs of quantity types is possible and what type of interaction can exist between the pairs. The theorems are used to rationalize the interaction matrix. The paper is accompanied by a companion article by the same authors that employs the interaction matrix in a component development strategy. The methodology is applied to example problems in the companion paper.

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A Component Strategy for the Formulation of System Dynamics Models

A component strategy to the development of system dynamics models is described. The approach concentrates on the formulation of the Forrester stock and flow diagram, and incorporates the concept of an interaction matrix to assist in the formulation of such models. The strategy facilitates the determination of the quantities to be included as well as the existence of connectors between the quantities and the identities of the quantities and connectors. The paper is accompanied by a companion article in this proceedings by the same authors that formally derives the interaction matrix. The advantages of a component-based approach to model development include 1) reuse of the components, 2) diminished dependence upon the competence of the model-builder for the creation of quality models, 3) greater opportunity for managers/policy makers to build their own models from components rather than from scratch, and 4) a development strategy that can be partially automated.

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Building a Sustainable, In-House System Dynamics Capability: How an Internal System Dynamics Group Can Develop a Distinctive Service and Become an Enduring Component of the Company's Operations

As consultants we have worked with clients over many years to develop their in-house system dynamics capabilities. Clearly, there are advantages for our clients to continue the work with internal resources that we have often started. Despite strong agreement by both consultants and clients on the benefits of developing an in-house capability, these efforts generally last for only a few years. In only a small number of cases have they become self-sustained. Through review of our successes and failures we can draw some conclusions on what is necessary to create a sustainable in-house capability. The four key forces that we have found influencing the long-term sustainability of an in-house capability are: A) creating, maintaining and "advertising" the internal center of excellence; B) using specific value-added analyses in the regular business planning cycle or as part of standard business processes; C) developing and maintaining an executive sponsor; and D) using external consultants to jump-start the process and periodically refresh the in-house capability.

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Evaluating the Performance Efficacy of Systems Thinking Tools

There are numerous systems thinking tools that have been introduced in the system dynamics literature, yet little is known about their efficacy in promoting performance improvements. A study was done involved fifty undergraduate business students to determine whether training in the use of systems thinking tools caused any observable performance improvement in the use of two different microworlds. The results of this exploratory research suggest that users of systems thinking tools proceed up a steep learning curve that causes a worse before better pattern of behavior. As user levels of mastery rise and the frequency of use of a given tool increases, the probability of experiencing performance improvements also increases.

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The Dynamics of Shifting Involvement: Formalizing and Testing the Oscillation between Private and Public Interests

In 'Shifting Involvements: Private Interest and Public Action', Hirshman outlines a theory of disappointment. In periods of strong consumption growth, people have high hopes for the new consumer durables they are suddenly able to afford, only to find these expectations rarely justified. The key variables the theory concentrates on is the understanding of formalisation of expectations and how these expectations generate disappointment. This 'disappointment dynamic' is the driving force shifting the interest of societies towards private affairs, and subsequent public interest. We show in this paper how Hirschman theory can be formalised in explicit feedback terms. Furthermore we focus on representing the two levels of analysis that Hirschman uses in his theory development. The first levels represents the formulation of individual expectations, followed by the collective consequences of the gap that exists between expected and realised satisfaction. Using this model we explore different possible behavioural patterns discussed by Hirschman.

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Yet Another Representation for System Dynamics Models and Its Advantages

The present paper relates to an artificial neural network (ANN) representation for a system dynamics model (SDM) and its advantages. The similarities between SDMs and ANNs have been noted, i.e., both of which store knowledge mainly in the structure of a model, rather than in other components. By a specially designed mapping scheme, it is shown that a given flow diagram (FD) can be mapped to a corresponding model in the

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representation of partial recurrent networks (PRNs) that will correctly behave like the one it mimics. Because a PRN can be trained with exemplar data, numeric propagation constraints can be identified by extracting rules from a set of multivariate time series of data by induction. In short, the neural representation for SDMs provides a new dimension of studying SD, and some traditionally hard problems in a FD might now be solved easier in the new representation.

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Interreg EU Programme: A New Assessment Approach

The objective of the project is to evaluate the methodological approach of system dynamics applied to the issues of European Union's programme Interreg III "Alcotra" (Latin Alps Cross-border Co-operation between Italy and France). The work focuses on the implementation of a model designed according to the principles of system dynamics applied to the assessment of Interreg. The specific objective of Interreg is to ensure that no national border will be an obstacle to balanced development and to the integration of the whole European area. It aims to promote cross-border co-operation between authorities in adjacent areas with the purpose of creating cross-border socio-economic centres through the implementation of joined regional policies for sustainable development. The aim is to employ this model as a Decision Support System proper, which can be usefully employed for ex ante analysis and subsequent outcome and impact assessment of the Interreg programme.

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A Dynamic Simulation Model of the Effects of Interdependent Infrastructures on Emergency Service Response

Models of telecommunications and emergency services were added to an existing infrastructure interdependencies model. The interdependency model tracks the flow of materials between infrastructures and other services. Telecommunications was represented in the model using bandwidth as a commodity that is supplied and consumed. The resulting model was used to evaluate alternative service restoration sequences for catastrophic disruptions caused by the an earthquake, and to evaluate whether or not service restoration priorities and sequences will significantly alter the potential death toll, the extent of physical damage, or utility service restoration times. The results of the analysis can also be used to identify data needs and model enhancements for improving model utility and portability.

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A System Dynamics Analysis of the Westray Mine Disaster

This paper describes a system dynamics analysis of the Westray mine disaster. The paper examines the causal structure of the Westray system, including relationships that could have led to conditions that caused the fatal explosion at the mine. The value of simulation is its ability to capture a "mental model" of the safety system, which can stimulate discussion among safety experts as to the systemic causes of a disaster. By taking into account feedback loops and non-linear relationships, which is not possible with conventional root cause analysis, a dynamic model of the system provides insights into the complex web of causes that can lead to disaster and valuable lessons for organizational learning.

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A Possible Method for Assessing the Relative Values of Alternative System Dynamics Models

Recent years have seen a debate within the system dynamics community about whether diagrammatic models can provide useful insights into problems involving feedback or whether one must always build a simulation model. Since building and testing a simulation requires much more effort than drawing a diagram the question arises of the measurement of the value added by that extra work or the value lost by forgoing it. However, there may be an analytical project also involves issues such as cost, replication of detail and so forth and different models might satisfy those requirements to a greater or lesser degree. The paper therefore uses another management science methodology, the Analytic Hierarchy Process, to propose a method of calculating an index of the relative value for money of competing system dynamics models. This may be a completely novel approach to some aspects of system dynamics practice.

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Evolution of a Dynamic Theory of Collaboration: Modeling Intergovernmental Use of Information Technology

Researchers from the Center for Technology in Government (CTG) collaborated with New York's Bureau of Housing Services (BHS) to develop an information repository—Homeless Information Management System (HIMS). This paper describes the evolution of an ongoing research project related to HIMS that focuses, using Group Model Building, on collaboration dynamics in interorganizational settings. Modelers and researchers at the University at Albany constructed formal models to explore the dynamics observed in HIMS. Four system dynamics models have

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been created that have acted as boundary objects to push forward theorizing about collaboration. The theory has evolved from centering on project dynamics, to the interaction dynamics of HIMS team members, to the dynamics generated by facilitation mechanisms. The evolution of this theory can inform group-model-building practice by presenting the possibility of changing the output (models built) to improve the theory (phenomena explanation) as an organized, and perhaps desirable, way of conducting the process.

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Addressing Intractable Conflict: The Potential of System Dynamics Training as an Intervention Tool: Case Study Rwanda

This paper explores how system analysis can aid in understanding intractable conflicts and the emerging patterns of genocide or violent civil war and will focus on how this understanding can better equip actors to ameliorate tensions without exacerbating or deepening the underlying conflicts. People often cope in the intractable conflict system through their denial of the systemic nature of it – for instance not seeing one's own role in perpetuating the conflict. As such introducing systems thinking faces particular challenges because it has to overcome these resistances, which are themselves part of the social psychological dynamics of conflict. It is important to see these resistances as loops within the system that reinforce each other. The paper will explore what some of these resistances are and how they are amplified/adapted in a situation of intractable conflict such as Rwanda. The paper considers the particular needs of the intractable conflict situation and how to adapt systems and conflict resolution methodology.

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SCACCO: An Expert System for Financial Accounting Teaching

From the Luca Paciolo Abaco era to modern ERP, accounting teaching methods are not really changed at all. In fact, students have to learn a group of accounting rules which are not always organized in systematic way. The aim of the paper is to show the main technical characteristics and the impact on students' performances of an expert system, programmed by the author in Visual Lansa, for formalizing and supporting the financial accounting learning process. The expert system "Scacco®" simulates, step by step, the systematic logic process every student has to follow in order to solve: 1) bookkeeping and accounting system problems; 2) annual report (balance sheets and income statement) "building" problems. From the system dynamics point of view, Scacco is a systematic model which, on one hand, represents firm operations and, on the other hand, is based on a "try and correct" feed-back mechanism.

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Aspects of the Dynamics of Cooperation in a Supply Chain Under Consideration of Trust

In this context cooperations are very important in all its forms between market solutions and hierarchy. Due to the fact that cooperations are not static but highly dynamic the relationships concerning the decisions of the management of cooperations should be well understood. So there is a need for a theoretically dynamic based analysis of co-operations. Trust can be seen as the crucial item for the constitution as well as the development of the cooperation over time, which is a dynamic and extremely complex phenomenon. The various links between the dynamic of cooperations and trust within a supply chain as a whole makes optimal decisions concerning the management of co-operations

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difficult as an aspect of supply chain management. The object of this paper is to discuss the different possibilities for transactions and co-ordinations for a company and to analyze cooperations itself as a dynamic construct.

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The Dynamics of Internet Aided Collaborative Work: The Case of Curriculum and Instruction Material Development in the Field of System Dynamics

Computer networks and in particular the Internet are used to transform work and provide new ways to collaborate. A new phenomenon with respect to Internet aided collaborative work is the emergence of large groups of people collaborating on a voluntary or semi-voluntary basis, in order to develop and improve a wide range of "information artifacts." This paper introduces the findings of a study being conducted to examine one such use of the Internet - to support asynchronous voluntary collaborative work in curriculum and instructional material development. Specifically, the study addresses how the use of Internet technologies might improve or impede collaborative and distributed work through a set of reinforcing and limiting dynamics underlying the voluntary collaborative work phenomenon. Curriculum and instruction material development in the field of system dynamics is chosen as the specific case area.

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Long Term Consequences of Genetically Modified Crops in Agriculture

There is evidence in published reports and scientific literature that GM crops can contaminate natural crops of the same family in the field or even weeds that are their distant relatives. We are considering the problem from an evolutionary point of view. Will GM crops exhibit a controllable dynamics, will they be dominated by or will they dominate the ecosystem? Will GM crops lead to new species? How will these new species affect agriculture? These are the types of questions that we try to answer in this paper. The scenario that we model is a situation where a "gene jump" occurs from some experimental genetically modified plot into a natural crop field. By a series of simulation experiments, we investigate the possible long term consequences of this gene jump. Our results indicate that in most situations, either GC crop or GC weed would dominate the field in the long term, which is an alarming result, justifying further research.

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An Application of System Dynamics Modeling to the Question of a Log Export Ban for Indonesia, with Comments on Illegal Logging

System dynamics modeling allows us to examine various scenarios within a complex system. We not only learn about the response of the system to test inputs which could never be tested in the real world, but we also learn to question our assumptions about the system itself. This paper presents a preliminary system dynamics investigation into the potential effects of a log export ban on the Indonesian forest sector. As a preliminary model its primary purpose is to help us visualize potential effects of a log export ban rather than to predict actual outcomes. The model provides relatively simplistic overviews of the wood processing sector, demand – price feedback loops, forest standing stock and log availability, capacity of the harvest sector, as well as export demand, price and log exports. In spite of its apparent simplicity the model examines important feedbacks that must be understood if the effects of a log ban are to be properly examined.

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A System Dynamics Approach for Technology Improvement Policy Analysis: The Case of Turkey

Technology has been one of the most important factors of the economic and social growth and globally scaled competitiveness, although not respected as a separate factor by traditional economists until recently. It is now widely accepted that technology improvement plays a very major role on national growth. Technology has a number of interactive and conflicting variables and parameters, which are not allowing an analysis with quantitative tools only. Complex dynamic analysis seems to be a proper tool to handle this sophistication. A system dynamics model constructed for policy analysis in Turkey with respect to technology improvement and comparison of various technology improvement policies. Under the scope of this paper; the elements effecting technology improvement are identified and analyzed by qualitative/quantitative methods, the key relations among these elements are identified, the influence model and the system model are drawn and some scenario analysis are performed for the comparison of possible technology improvement policies.

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Value-Creation Opportunities from Market Discontinuities in the Pharmaceutical Industry: Avoiding Value Destruction from Patent Expiry in a Branded Therapy Market

Patent expiries within a therapy class pose an especially complicated challenge for branded pharmaceuticals. This requires the remaining branded players to justify their price premium to maintain physicians' usage as the generic drug becomes available, or to reconsider their premium pricing position by evaluating the value-creation of alternative strategies. This paper outlines an approach for dealing constructively with this challenge based on the coordinated application of market intelligence and business strategy simulation modelling for the development of robust value-retaining strategies. Insights developed from recent client work suggest it is a reliable methodology for evaluating patent expiry challenges in the pharmaceutical industry, enabling significant value-creation. The discussion furthermore suggests key benefits may be achieved from applying strategy dynamics and system dynamics based approaches, to derive strategic direction in market discontinuities.

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System Dynamics of Utah Welfare Reform

System dynamics techniques were applied to an analysis of Utah welfare reform using STELLA system dynamics software developed by High Performance Systems. The dynamic problem posed by Utah welfare reform was discussed with a comprehensive group of stakeholders. A clear problem statement, a reference behavior, and an agreed-upon set of policy options resulted in the identification of the important associated problem variables, which were then translated into the language of stocks and flows. Finally, critical cause-and-effect

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relationships, again identified with stakeholder assistance, were represented by interconnections and additional analytical detail in the computer model. This paper will address the steps in the model-construction and learning processes as they have been developed and applied to date. Procedures employed to structure modeler-stakeholder interaction will be detailed. Preliminary results of the model, focusing on the sensitivity of the model to various policy scenarios, will also be discussed.

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Evolutionary Method for Design of Dynamic Global World-Class Business for the World Market Society

The concept of dynamic global world-class manufacturing (WCM) has become the single most motivating theory in many major industries, and reliability management is one of the basic dynamic WCM strategies for the world market. WCM techniques are a competitive strategy involving continuous improvement of products, processes and services to improve quality, reduce costs, increase productivity and increase total customer satisfaction. Competitive manufacturing technique will be a major management focus and trend in the 21st century. Global WCM techniques are applied within the framework of all activities concerned with manufacturing and therefore place emphasis of the dynamic nature of this system which concerns itself with immediate goals and long term objectives. The main objective of the paper is to propose a conceptual framework for dynamic global WCM and present tools which are used. The paper uses a case study to illustrate its findings based on a company experiencing both rapid growth and increasing international competition for achieving the world market.

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Organizational Change from a New Perspective: Pattern Feedback Control in Human Systems

The "dynamics of organizational change" may refer to either the dynamic (time dependent) nature of the way structural changes are made in a system's feedback control structure and/or to the nature of and the difficulties associated with the transitional time patterns. Unfortunately, the system dynamics philosophy and methodology have not been sufficiently developed in several important areas that are necessary for consistent success in achieving improved future real time patterns in real organizations. Also, the nature of the organizational change process, whether done by system dynamics analysts or managers, as a qualitatively and quantitatively different kind of feedback control from the Newtonian/Leibnizian calculus type of feedback control used in system dynamics analysis and programmed into

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system dynamics simulation programs, has not been recognized. This paper describes some of the gaps in the system dynamics philosophy/methodology and the nature of the new kind of feedback control, herein called Pattern Feedback Control (PFC).

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The ASTRA-Italia Model for Strategic Assessment of Transport Policies and Investments

The paper presents the ASTRA-Italia model, a tool to analyse the long-term effect of transport policies and investments. In the ASTRA-Italia system dynamics strategic transport model, mobility prediction is the result of a complex interaction process among four different components: transport, economy, land-use and environment. The tool is then capable to illustrate the reciprocal influences among transport and ecological and socio-economic systems. The model simulation period covers thirty years (2000-2030) and a reference scenario was constructed with a projection of past and current trends of key variables. Policy packages can be then tested and compared with such reference case. To explore sustainable paths, the model produces a great variety of quantified indicators including variations in: transport performance (pass*km and tonnes*km), modal shift, vehicle fleet development, traffic emissions, fuel consumption GDP, tax revenues. Monetary values are also estimated for external costs.

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Creating Content-Specific Lessons Incorporating System Dynamics Models

Lessons designed to incorporate system dynamics models provide students another means to explore, absorb, and retain core content in various subjects (specifically mathematics, social science, biology, and physics) taught at the secondary level of instruction. The type of lesson used depends upon various factors, and should be expected to produce testable results consistent with the purpose of the lesson. At this point lessons seem to group into four categories.

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Regional Economies and Innovative Performance as the Source of Competitiveness and Agglomeration: A System Dynamics Representation

This article makes use of the system dynamics to argue that a number of theories about the performance of territories, developed in the past 20 years, are more complementary than alternative; to demonstrate this, a model of local economy coherent with these schools is designed and simulated. According to these theories, the ability to produce and use

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knowledge is at the centre of regional competitiveness in the advanced world; the model shows the elements of the local economic system and how they have to work coherently towards the continuous process of innovation needed to be successful. The model also shows that, due to the cumulative nature of this innovation process, it is possible to obtain equilibria with agglomeration, even in the presence of apparently very similar territories. When this is the case, structural policies, aimed at allowing lagging regions to better innovate and imitate external knowledge, are appropriate.

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Data Quality Control and Improvement of Indirect Human Calorimeter by System Dynamics Approach

Using a system dynamics approach, a simulation model for data quality control and improvement of human calorimeter using the indirect calorimetry (IHC: indirect human calorimeter) was constructed. Accurate measurements of human energy expenditure are necessary in estimating appropriate energy requirement. IHC can measure continuously energy expenditure over 24 hours. O2 and CO2 analyzers and flow meter included in the IHC are required to detect accurately the small changes of gas concentration and ventilation rate. Data quality control of each device is important for accurate measurement of energy expenditure. Characteristics of the developed simulation model are that 1) the measurement errors of each device are given separately and artificially, and 2) dynamic change of energy expenditure including those errors can be simulated. The simulation model was applied to examine these characteristics evaluating quantitatively the propagation of each device's error at the IHC in the National Institute of Health and Nutrition, Japan.

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A Dynamic Theory of Service Management: Implications for Managing Service Improvements Avoiding the 'Service Jungle'

Despite the demonstrated benefits of industrial services in driving competitive advantage, most companies found it extremely difficult to manage the transition from product manufacturer to service provider successfully. In this context, we observed different phenomena. One phenomenon we term the "service jungle." The service jungle describes the phenomenon that service programs have often led to declining business because of increasing costs, which could not be recovered with corresponding returns. That leads overall to decreasing margins and weakens company's competitive positions. Despite of the high popularity of services and numerous service programs, just a few companies have gone into what we call the "service garden." For the last four years, we have worked with a variety of firms to understand the processes that lead to the "service jungle." This paper discusses the phenomenon on the basis of a dynamic theory of service management and describes guidelines to overcome it.

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Microworlds for Supporting Change Processes and Making Organizational Decisions: A Case Study with System Dynamics in the University Accreditation Process

This paper presents the research processes about making a methodological guidelines for the microworlds application as supporting technological tools in the change and making desicions process in a high education organization. This research is guided by systems thinking, with the Peter Senge organizational learning, and system dynamics, with the Jay Forrester models for organizational management. As methodological level, it is purposed the methodological guidelines for the construction and the University microworld use. And as application level, it is built a microworld that represents the University organizational change dynamics, showing a system dynamics model with the relevant items for the University accreditation, the change tendencies generated by the virtual laboratory about possible strategies for improvement accreditation conditions and the mental models that cohabit in the University about its management.

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System Dynamics in Research Processes About Sustainable Human Development of the Colombian Agricultural Sector

The present paper intends to make up a development proposal compressive approach of the horticultural sector. It integrate sdifferent research efforts and technological interventions by CORPOICA, in the frame of a long-time program which promotes the sustainability of this sector. The approach is built on system dynamics, attempting a synthesis with the sustainable human development conception and inquiring the system dynamics models' use in agricultural planning and the organizational learning role in the social web built. In the frame of sustainability, alimentary security becomes more important as a research subject, technological intervention and social strategy. In the context of our country, it is support in the agriculture, beginning with a local alimentary security proposal and actually as rural space rebuilt alternative, employment generation space and competitive strategy. In this context, social capital is seen as an strategy for organizational learning, in other words, communitarian learning.

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Managing Dynamics in the Global Oil and Gas Industry: Past Applications and Emerging Trends

The global oil and gas industry has a long history of system dynamics applications in three main areas: 1) market dynamics, the interactive movements of capacity, supply, demand, and prices; 2) business dynamics, the performance-driving interactions of corporations and their business units with suppliers, customers, competitors and other stakeholder groups; and 3) project dynamics, the interactions driving cost and schedule performance on the complex projects that develop new reserves and production/distribution capacity. System dynamics is in a unique position to contribute to more systematic management that will drive faster and more consistent growth of shareholder value. The future will see a blending of market, business and project dynamics, reflected in models that integrate the commoditized marketplace and asset portfolio management. These models will be the analysis engines for management systems that are fully integrated into the strategy-forming, planning and decision-making processes of the major oil and gas companies.

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Play with the Ants to Understand CASOS

The dynamics complex, adaptive, self-organizing systems (CASOS) produce often contradict the second law of thermodynamics. This paradox persists unless coupled to a system's macro level, where self-organizing agents act, is a micro level, where random processes increase entropy, i.e. uncertainty. The system's micro level permits overall system entropy to increase while sequestering its increase at the macro level, where autopoiesis, self-organization, occurs. Parunak & Brueckner (2001) built an ant pheromone-driven CASOS simulation and measured Shannon's entropy at the macro and micro levels, showing an entropy-based view of autopoiesis. This essay presents a system dynamics model that replicates parts of their results and examines self-organization causally, as opposed to measuring coincidental macro- and micro-level entropy. Despite its present inability to tag undifferentiated agents' individual attributes, the system dynamics method and software can help agent-system researchers understand how CASOS' circular or feedback-loop relations produce nonlinear dynamics spontaneously out of their local interactions.

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ISDC Presentations that Captivate Mind and Soul

Held alternately in North America and Europe, with occasional appearances in Asia and the Pacific Rim, our annual International System Dynamics Conference (ISDC) introduces newcomers to the field, keeps practitioners aware of current developments and presents unique networking opportunities. We even use the worldwide web to disseminate conference information and papers. Are you presenting at our next ISDC? Will your talk captivate the mind and soul of our diverse audience? Will it appeal to the intrinsic motives of both newcomers and our field's experts? Talking about what you do is exciting, fun and good publicity. Imagine your success once you focus on the action loop at the heart of great presentations: purpose, plan, prepare, present and probe. Its purpose is to help us all become great speakers. Although initial results are not always dramatic, great talks bring recognition, eventual business and add to public relations. Remember: to captivate your audience, you must capture it first.

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Computing Legal Damages in High-Profile Patent Infringement

When estimating patent damages, the fundamental task is to construct a “but-for” model that simulates, as closely as possible,

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the marketplace absent infringement. Calculation of damages is premised upon four principles: 1) A patent's value derives largely from the market power it confers to the patent owner; 2) When the price of a good increases, consumption of the good declines, and vice versa; 3) Only costs caused by extra sales should be charged against extra sales revenues; 4) Both the market power flowing from the patent and the relative bargaining power of the negotiators influence the outcome of royalty negotiations. This essay's system dynamics model simulates the BuSpar® market, absent infringement. The modeling process accounts for: the market power that the BuSpar® patent confers to Bristol-Myers Squibb Co.; the demand and price relation in the BuSpar® market; the cost of regaining lost sales using incremental costing; and the difference between royalty and lost profit damages.

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Mitsubishi Rayon's Penetration Strategy, Balance and Profitability

System dynamics modeling for learning helps Mitsubishi Rayon compete by creating new knowledge about the system structure lurking behind its strategic situation. Creating new knowledge often requires capturing unknown and unknowable aspects of system structure that may be neither easy to observe nor easy to measure. The system dynamics model this essay presents reveals a lot about this Japanese giant conglomerate's strategy design and implementation tactics. The model shows a tiny fragment of Mitsubishi Rayon's gigantic effort to re-perceive itself. The firm wants to see its Keiretsu infrastructure transform into an agile virtual enterprise network (VEN) of active agents that collaborate to achieve their transnational business goals. By becoming a VEN, Mitsubishi Rayon is poised to bring the necessary people and production processes together to form autopoietic, i.e. self-organizing, customer-centric value chains in the specialty chemicals industry.

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Extrapolating Expectations: An Explanation for Excess Volatility and Overreaction

In this paper, we try to explain excess market volatility by means of momentum. Price setting mechanisms are introduced based on demand/supply balance as well as based on mechanical trading strategies of investors. Two types of investors are introduced: fundamental investors who believe that the marketed assets have some intrinsic value and make their trades based on the relative value of the current price relative to that intrinsic value; and momentum traders, who extrapolate past stock performance into the future and act accordingly by buying when the stock price rises and by selling when the price falls. An additional feature of the proposed model is that it can actually explain post earnings

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announcement drift. The presence of momentum traders pushes the stock price further up (down) in the presence of good (bad) news, hence leading to the actual realization of their extrapolated expectations.

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Acceptable Risk and Mitigation Options: Dynamic Structure of Building Safety

This paper reports the results of a study designed to understand and facilitate disaster mitigation in communities characterized by low frequency/high magnitude earthquakes. A system dynamics model describes the distribution of building safety over time and the dynamic structure governing the decision-making that created the current distribution of building safety in a small town located near the New Madrid Fault Zone and therefore at significant earthquake risk. Data from this town is used to establish a 20-year baseline. Simulations are run over a 40-year period to examine the consequences of different building policies and the effects of a magnitude 7.0-earthquake in the year 2002.

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Financial Fragility, Heterogenous Agents' Interaction, and Aggregate Dynamics

This paper analyzes the emergence of economic fluctuations using a dynamic model where the economy is populated by heterogeneous interacting agents. We stress the fact that in such a setting it is possible to observe a lack of proportionality between causes and effects of business fluctuations. Our main point is that the strength of the propagation mechanism changes in time and grat consequences of small shocks are possible when propagation is strong. The main cause for this is a change in the average financial condition of firms. High financial fragility implies a worsening of credit conditions and a high probability of default for the firm. The main focus of the paper is twofold: 1) modeling the bank behavior in order to derive endogenously the credit market equilibrium and 2) stressing the importance of entry and exit processes of firms on the market to understand the business cycle.

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When Do Minor Shortages Inflate to Great Bubbles?

When demand exceeds supply, retailers hedge against shortages by placing multiple orders with multiple suppliers. This artificial growth in orders can severely affect suppliers, creating excess capacity, excess inventory, low capacity utilization, financial and reputation losses. This paper contributes to the understanding of order amplification caused by shortages, by providing a comprehensive causal map of the supplier-retailer relationships and a formal mathematical model of a subset of relationships. It provides closed form solutions to the dynamics of supplier backlogs when supplier capacity is fixed and simulation analysis when it is flexible. Parameter sensitivity provides a deeper understanding of long-term impacts and suggests emphasis for solution policies. For instance, the ability to quickly build capacity can effectively reduce the bubble size. Finally, the time it takes retailers to perceive supplier's delivery delay is an important leverage in controlling retailers' inflationary ordering. In particular, longer retailers' perception delays contribute to system stability.

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Modeling Erosion of Security and Safety Awareness

We develop a simple generic model for the erosion of safety or security standards based on the behavioral regulation theory of instrumental conditioning and on risk misperception. We show that the model is able to render expected reference behavior. To counteract the erosion of safety and security we propose policies in accordance with the behavioral regulation theory of instrumental conditioning mediated by risk perception, viz. educational programs to improve risk perception and 'social proof'. For details about the simulation model, cf. the parallel paper. There we model the erosion of safe sex practices for

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people at risk of contracting HIV infection through frequent change of sex partners in a high-risk group. The parallel paper contains also a section on issues on safety and security.

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Modeling the Erosion of Safe Sex Practices

As a starting hypothesis, we argue that the erosion of safe sex practices for people having frequent change of sexual partner might be explained in terms of two mechanisms: instrumental conditioning through "reward" (greater sexual pleasure) following unprotected sex and misperception of the risk to become infected by HIV due to low infectivity of HIV and long delays (long latency and incubation period). A causal-loop diagram is developed and discussed. However, the formulation of a stock-and-flow model requires a detailed discussion of the modern theory of instrumental conditioning (the behavioral regulation approach). Surprisingly, the behavioral regulation approach suggests as actual mechanism responsible for erosion of safe sex practices the return to the "behavioral bliss point" (zero condom use) due to a gradually declining perception of risk. Such misperception of risk impacts on the instrumental contingency (acceptance of safe sex). We propose counteracting policies in accordance with the behavioral regulation theory of instrumental conditioning mediated by risk perception.

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How Robust Are Conclusions from a Complex Calibrated Model, Really?: A Project Management Model Benchmark Using Fit-Constrained Monte Carlo Analysis

System dynamics-based simulation models are useful for analyzing complex systems characterized by large parameter spaces and pervasive nonlinearity. Unfortunately, these characteristics also make confidence intervals for model outcomes difficult to assess. Standard Monte Carlo testing with a priori realistic parameter variations produces simulated behavior that is a posteriori improbable, rendering simple Monte Carlo approaches inappropriate for establishing confidence intervals. This paper gives a case study of a model used to forecast completion of design and construction of a large defense program, and proposes a more correct Monte Carlo process, fit-constrained Monte Carlo analysis. A confidence interval for outcome is computed, using Monte Carlo trials and discarding combinations that do not achieve an acceptable fit of simulated behavior to historical data. The experiment confirmed the intuitive view that a well-formulated closed loop model calibrated against sparse but widespread data and an appropriate statistical fit criterion can create tight confidence intervals on some model outcomes.

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On Positioning System Dynamics as an Applied Science of Strategy Or: SD Is Scientific. We Haven't Said So Explicitly, and We Should

The field of System Dynamics (SD) and strategy practitioners share a common aspiration: to understand and control the success and failure of companies through appropriately rigorous methods. SD practitioners know that it has all the elements of proper scientific method, but gen-erally do not teach or explain the method with that framework and vocabulary. Outside the field, SD is generally perceived as lacking rigor. Positioning System Dynamics as an applied science of strategy would mitigate several of the difficulties that SD practitioners face, and create bene-fits both personal and societal. This repositioning could be accomplished through 1) teaching and publishing in the explicit language of iterative hypothesis testing and explicit choice of testing criteria, 2) teaching iteration and testing as the fundamental method, with knowledge of formula-tion and dynamics as refinements, rather than vice-versa, and 3) explicitly claiming a scientific approach to strategy as an area of personal or organizational competence.

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Policies Influencing the Diffusion of Instant Messaging

Many information and communication products show characteristics that are called network effects or positive demand externalities, i.e. their utility for users depends on how many other people also use the product. The paper investigates the diffusion of such products. Instant messaging is taken as an example. Strategic options of the players in the instant messaging market are presented and analyzed on the basis of a system dynamics model.

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Policy Optimization in Dynamic Models with Genetic Algorithms

Dynamic models are often built in order to evaluate the influence of policies on a complex system. Results can help organizations or politicians take appropriate decisions. In the model, those decisions are represented by a set of parameters, referred to as “policy parameters”. With the help of an objective function, it is possible to determine whether chosen values of the policy parameters influence the model’s outcome favorably or unfavorably. Finding optimal values for policy parameters is very difficult, if several policies are combined and the best set of values needs to be found. I have developed a tool that transforms Stella models to C++-code and with the help of a genetic

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algorithm finds a set of values for policy parameters for which a given objective function reaches a global optimum. The results allow to gain very thorough knowledge of the problem treated in the model.

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Dynamics of the Information Society

A new economy and new lifestyles emerge which are based on richness in information and extensive use of computer networks, in particular the Internet. This development offers new opportunities for regional wealth, for ecological sustainability and it brings new jobs. A dynamic systems model was built to allow a thorough analysis of this situation and its development. This model allows to test policies on how to use these opportunities to decrease risks and to avoid conflicts. The model is a result of several large research projects which included consulting and collaboration with regional planning. The model is now applied on a wider scale to develop and help in implementation of innovation policies.

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Economic Effects of Decentralization of Government with People Empowerment: An International Comparison of Four Asian and European Rural Localities

Devolution of political-administrative powers to localities and direct democratic people empowerment are thought to create a more conducive environment for local economic development. To investigate this, a policy and planning simulation model was developed. The study compares two decentralizing Asian localities with two politico-administratively decentralized European localities. The lack of hard data on the local level suggested the use of System Dynamics as analysis and simulation methodology. Social Network Analysis was used to develop the systems' power structure. Time simulations of people empowerment policy changes revealed that these matter and that fully empowered villagers are beneficial for the development of a locality.

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Legal Dynamics

One of the areas barely investigated by system dynamicists is the law. Although this may seem understandable, there are intriguing dynamic aspects in legal systems and particularly in the field of the administration of justice. In order to investigate whether a legal procedure could be modelled from a system dynamics perspective and to see whether this could lead to deeper insights into the mechanisms beyond the existing method of 'trial and error', the Dutch asylum procedure over the period 1980-2002

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was modelled. This paper describes the results of this study revealing unprecedented feedback loops implying the need for further research of the internal effects of legal procedures i.e. the need for a system dynamic approach of the law, or stated otherwise, the existence of a new approach: legal dynamics.

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The Dynamic Spatial Simulation Modeling of the Effects of Land Use Change on Avian Species

As part of the LEAM project, a comprehensive urban development model of Kane County, Illinois was constructed. The spatial dynamic simulation model presented in this paper is an integral part of the LEAM model and serves as a means to evaluate the effects of urban sprawl on two bird species selected as indicators for their ecosystems: Eastern meadowlark (Sturnella magna) for the grassland, and ovenbird (Seiurus aurocapillus) for forest ecosystems. The model was integrated with a hypothetical land use map through a spatial analysis software, Spatial Modelling Environment (SME), and tested for behavioural validity. The spatial modelling studies are still novel approaches and their success partly depends on availability of relevant and sufficient data. There is still much to improve in this field and it is realistic to expect great contributions to the scientific and practical theory from spatial dynamic modelling in the future.

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Assessment of Possible Effective Strategies in the Transition Process to a Knowledge-Based Economy: The Case of Turkey

The aim of this study is to introduce a framework which can be used for the assessment of possible strategies in the transition to a knowledge-based economy (KBE). For this purpose, a mixed integer programming (MIP) model is developed to determine the required levels of human resources and information and communications technology (ICT) investments for given levels of government R&D investment of the country shown to be the most significant determinant of the phenomenon. The model is solved for the case of Turkey. The results indicate that: (i) government R&D in Turkey should increase to considerable levels in order to trigger the transition to a KBE and (ii) transformation towards a KBE with an inefficient innovation system may require considerable amounts of additional resources compared to transformation with a more efficient system. The results illustrate that any improvement in the innovation system for Turkey may lead to considerable savings from the required human resources and ICT investments given same levels of R&D investment.

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Multi-Period Portfolio Assessment

This study explores the prospects of implementing a multi-period mathematical portfolio planning model for security trading in the Istanbul Stock Exchange, and compares the performance of different models for this purpose.

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How to Gain Competitiveness in a Mexican Small-Sized Company: A Systemic Approach

The recent quality tendencies and movements have meant that many different models and methodologies have emerged in order to get more market competitiveness for companies. Total Quality Management (TQM) is, undoubtedly, one of them. However, TQM presents some adaptation problems due to Mexico's culture. An adequate use of the methodology and its model conceptualization for small and medium-sized industry seems to be the central problem to address in this culture conflict, if we consider that this kind of industry is a productive support for Mexico. The purpose of this paper is twofold. The first is to show how this "problematique" should be addressed through a methodology with a systemic perspective. The second purpose is to go beyond the utilization of this methodology, showing some results from an application in a small-sized company in the center region of Mexico.

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The Coming Water Shortage in the Jordan River Basin: Finding Objectivity in a Subjective Problem

Water distribution and availability in the Jordan region were studied. Self-sufficiency in water availability within the region is determined by the minimum amount of water used per person that is renewable. The objectives of the study were to identify the causes of water shortages and alternative use of water to prolong future supplies. According to our analysis, Israel and Jordan will overutilise their water source by a factor of 2 and Palestine by a factor of 1, by the year 2030. Water recycling has a potential in all the countries. The agricultural sector makes up the bulk of the water use (73-85%). Different water-saving techniques and alternative crop production can drastically reduce water use. Diverting away from agriculture and alternatively developing the industry sector would alleviate the immediate water shortages but will make the region dependent on the global grain market.

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A Generic Tool Based on a System Dynamics Approach to Assess SME Business Stability and Help Designing Business Tactics and Action Plans within Transient, Non-Stationary Conditions

SME's play an important role in developing countries economy leveraging. The SME's are subjected to non-stationary conditions affecting business stability. These conditions arise due to economic environment transition or during business start-up phase. The problem is that business-monitoring tools such as the balanced scorecards are long term oriented and strategically focused. The SMEs' response in the short term during non-stationary conditions may cause serious damaging results or even lead to total business collapse. The objective is to develop a tool to monitor the SMEs' business short-term transient response to non-stationary conditions. Also to help developing business tactics and action plans. The chosen platform is a system dynamics model to provide simulation ability under different scenarios. The model is formulated in a generic way with the ability to define business attributes through set of model variables. The model is built using five basic sub-models: financial, human resources, operational, risk and environmental.

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Mapping and Modeling in the Australian Taxation Office: A Case Study

This paper is a case study of a major System Dynamics (SD) intervention in the Australian Tax Office (ATO). The intervention lasted two years and involved an extensive roll out of SD tools and the methodology. The context for the paper is the Action Research work based at Monash University and is a reflection on the organisational and political structures that are necessary to sustain a large-scale SD intervention in a large bureaucracy.

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IT Future in Egypt: Model of Workforce Demand and Suppy in the IT Field

Is the IT market demand equal to the increase in IT workforce supply in Egypt? A very important factor we should take in consideration is how much the quality of the trainees meets the international quality of IT to reach the goal of exporting and make a leap in the IT industry. So it's important for us to have an overall and accurate understanding of the effects of excess training programs relative to the projects available in the IT market in Egypt. System dynamics is considered a methodology that bridges the gap between understanding structures and

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understanding behavior. System dynamics enable most people to describe and analyze a system, based on an intuitive system understanding, and more to use system dynamics promotes our intuitive system understanding. The purpose of our model is to use system dynamics to build a simulation model that will help us to understand the IT market situation in Egypt in the next few years according to the market demand and supply.

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Business Transformation Success Dynamics: It's the Communication

A study of Business Transformation (BT) Success involving fifteen corporations framed business transformation as a type of large-scale strategic renewal implemented via a diffusion of innovation process within a socially constructed organisational environment. Based on the qualitative and quantitative analysis of the communication patterns examined in this study, the complex relationships were abstracted and reflected in an adapted diffusion of innovation dynamic model that has communication effectiveness as a key influencing variable. The key findings of the communications network analysis (CNA) showed that success was correlated with average path length, opinion leadership and the presence of weak ties, with a saturation effect on communication after a certain network density is reached (referred to in CNA literature as percolation effect). Simulation runs replicating observed BT Success Index measures showed that with one variable missing the successful implementation is delayed, two variables missing results in failure and that a saturation point for communication exists.

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Making Complex Network Analysis in System Dynamics

As urban models in system dynamics are extremely complex if an area is subdivided in many dynamic and interacting areas, managing complexity of the urban network interactions is essential. A recently developed interregional model of The Netherlands illustrates the implementation of the spatial dimension in urban dynamics. The model describes 40 self-organizing urban areas and distribution of migrants, firms and commuting between 40 regions simultaneously. Developments in regional labor markets, housing markets and land-use can be explained by internal as well as by external regional conditions. The applied approach gives many opportunities to make large disaggregated models in system dynamics. Spatial or sectional interactions (network models) can be modeled while model structures remain manageable. In general, as vector-based and matrix-based calculations can be implemented in system

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dynamics easily, many (existing) static models can be applied dynamically. Hence, the usefulness of system dynamics in modeling complex systems broadly is enlarged.

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Active Modeling and Simulation in Learning Environments Concerning Business Subject Matters

How can the quality of the learning process be evaluated? Without reference to a scientific (learning) theory it is not possible to develop an appropriate diagnostic approach. The proposal is that the synopsis of similar concepts could foster the development of a platform for a (learning-) theory based construction for sd-based learning environments and their evaluation. The process of synopsis can lead to systematic procedures for identifying misconceptions between the different research fields, providing an overview of concepts which help to cope with complexity, elaborating possible support by educational means, grounding approaches to synergetic effects, prevent neglect of alternative perspectives, and help develop appropriate diagnostic instruments based on theoretical background. This final item should prevent the eclectic selection of measurement tools for active modelling in business subject matters, depending alternatively on the 'best fit' for the designed experiment. It could then be demonstrated which criteria support this type of measurement.

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Using Dynamic Simulation to Teach Physics in a Real-World Context

Dynamic simulation has great potential as a tool for teaching physics and science in general. This paper describes a family of simulators that have been developed to teach several topics in physics including circular motion, collisions, energy storage, and heat flow. These simulators provide students with laboratories for experimenting with the phenomena in the context of real-world situations such as driving, home energy conservation, and sports. The simulators were designed to serve as companions to a curriculum called Active Physics (AP) which was created with NSF support to make the subject more appealing and understandable to the majority of high school students who otherwise do not study physics. The paper contrasts dynamic simulation and traditional approaches to teaching physics. It also discusses the value of simulators with "user-friendly" interfaces compared to using system dynamics models alone. The paper describes how each phenomenon was modeled and presents interfaces for each simulator.

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Communities with Multiple Afflictions: A System Dynamics Approach to the Study and Prevention of Syndemics

The term syndemic was coined by the medical anthropologist Merrill Singer to describe the mutually reinforcing nature of health-related problems such as substance abuse, violence, and AIDS, that disproportionately impact inner city neighborhoods burdened by economic hardship, deteriorated infrastructure, social disruption, malnutrition, and inadequate health care. Public health scholars agree that effective responses to the intertwined afflictions of the urban poor require comprehensive, system-wide interventions. To strengthen the scientific foundation for such initiatives, the CDC is supporting research on syndemics, including the use of system dynamics modeling to investigate how and why syndemics develop, and to evaluate alternative approaches to intervention for particular community contexts. At present, a generic (not yet case-specific) model has been developed based on the literature and expert observations. We present the model and some results, and outline plans for carrying the work forward.

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Solutions to Improve Performance in the UK House Building Supply Chain: The Use of A System Dynamics Model

The private housebuilding industry in the UK is plagued with problems. In order to assess the potential benefits of supply chain management principles for the housebuilding industry, a generic model has been developed. This model, based on Forrester production and distribution systems and an Inventory and Order Based Production Control System, takes into consideration developers, merchants and manufacturers. The model has been used in four scenarios for the low-value fit-out supply chain, which focuses on products such as doors, lintels, skirting boards, etc. The simulation results show that using one national merchant instead of several regional merchants reduces demand amplification and total supply chain inventory costs. Information enrichment also improves performance, while the reduction of manufacturing lead-times has a detrimental effect on total supply chain inventory costs. It is concluded that private housebuilding can improve its performance by implementing supply chain management principles.

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A System Dynamics Model for the UK Private House Building Supply Chain

This paper presents a system dynamics model for the private

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housebuilding supply chain. A quick review of the main problems of the housebuilding industry in the UK is given followed by a presentation of the similarities and differences of the housebuilding industry with manufacturing in order to ensure that manufacturing solutions can be used for the housebuilding industry. A model of a typical housebuilding supply chain is developed using a set of sub-systems which can be "switched off" to model specific scenarios. This model is based on an Inventory and Order Based Production and Control System (IOBPCS) which is widely used to represent manufacturing companies. The IOBPCS model is then further developed to incorporate specific features of housebuilding supply chains. A review of tests to build up confidence in the model shows that the model can be used with confidence in terms of its validity, credibility and generality.

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Research on Measure of Portfolio Investment Risk

The complexity and indetermination of financial risk elements make risk control more difficult and in real situations we can just use warning and prevention measures to deal with these risks. The measure of risk is an important instrument to disclose it. Securities investment also confronts many stochastic factors that cannot be controlled. Through comparing the different approaches to measure portfolio investment risk, this paper presents the semi-beta model measuring systematic risks based on the semi-variance and empirical study of this model is given with Chinese listed companies. Finally, we explore the new measure methods of portfolio investment risk.

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Is Explicit Information Important for Performance in Dynamic Systems?

In order to gain some insight in how to assist understanding and performance in dynamic systems, participants were asked to interact with a predator-prey system on a personal computer. Their task was to achieve equilibrium by controlling the size of the predator population. Results were presented in line graphs in all three conditions. In one condition pictures illustrating the population sizes was added, intended to make this information more explicit. In a second condition pictures illustrated the prevailing conditions in the system, to explicitly suggest conclusions to be drawn and actions to be taken. Although this was expected to facilitate performance, the results revealed an equally low performance in all groups. The overall success rate was 33%. This could be explained either as failure in interpreting the line graphs and/or the pictures not being explicit enough to assist deduction. Further research is needed to settle which was the case.

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Product Development Resource Allocation with Foresight

Shortening project duration is critical to product development project success in many industries. As a primary driver of progress and an effective management tool, resource allocation among development activities can strongly influence project duration. Effective allocation is difficult due to the inherent closed loop flow of development work and the dynamic demand patterns of work backlogs. The Resource Allocation Policy Matrix is proposed as a means of describing resource allocation policies in dynamic systems. A simple system dynamics model and control theoretic model of resource allocation in a product development model are developed. The control theory model is used to specify a foresighted policy, which is tested with the system dynamics model. The benefits of foresight are found to reduce with increasing complexity. Process concurrence is found to potentially reverse the impact of foresight on project duration. The model structure is used to explain these results and future research topics are discussed.

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Alternative Modeling Approaches: A Case Study in the Oil and Gas Industry

Simulation modeling is one technique that BP relies on to improve the quality of capital investment decisions. To date these simulations have been highly detailed discrete event simulations with the financial computations run in parallel using

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spreadsheets. In an ongoing project, some of the tools and thinking of system dynamics are being introduced. In this study, we will discuss a project in which we introduced a continuously formulated model as a supplement to the discrete event model. For this case we found that the continuously formulated model could be used to address the same issues as the discrete model and could do so efficiently. We also found that the discussion generated by this alternative formulation was more productive and tended to lead the project team in a more interesting direction. While all of these results are tentative, we do believe this is a worthwhile approach to developing models in support of investment decisions.

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Can Students Learn Stock-Flow Thinking?: An Empirical Investigation

Linda Booth Sweeney and John D. Sterman (2000) were able to show in their remarkable study that the ability of MIT-students to discern between stocks and flows in practical situations is rather low. In a sequel study Guenther Ossimitz (2001) showed that the performance of Austrian Business Administration students on "Bath Tub Dynamics tasks" is even worse than in Sweeney and Sterman. The results also gave first indications that some of the observed problems might be due to deficiencies in correctly interpreting flow-related functional graphs. In the present paper we report about another study investigating students' abilities in stock-flow- thinking thereby introducing for the first time a pretest-posttest design with a 90-minute crash course introducing basic stock-flow concepts between the two times of testing. We were able to demonstrate that even an intervention as makeshift as our crash course was suitable to bring about an improvement of performance.

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Future Demand and Supply of Food in China: A Modeling Attempt

This paper focuses on future scenarios of demand and supply of grain in China. Economic development has been growing at a steady pace for decades and there are no signs of a decline in the near future. Projections of population trends show that the population will continue to expand until 2050, when a levelling-off is predicted. The growth of both population and economy drives industrialisation and urbanisation where area for settlement and infrastructure is demanded. Agricultural land is converted into urban area with high water consumption and pollution problems. People with a higher income diversify the diet, a diet that needs a larger area for production. The fundamental basis for self-subsistence in food production - agricultural land and clean water - is diminishing rapidly and

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may soon necessitate an extensive grain import. This study concludes that even if conservation measures are carried out China may face an extensive need for import of grain products.

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Micro-Macro Finance Structure Modeling

In many developing countries, micro finance has been successfully introduced as a useful tool for poverty reduction and entrepreneur development. However, a weak macro and medium level financial structure can put a limit on sound socio-economic development even if the macro level financing structure is strengthening and accelerating micro enterprise sector development. Even when the micro enterprise sector has steady development in the first phase, this development can be interrupted suddenly by adverse occurrences in the macro level economy or natural disasters. Seamless linkage between the micro enterprise sector and the large enterprise section with the SME: Small and Medium Enterprise sector is necessary, and a key issue is the financing structure for the SME. We have tried to develop a micro, macro and linkage model that focuses on the financial mechanism that stimulates economic development. We conclude that a sound financing structure focuses on the SME sector and development of the SME sector has a positive impact on economic development in the long term.

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Dynamics of Interorganizational Learning

This paper proposes a model that gives deeper insights into the dynamics of interorganizational learning specified for the example of alliances. Current alliance research tends to neglect a feedback-perspective which might be the reason why certain behavioral effects cannot be explained. However, based on alliance research, three different major feedback-loops that influence interorganizational learning dynamics are identified in this paper: first, a reinforcing loop called ‘trust drives learning’. It shows that trust between the coworkers in an alliance has a positive impact on learning. Second, a balancing feedback-loop named ‘inertia cuts trust’ states that organizational inertia hinders the development of trust between coworkers. Third, a positive feedback-loop called ‘let’s learn together’ underlines that two parent companies aim for common learning instead for learning from the partner when forming a learning alliance. The model offers new insights into alliance learning as well as insights into how specific influencing factors interrelate with each other.

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Cybernetic Formulation of Some Functions of Management: Types of Simulation and Optimization Approaches within the System Dynamics Method

The purpose of this paper is to present the cybernetic formulation of some functions of management. On these grounds, the proposal for the classification of the types of simulation and optimization approaches within the system dynamics method is presented by the author. Some of the investigation is derived from the classic works of Forrester, Coyle, Wolsterholme and others, but some constitute the author's own ideas, developed in recent years. The author welcomes any discussion on this subject.

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Optimal Dynamical Balance of Raw Materials: Some Concepts of Embedding Optimization in Simulation on System Dynamics Models and Vice Versa

The purpose of this paper is to present the optimal dynamic balance of raw materials. This balance refers to the balance of production presented in a paper of the same authors in Atlanta. Now, on that background two different formulations of this problem are discussed here, using the examples presented. The concept of embedding optimization in simulation on system dynamics models and vice versa are discussed. Many simulation experiments were carried out by the authors and the results are presented in this paper, respectively.

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An Extended Taxonomy of System Dynamics Models of Higher Education

A number of papers have been published describing various system dynamics models of higher education institutions and issues, on topics including external forces, corporate governance, planning, resourcing & budgeting, human resource management, teaching quality, teaching practice, microworlds and enrolment demand. This paper builds on a previous paper that provided an initial 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 an extended taxonomy of system dynamics models in higher education. This

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paper builds on the initial taxonomy by widening the scope of the survey of completed investigations in higher education management. The findings from these investigations are briefly described. The taxonomy classifies the completed investigations into eight specific areas of concern and five hierarchical levels.

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Toward a Taxonomy of System Dynamics Models of the Information Systems Investment Appraisal Process

A number of papers have been published on various issues relevant to system dynamics models of the Information Systems Investment Appraisal Process from several academic and professional viewpoints. This paper contends that there is a need to catalogue and classify this work in order to highlight potential areas of research in this field of study and to identify system archetypes at different hierarchical levels and discover new ones. The initial taxonomy is based on a limited literature survey. The contribution and relevance of each of the sources examined is briefly described. The taxonomy classifies the completed investigations into five specific areas of concern and five viewpoints.

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System Dynamics Model Development of the Canary Islands for Supporting Strategic Public Decisions

The present paper centers on the problems of decision-making and decision support related to strategic public decisions. A methodological approach was developed to support decision-making where decision-makers are confronted with unexpected events. The methodology considers the fact that strategic decisions involve a large breadth of variables, qualitative and quantitative; and that they imply distributed and remote interaction between different actors. The approach is based on the building of qualitative models and the application of system dynamics for the development of a simulation model. Variables were identified which affect the sustainable improvement of the quality of life in the Canary Islands. We used two methods to address the problem: analysis of the driving dependent forces and system dynamics.

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The Rubber Industry and Extended Producers' Responsibility Framework: Opportunities and Threats for Swedish Rubber Manufacturers

An array of sustainable ways either to reduce the amount of waste rubber generated or for the re-utilisation of waste rubber products as different means of resources at the end of their

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service lives are provided and briefly evaluated from economic, social and environmental perspectives. Potential measures which the Swedish rubber industry and its major stakeholders can implement (within the context of extended producer's responsibility framework) to increase source reduction, reuse, material recycling, and energy recovery from waste rubber are examined. Based on the concept of system dynamics, the links between different issues, possible problems arising from them and the solutions, and their relation to the sustainable waste rubber management system are analysed by understanding the cause and effect relationship between important parameters. A model is developed using Stella 5.1.1u to help the decision makers to evaluate different scenarios in Swedish waste rubber management.

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The Rise and Fall of Independent Electricity Retailers in Germany

In the beginning of the liberalization of the German electricity market a great number of new, independent electricity retailers entered the market with mostly very competitive prices. Everybody expected a highly dynamic market with high switching rates and the price as the number one switching criteria. Even the big players started to lower their consumer prices, launched marketing campaigns and branded their products. The result of this price-driven competition was the loss of earnings for all companies, low switching rates, and most of the new retailers were forced to sell their customers or close their businesses. The reasons for this disaster are misperception of the market structure and too optimistic expectations of customer reactions and wishes. This paper deals with these misperceptions and the differences between the estimated and the real market behaviour.

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The Individual Daily Mobility Simulation Model 'MobiSim'

The simulation model MobiSim was elaborated on the demand of the French Ministry of Transport. The objectives are to provide assistance in strategic decision making on collective transportation and the daily individual displacement in their relationships (interconnections) with the territory development. MobiSim contains six submodels: population, housing, job,

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transportation, displacement and environment. The model approaches daily mobility by essential motives of displacement: "house-work", “shopping”, “displacements for educational needs”; into and between zones, for the population of socio-professional categories and age groups. The structure of job is represented by categories of jobs and types of enterprise activity. The model addresses the modes of displacement and categories of housing corresponding to the household’s size. The model was established with Vensim and consists of nearly 6,000 equations. The interface understands currently 17 screens, allowing it to establish scenarios and to collect some output results describing the evolution of daily individual mobility.

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Simulation of Evolution Dynamics of a Social System: Ethnic Solidarity Level

In this paper the hierarchical approach to construct a simulation model of a complex social system is presented. We consider society as a complex system. It has a hierarchical structure with the following subsystem levels: biosphere, ethnosphere, sociosphere, psychosphere, anthroposphere. The next level is built on a previous one by hierarchical rule. The presented research is a demonstration of creating the society model on an ethnic solidarity level. This model describes the behavior of the ethnic system as a separate part of the general complex social system. The ethnic system includes a few ethnoses and provides their interactions. The interactions transmit by ethnic fields. The model is described by a system of parabolic differential equations. The software TERRI is used for the forecast of arising ethnic conflicts. Based on simulation results the researcher can compute the direction of ethnic field distribution and the most probable points of skirmish between ethnoses.

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Think DEEP: A Participatory Research Project

DEEP (Distributive Effects of Economic Policy) is an ongoing project of the Integrated Social Development Center, a Ghanaian non-governmental organization, to build a disaggregated dynamic economic model of Ghana’s economy to provide a clear understanding of the economy-wide feedbacks that determine the effects of particular government policies and external shocks on the income and quality of life of the poor and marginalized. The model is structured around a dynamic social accounting matrix framework, which gives a comprehensive, disaggregated map of nominal money flows in the economy. While social accounting matrices are normally used to construct computable general equilibrium models, using one to structure a dynamic model is an innovation with substantial advantages. As the relevance and credibility of the model are established, it should become an

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essential tool for public sector agencies involved in formulating and advising government on the structural options available for Ghana, as well as a powerful framework for discussion.

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Sustainable Capacity for Health Systems Management: A Training Project for Senior Government Health Managers

Lack of positive outcome across social sectors has forced the government to develop new ways of systems management and maximize the utilization of scarce resources. The health system managers are trained primarily in clinical skills and learn systems management as they go along. This project was designed to train health managers in those areas. Twelve government health managers conducted an appraisal to develop a pertinent health systems management course. Forty-three district health managers were trained and evaluated for knowledge-gained during the course. The results showed varying levels of knowledge before the workshop, which became uniform by the end of the workshop; there was an overall increase in knowledge-gained during the workshop. The project recommends developing a national forum for district health managers. It would serve the critical purpose of continuing education, systems networking among districts and understanding the dynamics of systems management in promoting efficient health care.

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Integrative Mechanisms in New Product Development Projects: Effect of Project Complexity on Project Performance: A System Dynamics Approach

The current paper investigates whether the shift to more integration, that is use of concurrent engineering process and cross-functional teams organisation, in new product development (NPD) projects is suitable for all types of projects regardless of their level of "project complexity." The current paper addresses this research question in two steps. First, a formal framework of "project complexity" is developed for NPD projects in which its contributing factors are determined. Second, a system dynamics model is developed to investigate this issue. The model is used to quantify the extent of "project complexity" effects on the relationship between the level of integration in a project and one performance indicator: development cycle time. The model was run for a single phase situation and showed that product complexity and project uncertainty increases project development cycle time and that increasing co-ordination does not offset these negative effects on project schedule performance.

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A System Dynamics Approach to the Evaluation of Internet Venture Business

Since 1998, venture businesses in Korea have been flourishing because there were substantial supports from the Korean government. Recently, the government-driven policy has been transformed into the characteristic of a market-driven investment. This research tries to clarify the major ecosystem of venture businesses at this point by forming a conceptual map. The result of this research argues that current methods of performance measurement are not suitable for a comprehensive explanation of the dynamic nature of venture businesses. For a better reflection, it is suggested to develop a simulator which allows empirical and realistic validation of venture business performance. This research defies the current notion that the stock market is the only factor to decide the success or failure of venture firms. Instead, this study could support the idea of utilizing the simulator as an investment decision support system for venture businesses.

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The System Dynamics Approach to Developing AVCS Maglev Vehicle Development Model

AVCS maglev is the synergistic combination of Advanced Vehicle Control Systems (AVCS) and the high-speed magnetic levitation (Maglev) technology. AVCS maglev will provide a safe, high-speed, high-capacity, energy-efficient, environment-friendly intercity and intracity transportation system. The vehicles using the "magway" (maglev guideway), like present day automobiles, would be privately owned and could operate on ordinary highways and streets as well as the AVCS magways. In this paper, the AVCS Maglev Vehicle Development Model (VDM) is developed to outline the important factors in reducing the weight and the price of the vehicle. Reducing the weight of the vehicle will help increase the operating efficiency and reducing the price will help increase the accessibility to this highly beneficial transportation system. The AVCS Maglev Vehicle Development Model is described in two complementary forms of the system dynamics modeling, causal diagrams and DYNAMO equations.

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Kinetic Process Graphs: Building Intuitive and Parsimonious Material Stock-Flow Diagrams with Modifed Bond Graph Notations

This paper presents a new graphical modelling language extending the stock-flow (SF) diagrams used in system dynamics: “Kinetic Process Graphs” or KPG’s. A KPG groups

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in a single flow-process some mechanisms representing flows modelled separately in a SF diagram but cognitively linked in our mental models as belonging to a single process using and providing material resources of different kinds. KPG's contain SF diagrams as special cases and every KPG may be transformed into a SF equivalent. However for many processes a KPG is more parsimonious in arrows and thus less visually complex than its corresponding SF diagram. It is also closer to our cognitive or mental models and thus more intuitive. In consequence, for this class of problems, KPG models are often easier to obtain, explain and maintain than SF diagrams and frequently suggest new vistas on a given problem. We conclude by showing where KPG's belong in the family of modelling languages and by discussing our current research.

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Hospital Production System Modeling and Simulation Insight of Operating Theatre Planning

Nowadays, hospitals undergo massive changes. The objective that hospital managers must reach is to optimise its production by meeting the customers' demands. In this paper, we are more particularly interested in the operating theatre management, which is the actual matter of great concern to hospitals. More precisely, we are trying to improve the way the duration of an operation can be calculated according to the operated patient's profile. We first used rough sets method to determine the factors that are the most explanatory of a great change in the duration of operation. So, for a given pathology, we have at first created sets of patients with roughly the same duration of operation. On the basis of these sets, the rough set theory helped us to determine the profile of the patients included in these sets and thus to estimate the durations of operation of new patients according to their profiles and pathologies.

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Introducing Digital Design Methods to System Dynamics Education

One of the origins of system dynamics is control theory. Thus, it is worthwhile to investigate how the growing use of digital models as means of control should affect the field of system dynamics. In particular, it would be interesting to explore how the introduction of digital models could enrich the learning of system dynamics in K-12 curriculum. This paper proposes to do so through hybrid systems modeling. Hybrid systems are dynamic systems in which a digital element controls a continuous process. The paper illustrates the relevance of hybrid systems to K-12 education, and describes how hybrid systems may be modeled by using icon-based software such as STELLA.

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Two examples showing an implementation that is suitable for high school students are presented as well as an outline for future research.

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Modeling Generic Structures and Patterns in Social Psychology

System dynamics has been enriched from many disciplines. This paper describes our effort to discover generic structures in the field of social psychology. Social psychologists have accumulated a body of empirical studies and theories that are reproducible and apply to a variety of social situations. Our task was to start modeling a few pivotal dynamic effects found in the social psychology literature. We present models of the dynamics of an important social process, namely, the "self-fulfilling prophecy." The structure underlying this process is associated with the drifting goals archetype. Next we model the dynamic effects of contact between groups. Finally, we develop a set of models that represent a key process in social psychology, namely the "fundamental attribution error." We hope that the approach to modeling generic structures in social psychology will enrich future system dynamics models by including relevant biases and distortions in perception discovered by social psychologists.

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Organizational Change at the Team Level: The Dynamics of High Performing Self-Directed Work Teams from a Learning Organizational Perspective

This paper describes a model that explains the changes workers go through in formation and evolution of self-directed work teams (SDWT) over a six year period. The formation phase is characterized by major increases in worker commitment to the team concept. Upper management has to convince workers that the company will give them the freedom and resources to function as a SDWT. Once the team comes into existence, another set of processes dominate. The model describes the tradeoff between being empowered to set work intensity and worker accountability. High performing teams may seek external resources to raise the performance bar, through internal pressure to excel. Raising the bar generates burnout as an unintended consequence. However, high performing teams can be relatively immune to burnout. The model hypothesizes that loop processes, associated with team spirit and zeal for the job, appear late in the game to ameliorate the effects of burnout.

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A Platform for System Dynamics Modeling: Methodologies for the Use of Predefined Model Components

In the poster presentation a platform for component-based system dynamics models is developed. The platform is designed to support the formal model building process with predefined, standardized model-components. The research presented, focuses on methodological considerations. In order to build models with predefined components, different methodolgies and concepts are discussed and integrated. These are: 1 .hierarchical modeling, 2. reference modeling, 3. object orientation, 4. problem orientation 5. transferability/ reusability of generic structures, 6. validation of component-based models. The components are based on the concepts of generic structures. They allow to vary the level of resolution of the resulting component-based simulation models.

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System Dynamics as the Link between Corporate Vision and Key Performance Indicators

The BSC has gained corporate support because of its potential to link vision, strategy and deliverables via a coherent set of KPI's. Unfortunately, the BSC has largely failed to deliver this ideal because of the lack of a rigorous methodology for selecting the metrics and for establishing the relationship between the metrics and the corporate strategy. Rather, metrics are typically based on group consensus or individual intuition, influenced strongly by data availability and the effort of collection and maintenance. This paper proposes an approach whereby possible metrics are plotted against the high level activities of the organisation. Cognitive mapping and hierarchical cluster analysis are used to derive a rational basis for identifying interrelationships between the metrics and their linkages to corporate strategy and vision, as a precursor to the development of a balanced scorecard framework.

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Functionality of Banks and Hedge Funds and Contagion Between Financial Institutions

The paper studies crises and contagion effects in the framework of two financial institutions: a bank and a hedge fund. System dynamics models of a hedge fund and a bank are formulated. The concept of contagion is discussed in the framework of these two financial institutions. The goal of the paper is to understand conditions under which each of the financial institutions can fail and determine when a failure in one financial institution can trigger a contagion effect that leads to the failure in another

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financial institution. Both models and the concept of contagion are validated and discussed within established financial frameworks. The paper provides conclusions and policies how to avoid or mitigate the effects of financial crises and contagion.

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A Worker Productivity Model

A model with the purpose of explaining the behavior or the productivity is presented. The model is based on the concept developed by Hershauer and Ruch in 1978. The main object of the new model is to have a model that can be used to simulate the response of the productivity of a worker to different actions. The new model considers ten factors that influence the productivity of a worker. They are located inside four levels of activities: Personal factors (responsibility, learning capacity and satisfaction), Work Group factors (leadership and work team organization), Technological factors (training and working methods) and Organizational factors (qualitative incentives, quantitative incentives and productivity indicators). The development of the model consists on two stages. In the first stage, the dynamic model was constructed. The second stage consists on using the model at different companies with the purpose of adjusting the values assigned to several auxiliary variables.

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Understanding the Psychosocial Dynamics of HIV/AIDS Prevention and Care in the Community: Base Case Model Findings and Implications

A system dynamics model was built for the purpose of fostering a greater understanding about the psychosocial dynamics of HIV/AIDS prevention and care in the community over a twentyyear time horizon, from the epidemic's inception (circa 1981) to the present. In particular, the psychosocial dynamics of perceived stigma, complacency, and [dis]empowerment were studied in relation to the epidemiology of HIV/AIDS in Michigan. The study was informed by the results of an extensive qualitative research project that explored the current and emerging needs of persons living with HIV/AIDS (PLWHA) and by the insight and knowledge of a group of ten core informants from Michigan's HIV community. The underlying dynamics of the problem focus in the study were expressed in a set of five key causal processes. Initial feedback from members of Michigan's HIV community affirmed that the base case model has provided deeper insight into the phenomena of HIV/AIDS prevention and care.

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Computing and Engineering Distance Education Centre (CEDEC): A Systemic Approach

The paper considers the problem of capacity constraints at an educational centre. It begins with an economic analysis of the effect on capacity due to an increase in demand. The limitations of such an analysis are then shown. A causal loop diagram and a system dynamics model are then constructed. By running these models a deeper understanding of the problem is obtained. Full use is made of the archetype "shifting the burden." Modeling using SD gives management a practical tool for solving problems especially in its treatment of delay lags.

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Measuring Performance in a City Water Company Through a Dynamic Balanced Scorecard

To promote public utilities' competitiveness, public organisations publish rating reports, comparing results achieved by different companies. Those results are not only referred to the financial dimension, but also to 'soft' variables, which impact in companies' long-term survival and growth. Management accounting models seem to have limitations in performance measurement, particularly in evaluating soft variables. For this reason, many companies apply the Balanced Scorecard (BSC). However, this tool lacks a proper consideration of delays between causes and effects, and a feedback loop framework between the different perspectives. Here, we present an system dynamics-based BSC, developed upon an analysis of an Italian water company, Amap Spa. By modelling the structure generating the key-variables behaviours, it provides managers with a decision-making tool based on simulations, which helps them to gain insights into the relation between decisions and performances.

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Using Qualitative Methods in the Conceptualization and Assessment of System Dynamics Models

The field of system dynamics depends heavily upon the use of quantitative data to generate feedback models. This paper argues that qualitative data and their analysis do have a central role to play at all levels of the modeling process. Although the classic literature on system dynamics strongly supports this argument, the protocols to incorporate this information during the modeling process are not detailed by the most influential authors. Data gathering techniques and qualitative data analysis techniques

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could all have a strong, critical role in rigorous system dynamics efforts. The paper describes some of the main qualitative techniques developed by social scientists and explores their suitability in the different stages of the modeling process. Additionally, the authors argue that the techniques described in the paper could contribute to the understanding of the modeling process, facilitate communication among modelers and clients, and set up a methodological framework to promote constructive discussion around the merits of qualitative versus quantitative modeling.

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Links Between Systems Thinking and Complex Problem Solving: Further Evidence

There is a widely held belief that systems thinking is an answer to the increasing complexity of the environments in which we live and function. Despite strong assertions, however, the relationship between systems thinking and complex problem solving has received slight attention in the literature. Using Richmond's (1997) seven-classification scheme as the theoretical base, this paper investigates the link between systems thinking and complex problem solving. The Verbal Protocol Analysis (VPA) methodology was used to gather and analyse the empirical data. The findings of the study indicate that while the degree of systems thinking does matter, in fact, it is certain types of systemic thinking that are more relevant to performance. Further, evidence shows that subject's approach to the problem is also a highly pertinent factor in task performance in that better performers displayed a distinctive pattern of thought that differed from that of the worse performers.

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Software Process Concurrence

Process concurrence provides a robust framework for modeling software processes and their constraint mechanisms. It is general enough to characterize a broad spectrum of current and emerging methodologies in terms of work available to complete on a project. It is more generally applicable than the Rayleigh curve, provides a detailed view of process dynamics and is meaningful for planning and improvement purposes. With it one can derive optimal staffing profiles for different project types, and as a shared project model it serves to improve stakeholder communication. Many modern techniques serve to increase concurrence (and thus decrease cycle time) in several ways like increasing task parallelism or automating product elaboration. Process concurrence can evaluate such strategies by modeling task interdependency constraints between and within phases. This paper will introduce process concurrence, show examples from the software development domain, compare concurrence

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relationships for typical development situations, run some simulation experiments, and present lessons for practitioners based on the modeling.

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Creating Competitive Advantage through Dynamic Resource Interactions

In the context of the resource-based view, some researchers have pointed out that individual resources are not valuable by themselves, but produce value only in combination with other resources. Our belief is that a collection of resources that interacts within itself in specific manners to produce complex behaviors, over time, could be a source of value to organizations. This paper seeks to explain the divergent performance profiles presented by two almost identical branches of an insurance firm. Simulations are carried out to examine the consequences of particular sets of interactions on identical initial resource heterogeneity. The simulations differentiate the impacts of initial resource heterogeneity and interaction amongst resources in contributing to the complex behavior of resources. Some conclusions are drawn about the significance of these two factors in the generation and sustenance of competitive advantage.

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Governing a Complex Social System with System Dynamics: The Management and Economics of an Airport Hub

Managing a hub successfully implies the interaction of numerous actors, both public and private, operating at local, national and international levels. Such a complexity implies that, rather than the content of a single decision, it is important to understand the dynamics emerging from an articulated system of decisions. In order to improve the quality of single decisions, the ability is

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required to generate valid systemic conceptual models aimed at understanding of the long-term consequences. This paper can be considered the result of the second evolution of the hub model. A first evolution of the model was presented in a paper written in 2000. While the 2000 paper focused particularly on hub creation, this paper focuses on hub management and the economic impact of managerial choices. The directions proposed by the model and the possibility of generalizing it in other systemic contexts are explored.

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Re-Focusing the Competitive System in a Public Utility Company: A Feedback-Oriented Approach: The Case of AMIA

During the last decade, environmental issues have been taken into a serious consideration. Lawmakers have been addressing their activities towards a more severe regulation of the urban waste sector, trying to create the structure for a competitive market. This paper analyses the case of Amia Spa, the municipal waste management company of Palermo. Although the managers are confident on their knowledge about company's internal processes, they are aware of their weakness in understanding the structure of their competitive system, since the "municipality" way of thinking is still ingrained in the company's culture. A preliminary qualitative system dynamics model was built to help Amia's managers to critically review their assumptions about the competitive system. Our main goal was demonstrating how systems thinking principles and system dynamics could support Amia's managers in their learning process oriented to the understanding of the structure underlying the new market segments the company will serve.

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Modeling the Impact of Knowledge-Based Innovations: The Case of Best Practices Implementation in a Small Health Care Private Practice

This study uses a group model building approach to create a dynamic theory of the impact that the implementation of knowledge-based innovations has on the behavior of a small health care private practice centered in customer value and service quality. The development of the model generated an increase in the employee awareness of the impact of their work in the organization, and a preliminary understanding of the dynamics of innovation implementation in the firm. However, by the end of the study, the complete interconnectedness of the system was not yet clear for everyone. The results suggest that in small health-care practices, like the one studied, to pay attention to the feedback processes in place in the organization, to manage

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innovations in a purposeful way, and to manage the relation with the environment have important influences on the success of innovation implementation. The system dynamics model developed—presenting an endogenous theory of how service organizations influence their demand—for the study is explained.

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Management of Asthma Treatment

In treatment of many diseases, there is a tendency to rely on short-term treatment. Short-term treatment provides relieves for the patient from suffering and is seek by those who are under pain. However, such a short-term treatment has some long-term consequences and makes the long-term treatment much more difficult. In addition, continuous use of short-term treatment creates habit and addiction for the patient in many diseases. Such addiction makes it difficult for the patient to avoid short-term treatment. These dynamics are common for many diseases including asthma. In this paper a model is presented that captures the dynamic of asthma treatment. The model is used to examine different treatment strategies and their impacts on the patients in terms of suffering and the control and the essential treatment of the disease. The model can be used to help the management of asthma treatment by both patients and physicians.

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Officer Retention: Incentives and Their Effect on Officer Behavior Concerning Career Decisions

The retention of quality officers is a critical issue for the Army.

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This paper proposes that the problem is managing personnel expectations when faced with career decisions. Through causal loop modeling it is possible to identify incentive behavior loops that influence officer retention decisions. The initial effort for this research project is the identification of incentive and disincentive variables, then to determine and explain the causal relationships affecting officer retention at each grade level. The critical secondary effort is to develop the causal loop structure for each officer rank and determine the loop behaviors that emerge. This phase of the research will identify loops that could yield multiple behaviors, verify the variables that influence officer retention decisions, and help build the final simulation model. The simulation model will be used to experiment with various policy options designed to increase and stabilize the Army's retention problem.

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A Model for Cultural Change in Schools: An Evaluation of Some New Learning Organization Methodologies

Schools are complex systems and have traditionally been resistant to change due to a combination of complex social and cultural factors. In spite of many attempts to effect meaningful change and improvement, schools have remained relatively unchanged in a deterministic scientific paradigm, rather than a systemic change paradigm, or in the context of modernity rather than post modernity. To change the culture of schools therefore requires new, advanced and sophisticated approaches. The essential task in creating a LO was the creation of enabling cultures and structures, which were needed at the individual and organisational level. This was the essential focus for the creation of a LO "Model of Cultural Change in Schools", that would augment such cultures and structures. This paper looks at such a model for cultural change and presents the results of research into the effectiveness of selected learning organisation methodologies in changing a school's culture. These methodologies include "dialogue", "scenario analysis", and "learning histories".

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Improving Causal Mapping Practice Using the System Dynamics 'Front-End' Tool

Causal loop diagrams are graphical aids for depicting hypotheses about causality and feedback mechanisms. Though widely used, causal loop diagramming has significant limitations. Causal loop diagrams can contain numerous untested assumptions about causality. This paper demonstrates how causal loop diagramming practice can be made more robust. The proffered technique described in this paper suggests how we might improve the ways

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we contemplate cause and effect. Applying the technique, and using the tool, offers new opportunities for testing assumptions about multi-factorial causal influences. The paper suggests that our first attempts at building remedial strategies for complex systemic problems might be completed without building quantitative stock and flow models. The paper demonstrates how causal loop diagrams can be kept free of errors in logic. It also raises a number of important issues regarding the ways we view combinations of potentially confounding causal influences, and identifies the need for further research in this area.

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Application of System Dynamics in Car-Following Models

Over the past 50 years, many different "car-following" models have been proposed to describe driver behaviour in a traffic stream. A number of inherent assumptions about human constraints and preferences in existing car-following models hamper their validity for use in the design and evaluation of different ITS (Intelligent Transportation Systems) technologies and/or controls such as AVCSS (Advanced Vehicle Control and Safety Systems). In this paper we introduce a new system dynamics (SD) car-following model that addresses many of the shortcomings of existing car-following models and provides a more relevant platform for simulating driver behavior in all types of car-following situations subject to changing traffic conditions. The proposed SD model was developed and validated based on observed vehicle tracking data. Preliminary results suggest that the proposed model yields speed and spacing profiles for vehicles in "real time" that compare well with those observed empirically.

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A Strategic and Integrated Approach to Human Issues in Air Traffic Management

One current and future challenge is demonstrating and creating awareness and understanding among corporate teams about how incorporating human factors in their various business areas can improve performance and assist in timely implementation. Building a strategic model of human issues embedded within a collaborative scenario planning process helps to build this bridge. This paper outlines how such an approach is being applied to improve the planning for air traffic controllers, shows how such an approach could be extended to other human issues, and demonstrates their impact on ATM business performance.

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Applying the Managing from Clarity Methodology to Sustainable Management of the Water Supply and Recollection System in the City of Leon

This paper tells about our experience in using the "Managing from Clarity" methodology – systems thinking and system dynamics – to aid group decision-making and strategy development for the governmental water management system in the city of Leon, Mexico, named SAPAL. The methodology consists in gaining strategic clarity in how the management team designs and manages five strategic elements – its Goals, Resources, Actions, Structure and People (GRASP). This clarity helps leaders to understand from a systemic point of view the organization with which they are interacting every day, to understand how to move it in the desired direction and provides them with a dynamic and comprehensive tool with which to communicate the whole view of the organization and where everyone fits in it.

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Dynamics of Information in the Meat Supply Chain: The Argentinean Case

This work analyzes the bovine meat chain in Argentina. Using system dynamics a model was elaborated. This model picks up the operation of the supply chain coordination of bovine meat. This model picks up delays, feedback and non-lineal relationships to explain the coordination mechanisms among the different actors. The chain works with a mechanism of market coordination. Delays in the transmission of the price are common. These delays are confused with the shortage of information inside the production and distribution system. If the mechanisms of information transmission worked, coordinately, this information it would arrive quickly to the producer who could improve the product quality by means of superior genetics, quick selection for precocity, fertility, speed of growth, feeding, sanity, etc. The delays in the arrival of the information affect the correct offer chain coordination.

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Dealing with Complexity in Telecom: A System Dynamics Approach for Planning New Services and Technologies

Telecom markets are undergoing rapid change all over the world. Economy globalisation, deregulation, technology evolution and increased competition all present continuous challenges to telecom players. In order to successfully operate in this new scenario, telecom operators and service providers must use new

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approaches, tools and techniques to face the demand for new services and applications by users. The complexity and dynamism exhibited by such a scenario and by the features and technologies inherent to new telecom services, make a system thinking/system dynamics approach especially suited for the job. This paper presents the methodology for telecom service planning that has been used by our team at CPqD. The methodology incorporates a systems thinking/system dynamics approach in order to support business modelling and the risk analysis. The paper also shows how the methodology is put to work, helping a software developer to evaluate and compare different business models associated with an electronic courier service.

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World Integrated Warning Forecasting System Based on System Dynamics Principles as a Basic Factor in Sustainable Development

The world is in crisis. For reaching sustainable development, it is necessary to change methods of shaping policy based on knowledge of its complex and future results. We ought to create the possibility of forecasting and measurably evaluating policy effects and other changes in life conditions. This will allow economics to change based on accounts of complex profits and costs with their social and natural elements. To this end a big international science-technology operation on the popular and common use of system dynamics should be done. For proper governance I propose also popularizing the System of Life (SoL) – a general homeomorphic conceptual model. SoL reflects common properties and structural features of systems: man – technology – environment (social and/or natural), their sub-systems (especially man – technology) and over-systems. It reflects life-systems feedbacks. It also reflects the life processes of these kinds of systems. SoL includes static as well as dynamic properties and structural features of such systems.

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A Simulation Study of Domestic Rice Distribution Under New Japanese Food Law of 1994

The Japanese government has been developing policy in Japanese agriculture in a new international environment. A new Food Law was established in 1994. The old law had provided for government control over the production, purchase and pricing of rice, but the new law confines its role mainly to storage. The government projects the supply and demand of rice to ensure stabilization, establish the price, and implement production adjustments and coordination of a flexible stockpiling system. A simulation study was made to obtain basic information about the

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operation of stockpiles and the amount of planned distribution of governmental purchases and imports. Assuming that rice is shipped through the voluntarily marketed rice channel or through government channels, a system dynamics model of rice distribution was constructed. Our simulation greatly helps to understand that the voluntarily marketed distribution plan may be approved to maintain stockpiles and withhold rice from the market if necessary.

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Immanent Haziness of Social Systems: Mathematical Description and Control

The hierarchical multilevel system theory is used to the social system evolution description. The development of the social system as an evolution of systems with inside non-determination is studied on the base of non-standard analysis. The evolution of social systems is represented as a movement in the space of states. "Human" states space is the reduction of full space which is happening by the filtration. The global and local optimal trajectories from point of view of mathematics are determined.

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Applying System Dynamics Modeling for Learning to a Messy Problem in the Public Sector

This paper describes a community modeling process for the Greater Boston region developed jointly by the author and the Boston Foundation that emphasized the modeling-as-learning approach and addressed the unique characteristics of this public sector situation. The process was successfully piloted in a series of eight three-hour workshops. By repeating the workshop multiple times, we were able to develop greater confidence in the vision, trends, possible drivers, and recommended strategies. Formal feedback forms and informal questioning indicated that participants left the workshops energized by their new insight and hopeful that change was possible. Subsequent stages of the process have yet to be developed but they will build on the work already done. In a very real way, the modeling process might even serve to assist in defining the problem itself more clearly as the systemic interrelations of the key trends are better understood and we gain confidence in our chosen model boundary.

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A Dynamic Model for the Development of New Technologies for Ship Systems

In this age of constant influx of new technologies, organizations must continually adopt and exploit new technologies. Unfortunately, adopting new technologies may bring unexpected consequences for the systems the organization procures. The traditional systems engineering implementation process as practiced in many organizations can be thought of as the chief reason for the ineffective implementation of new technologies. It fails to adequately plan for the technology's life cycle that includes development, integration on existing platforms, operations and disposal. The objective of this research is to develop a system dynamics modeling framework that will allow for the evaluation of the technology development process as an integral part of the technology implementation process. The fundamental dynamic behaviors will be explored given that cost overruns are a very important control mechanism within the technology development process. As part of this modeling effort the effects of workforce training, complexity and maturity of the new technology, and rework will be addressed.

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Growing Vacationland by Retaining and Attracting Knowledge Workers

This paper considers the benefit of retaining and attracting highly skilled workers as a means toward prompting job and income creation in the State of Maine, a rural region of the US with a small share of high-tech jobs. The region faces dual problems of the out-migration of young, educated workers and an inability to grow its labor force with the kind of knowledge workers that high-tech firms want. As a consequence, the State has limited success in attracting or growing high-tech companies. Research findings from other regions demonstrate the crucial linkage between a region's quality of place and its ability to attract and

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retain knowledge workers. Can Maine follow a similar path? The paper proposes developing a system dynamics model based upon the knowledge of participants involved in a collaborative effort. The desirability of forging public-private alliances to stimulate investment in the cultural capital of the State is explored.

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Environmental Carrying Capacity of the Seoul Metropolitan Area: Estimation, Implication and Limitations

The purpose of this paper is estimating the environmental carrying capacity of the Seoul Metropolitan Area for sustainable city management using a system dynamics model. Environmental carrying capacity can be defined as the level of human activity which a region can sustain at an acceptable quality of life level. In this paper, the environmental carrying capacity was operationalized as a maximum number of industry structure, population, and housing that can sustain a certain level of environmental quality. The model developed limits its main focus to the NO2 level of ambient air of Seoul. A box model was used to improve the estimation of ambient air quality of Seoul. The box model was translated into a system dynamics model and combined with an urban dynamics model to estimate the maximum number of population, industry structure, and housing at an equilibrium point that sustains a desirable NO2 level. Several policy implications for sustainable city management are discussed.

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Savings-Investments Model in Egypt

This work is an extension of the work by Nathan Forrester on the use of basic macroeconomic theory to stabilize policy analysis. Our main contribution, in this paper, is embedding the gap between savings and investments that already exists in the Egyptian economy and how to eliminate this gap. Explaining the reasons beyond this problem needs first to exhibit the Egyptian economic cycle represented in the production cycle of gross domestic production (GDP). The GDP depends on potential production (which consists of labor force and capital available in our society) and total demand in short-term. The capital formation cycle depends on total domestic investment, which consists of public investment and private investment. The total domestic investment depends on what is available from local resources. The macroeconomic level contains many feedback loops that require us to offer a structural interpretation of the behavior of the Egyptian economy.

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Reindeer Husbandry: A Practical Decision Tool for Adaptation of Herds to Rangelands

This decision-tool is focused on the adaptation of reindeer herds to available food resources in a district, i.e. to the availability and quality of winter and summer pastures. Previous studies have found that practical management is complicated by the dynamics involved and by lack of precise information. Hence one is faced with an information problem. The decision-tool captures the essence of optimisation models and should be sufficiently simple to be used in practice. In short, the decision-tool helps organize raw time-series data such that they become directly useful for decision-making. The intention is that the tool shall stimulate to reflection and discussions that may lead to increased mutual understanding, better collection and use of data, and to better strategies. Case studies from the Nordic countries indicate that the tool produces new and interesting insights from existing data. Feel free to ask the authors for a demonstration of the tool.

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Aggregate Versus Cohort Models: A Policy Sensitivity Analysis

The purpose of this paper is twofold. First, we compare two representations of a fish stock: a complex cohort (age-class) model and a simple aggregate (surplus growth) model. A key question is whether the aggregate model is an appropriate simplification of the more complex model. The comparison is made with respect to the optimal fishing strategies that follow from each representation. With proper economic mechanisms in place, the difference between the two harvesting policies is surprisingly small. Second, we see the comparison as an example of an advanced sensitivity analysis, where sensitivity in terms of policy is considered rather than in terms of behavior. Assuming the ultimate aim of modeling is better policies, our choice seems a proper one. However, we also recognize that in many cases, less costly tests of behavioral sensitivity may prove more practical.

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Value of Predicting Environmental Variation in Fishery Management

Decision-makers are often concerned with forecasts of environmental variables. However, the value of forecasts in terms of improved quality of decisions is not extensively studied. In this article we investigate the value of forecasts by the use of stochastic, dynamic optimization. The case is Northeast Arctic cod (Gadus Morhua) in the Barents Sea. We find that the value of ideal forecasts, when used to their full potential, is around 3 to

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5 percent improvement in expected net present value. More realistic forecasts lead to improvements less than one percent. For practical purposes, it is only the forecast for the coming year that matters, long-term forecasts are of no use because the managed fishery is very flexible. These findings suggest that highly simplified forecasts can be used in models. The conclusions are likely to be somewhat sensitive to choice of model, a theme for further research.

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Repeated Overshoot and Collapse Behavior: An Example from the Petroleum Industry

Repeated overshoot and collapse behavior is commonly observed both in manufacturing and service industries, as well as in other social and ecological systems. This paper uses an example from the petroleum industry to illustrate a causal structure that can give rise to such behavior. Increasing business unit performance repeatedly erodes and overshoots the capacity of the business to continue to produce increasing performance. When business unit performance falls due to eroded capacity, the capacity gradually recovers, eventually enabling a new spurt of business growth. Changing the capacity acquisition policy shifts business performance behavior from repeated overshoot and collapse to desired exponential growth. Model extensions, including balancing capacity acquisition against the risk of having too much capacity in a market downturn, are discussed.

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Air Traffic Controller Manpower Planning Modeling: A Learning Platform for Understanding the Staffing Process

Air Traffic Controller (ATCO) shortages seem difficult to overcome worldwide. Some aspects of manpower needs are probably considered at too late a stage or their impact is underestimated. An ATCO Manpower Planning (MP) simulation model (LAMPS) has been developed to assess the overall MP process in relation to air traffic demand over a period of 15 years. LAMPS enables the various players/decision makers to increase awareness of the impact of MP policy decisions in the long term, thus providing a learning platform for improved decision making.

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Simulation of a B2C E-Commerce Model of Durable Consumption Goods

The work managed to develop an administrative tool that has the purpose of facilitating the strategic decision-making knowing the results towards the future of the actions, without having to invest money, time, resources and personnel. Additionally the risk of

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making erroneous decisions is diminished and it qualifies the managers. It gives fast and easy answer to the day to day questions of "What happens if...?" making it possible to play with the company. The model developed "simulation of a B2C e-commerce model of durable consumption goods" based on real data obtained from Amazon.com, Buy.com and Egghead, allows taking different decisions: price, site launching (budget and time period), marketing expenses and selling of banner advertising. The different decisions enable the trial and error development of a profitable dynamic strategy. As you play with the model you may experiment different scenarios and use variable sensibility.

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The Dynamics of Strategic Electricity Trading

As electricity markets are turning competitive, uncertainty becomes a major threat to trading companies. In this environment a single strategic intent seems inappropriate as important endogenous and exogenous variables are not predictable and may have important negative impact on the company's performance. In this paper, we undertake Markides' idea of a portfolio of strategies (2000, 2001) and apply it to the electricity trading industry. We explore the viability of this approach, that embeds feedback thinking, by using a system dynamics model for a hypothetical electricity market. We use Porter's competitive advantage framework and apply it to three generic strategies in order to examine the idea of a portfolio of strategies. We describe the system dynamics model that was developed for this purpose and present simulation results.

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Modeling the Dynamic Complexity of the Energy Policymaking Process

This paper presents a system dynamics approach to modeling how electric energy policy is created and modified in democratic nations. The selection of future generation capacity depends upon the comparative economics between technologies. These economics are subject to variation as societal concerns about such issues as supply reliability, safety, and environmental effects change. The model represents the issues that create concern and the various segments of society that articulate the concerns. The model incorporates a representation of how the political structure within the United States responds to concerns in terms of policy outputs that affect energy economics. Decisions regarding capacity additions are based upon the most profitable choice available to the utility at the moment of decision. Demand is treated as an exogenous variable. Energy production to meet the demand produces byproducts and consequences that in turn feedback to the societal sector concerns.

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A System Dynamics Model for a New Perspective on the Colombia Decentralisation Process Reform

Since the mid 80's, Colombia has developed a full decentralisation process in order to achieve better results in local governments. However, the performance hasn't been the best. Colombia shows a worrying situation, high levels of poverty, violence, and corruption and a low quality of life. An additional element is that the Colombian decentralisation model has been dominated by an economical approach. This means that the policies have been based on statistical and econometric analysis. But it lacks a systemic view. The aim of this paper is to show how system dynamics may complement the public policy analysis in Colombia, in particular the intergovernmental and decentralisation policy design. To achieve this purpose, the project develops a system dynamics model around the problem mentioned above, specifically its focuses in the financial transfers policy and its problems associated with it.

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Stock-Flow Thinking and Reading Stock-Flow-Related Graphs: An Empirical Investigation in Dynamic Thinking Abilities

This paper reports on an empirical study of the ability of university students to discern between stocks and flows. It is a sequel to the "Bathtub Dynamics" study of Sweeney/Sterman 2000. The 154 subjects were given six different tasks. Some of them required the ability to read and interpret time-graphs. The findings were alarming. Generally the study showed severe deficits in the ability to discern between stocks and flows. These deficits did not depend upon whether the tasks required to read/draw graphs or not. Graphs showing the development of flows over time were interpreted by many subjects as if these were graphs of stocks. The findings of this study motivated a sequel study, which has been done in the Spring 2001 semester. In this study the effect of a “crash course” in stockflow thinking was tested in a pretest-posttest design. The results are summarized in Kainz/Ossimitz (2002).

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Design of Information Systems: Simulating the Effectiveness of Knowledge Transfer Throughout the System Analysis Phase

One of the critical issues determining the successful development of information systems is what might be described as the communication gap between the user group and the IS development group that occurs during the system analysis phase.

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This gap, we contend, stems from the lack of understanding of one another's domain knowledge without for example, a common vocabulary it is difficult to exchange knowledge. This article presents a system dynamics model that can simulate various knowledge exchange scenarios, to help develop strategies for an optimal knowledge transfer between these two groups. Knowledge exchange scenarios are a function of both the quantity (e.g. vocabulary) and quality (e.g. timeliness) of the knowledge possessed by each group. The paper concludes with a demonstration of different policy implementations and their impact on the effectiveness of the knowledge transfer during the systems analysis phase.

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Dynamic Analysis of the Viability of Alternative Energy Sources in Meeting the Electricity Demand

The viability of alternative and renewable energy sources in meeting the electricity demand in the long term has often been challenged. It has been argued that it is unrealistic and infeasible to meet a significant part of the electricity demand by alternative sources, because such sources are not only uncertain and inadequate, but they also exhibit high variability by nature. In this research we build a dynamic model in order to investigate if alternative energy sources can play a viable role in meeting the electricity demand in the long term. The model is constructed and calibrated using relevant energy and electricity data of Turkey. Different investment policies are investigated, based on cost considerations, on environmental indicators and other criteria. Results of different policy scenarios reveal the importance and viability of alternative energy sources under different conditions. We also investigate scenarios/policies that encourage energy savings.

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Structural Changes in US Dairy Farming and the Role of Government Policy

Agricultural policy faces conflicting social goals. On one hand, efficient large-scale agriculture provides an adequate, low cost food supply, but many Americans continue to idealize the smaller family farm , believing that it promotes a democratic society with strong values. The changing structure of agriculture from many small farms to fewer but larger farms is a concern often expressed. Many causes have been suggested to explain the decay in farm numbers and continual growth in average farm size. These include technological changes, lower production costs on larger operations, barriers to entry and expansion due to large required investments in land, buildings, and equipment, opportunities for earning income by working off the farm, and

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government policies that affect farm profitability. This research examines these factors and their interactions in the dynamic context of the U.S. dairy industry, with an emphasis on government policy intervention.

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The Process Model of Problem-Solving Difficulty

Groups and organizations, or in general multi-actor decision-making groups, frequently come across complex problems in which neither the problem definition nor the interrelations of parts that make up the problem are well defined. Members of a decision-making group have disagreements on what the problem is and/or how it should be solved. The study reported in this paper represents a causal loop diagram which brings together different causes that lead the group members into disagreement. In this way features of individual and group decision-making can be integrated in a coherent framework. By analyzing the problem from a feedback point of view, we hope to clarify the self-perpetuating quality of these problems. The main feedback loops in this model were identified with the aim of pointing out key issues to keep in mind for interventions in complex problems. A small portion of this model was also quantified to show the possible creation of a sustained disagreement situation.

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Exploring the Dynamics of the Mobile Internet Service Market in Korea

In recent years many research institutes have reported their predictions on the growth of mobile Internet services, announcing that the market would show explosive growth and replace the wired Internet service market rapidly. However, the reality we are facing at present is quite different from their expectations. The realized share of the mobile services in Korea last year was only about one percent of the total network service market. What are the reasons for the gap between the prospects and the realities? Starting from this question, this paper attempts some reasoning about why traditional number-crunching methods are no longer appropriate for the forecast of newly emerging markets and explores their generic pitfalls. As an alternative, by introducing systems thinking from a structural perspective, this paper presents examples of system dynamics models at a meta level for the mobile Internet service market in Korea, followed by its rationale as a new tool for forecasting and policy-making support.

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A System Dynamics for Recognition of Other Peoples' Perspective as Reinterpretation of the Essential Assignment of the Systems Approach

The present paper proposes a system dynamics for recognition. System dynamics has been considered a thinking technology of the system approach to modeling and computer simulation. Its use has been defined for several areas such as optimation, planification, control, prospective, learning and representation. This paper proposes and describe the process to define a reference framing for a system dynamics that is presented for recognition of other peoples' perspective. This goal is defined in a way to consider the recognition of the others' perspectives the fundamental goal of the system approach. The diversity of uses of system dynamics defines researching areas related to the research area of this work. A synthesis of the methodology and some reflections about systemic technologies and their instrumentalization (enframing) process, like a non-recognition of the essential's assigment of the systems approach, will be presented.

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State Policies on Self-Sufficiency in Agricultural Section of Iran

A system dynamics approach is presented in this paper to study the long-term effects of Iranian State policies to support agriculture and gain self-sufficiency (SS) of products. Agriculture is studied as one section of the whole national economy. The self-sufficiency index is defined in terms of the ability of the economy to domestically answer the demand for food. Policies such as controlled exchange rate and fixed prices have important effects on production and export of foods. These policies are taken to support consumers and producers against high prices, to increase the SS index and the nutrition rate. In the model presented, the aim is to measure variables like export, ICOR index, the ratio of investment to surplus, and SS index against counter policies such as equilibrium prices and floating exchange rates in long term. It is shown that recommended policies to activate the whole economy are equally effective in this special section.

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The Impact of the HIV/AIDS Epidemic on the Population Age Structure of Zimbabwe

The HIV/AIDS multistage model presented here has been expressly developed and adapted to the specific Zimbabwean situation to evaluate the effects of the implementation of different possible policies, which are intended to fight the virus

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diffusion, on the population as a whole and specifically on its age distribution. Very interesting insights have been gained by testing the model with different actual policies, specifically the introduction of the HAART treatment, which is able to stretch the expected lifetime of infected subjects and improve their life conditions, and the introduction of Viramune/Nevirapina. The results of these kinds of interventions have also been compared with those of more soft oriented policies, such as sensitization or information campaign, and the opportunity to integrate one with each other has been evaluated. The resulting model behaviors in these hypothetical scenarios have in some cases been counterintuitive and ultimately lead to reflection on the recent development of HIV/AIDS international agreements.

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A Conceptual Model for the Municipality of Vila Real

To manage present situations, such as housing, traffic, employment and environmental quality, as well as to path a sustainable future for the municipality, the town hall of Vila Real and the University of Trás-os-Montes e Alto Douro have jointly launched a project to enhance decision-making at key processes – namely strategic planning and management. The joint project is structured along the classic "intelligence-design-choice" model of decision-making, with slight modifications. The first phase of the project is to describe the current situation in the municipality by producing a conceptual system model, and simultaneously seek problem situations and opportunities. The second phase involves a numerical version of the system model, still descriptive in nature, and the creation of possible development or management scenarios. The third phase involves the simulation of these scenarios and the selection of the best one(s) against a set of community-wide value criteria. This last phase also features a global review of the project.

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The Challenge of Teaching System Dynamics in the ITESM System: A Proposal for a Teaching-Learning Method

This paper addresses the didactic of the course of System Dynamics after a redesign process at ITESM Campus Monterrey. Design elements, educative intention, general objective, didactic strategy, contents, evaluation system, and information technology in use are discussed. Implementation has been done using a technological platform based on Lotus Notes / Learning Space. Qualitative results of implementation are presented indicating the advantages in both directions: (1) learning by the students and (2) teaching-practice transferring by the teachers.

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Reorganizing the Clinical Treatment of Stroke Patients

With the aim of improving patient outcome, the County of Funen - after adoption of a new hospital structure in May 2001 - decided that stroke treatment in future should be carried out in 2 stroke units and one rehabilitation unit. The County has a total catchment area of approx. 470,000 inhabitants. Stroke treatment has so far been carried out in 8 different hospital units in the county. In June 2001, a working group with a multidisciplinary representation from the units involved, including general practice and the municipalities, was set up with the task of making proposals as to how treatment should be organised and which capacity the new units should have. Altogether, 16 different departments were involved in the work. This poster shows how ideas from system dynamics and the simulation program I'think was used to help the working group in their considerations.

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The Economics of a Biting Minimum Wage

Conventional wisdom as regards the effects of a biting minimum wage (MW) is challenged in this paper through the findings of a system dynamics model. Given a number of different plausible assumptions, a number of counterintuitive results are found to emerge such as a longer term permanent increase in employment levels, a greater total number of businesses in the economy associated with lower total employment levels than originally, and a trade-off in the wellbeing and the employment levels between those firms whose cost structure was affected by the MW and the unaffected firms. Finally, two variables that are normally considered to be irrelevant to the investigation of the economic effects of a biting MW, namely consumption spending and fixed costs per business, come to the forefront of the analysis.

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Symphony of Eigenvalues: A Prototype for Sonification in System Dynamics

Sonification is the use of nonspeech audio to convey information and can enhance the ability of system dynamics in the analysis of relationships between structure and behavior. Today's desktop computing power allows users of software such as MAX and MSP to create a variety of sounds whose parameters are determined by the mappings of imported data. The prototype discussed used pitch, timbre and amplitude to describe the values and first and second order differences, respectively, of the state variables. A two-parameter model of Hares and Lynx demonstrated the sonic effects, while another two-parameter

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model of Alcohol and Cells featured the addition of sonified eigenvalues, illustrating the combined fields' potential to provide an early warning detection to changes in feedback loop dominance. The prototype's ability to express 10 parameters of interest with just 4 sounds should appeal to the fields of business, education, and the arts.

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Market Model Design and Systems Thinking as Decision Support: Public Wireless LAN Market Dynamics as a Case Study

Wireless computer networks have rapidly achieved a wide market acceptance since 1999. Until recently, telephone systems have been the unchallenged bearers of public data traffic in a mobile context, but lately questions have been raised about possibilities of using alternative technologies for data transfer; the benefits of a third generation mobile infrastructure have even questioned by proponents of public wireless computer networks. In this paper, the evolution of a fictive market for public wireless networks is modelled in a system dynamics interface. The research purpose is to investigate how a given performance measure – in this case cash flow – is affected by different parameters in a causal model, for public wireless computer networks, in order to visualise the actual system. The model is intended to help the explanation, understanding and possibly even prediction of the market for public wireless computer networks, by enabling the testing of possible scenarios.

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System Dynamics and Intelligent Agent-Based Simulation: Where is the Synergy?

System dynamics also allows managers to make their understanding of business problems explicit and improve upon them. This occurs by modelling structures that underlie behaviour of systems. While system dynamics acknowledges the critical role of personal and organizational mental models as the foundation or key influencers of structure, it does not explicitly model mental models. In contrast, in Agent-Based Modelling (ABM), organizations are modelled as a system of semiautonomous decision-making parts (purposeful individuals) called agents. Experience shows that even a simple agent-based model can exhibit complex behaviour patterns and provide valuable information about the dynamics of real world systems. In this paper the two different simulation approaches to learning effectiveness, i.e., agent-based modelling and system dynamics, are compared conceptually and the potential synergy between them is discussed. This paper is theoretical and exploratory in nature. Further studies are needed to provide empirical evidence.

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Setting Strategic Agendas: The Use of Qualitative Methods in Highly Politicized Contexts

In the early phases of using simulation models to support strategic decision-making, the emphasis is on expressing information and physical flows. While this is appropriate for many managed systems, we suggest that it is inappropriate for a large class of problems involving the motivations and powers of agents in the system. In such highly politicised systems it is necessary to take the political aspects of power into account at an early stage in the analysis. We present an approach to this class of problems, using a qualitative procedure based on influence diagrams. This method has been extensively and successful use in consultancy to study the motivations and powers of agents and thereby produces naturally an output directed at action planning at the strategic level. While it is complementary to numerical system dynamics approaches, it is more successful in deriving components of strategic action directly from analysis.

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An Artificial Stock Market in a System Dynamics Approach

In order to model the stock market behavior and characterize asset price and wealth dynamics arising from interactions of heterogeneous agents, this paper studies the price dynamics induced by two of the most commonly used financial trading strategies. It shows how these strategies amplify noise, and cause phenomena such as excess and cluster volatility. Since this kind of study starts from the analysis of trading strategies, it follows the bottom-up approach that is typical of agent-based financial markets. Investors' trading rules are modeled more or less as the strategies are used in the real world. In closing, some of the questions centred on market stability will be discussed. No attempt has been made to make forecasts, which are not trivial for this kind of model. To model market behavior and trading strategies, system dynamics methodology has been used.

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A Model for Evaluating the Policy Impact on Poverty

For decades poverty reduction in developing countries has been one of the most challenging tasks for the policy maker. Recent trends show the income distribution has become more biased toward the rich. This paper reports on efforts to develop a dynamic model to evaluate the impact of alternative policies focused on the poor, including such common ideas as providing them free health care and reducing their income tax obligation.

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The model measures the impact of a particular policy on the Gini coefficient or the number of households below a poverty line. The purpose for creating the model is to possibly develop a poverty reduction sector to include in the T21 (Threshold 21) National Development Model.

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Nation State Food Security: A Simulation of Food Production, Population Consumption, and Sustainable Developmetn

The goals of the present paper are: (1) to develop and evaluate a system dynamics food security model based upon a combination of Malthusian, neoclassical, and distributionist methodologies as they are used to study nation-state food security behavior in a complex global arena; and (2) to infer from the evaluation of this model some implications, or insights, for food security policies. Our research is heavily grounded in the theory of nonlinear dynamics and feedback control originally developed in mathematics, physics, and engineering. Utilizing system dynamics methods and tools, we seek to explain interactions between nation states by phenomena such as their prior behavior within the structure of interrelated political, economic, and ecological systems. Because learning about these complex systems requires more than technical tools to create mathematical models, dynamic simulation will be utilized to bridge the physical and technical sciences with the cognitive psychology, economics, and environmental specializations of the social sciences.

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Learning from Experience with Delayed Feedback

Many important settings in individual and organizational life involve allocating resources between different types of activities with different delays between allocation and results. Empirical studies show that learning is difficult in dynamic systems and people often fail to learn from experience in the presence of delays. Understanding the processes that hinder learning from experience is central to improving learning and decisionmaking. We use a formal model to examine the effect of time delays on learning from experience. The model represents a decision-maker engaged in a continuous time allocation task who learns from his performance as he tries to improve the payoff determined by his own actions. Our analysis shows that in an easy learning task where the payoff landscape is smooth and has only a single peak, we can still observe sub-optimal performance. Moreover, the decision-maker can learn to believe that the sub-optimal performance is really the best she can do.

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Systems Approach to Business Rules

In the traditional way of information system development everything is put into code. Every time a business event occurs the decision-maker needs to look into the 'code' for business rules to take a decision with respect to the business event. Therefore, access to the business rules for the decision-maker is a problem. Every decision-maker may not and need not be a software professional. The primary motive behind the business rules approach is to separate business logic from program logic. Software engineering professionals are addressing these concerns. To understand the business rules approach in a holistic manner and make it an effective tool for decision-making, software engineering tools are not enough when the motive is to understand the business process and business dynamics and to help decision-makers take a decision using business rules. This study uses systems thinking principles to address these issues. It uses cognitive modeling and interpretive structural modeling to understand the business process.

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Dynamics of Schedule Pressure in Software Projects

This paper studies the dynamics of schedule pressure in software projects. It constructs a system dynamics model of the software development process, which includes the following modules: Flow of Work, Work Being Done, Inspection, Fault Detection and Rework, and Supplementary Variables. It includes the

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module 'Effect of Schedule Pressure' and integrates it with the rest of the model. The model presents the results of two sets of schedule-related policies of a system dynamics model. The first set of policies that pertain to the base model does not consider the effect of schedule pressure on the staff productivity and errorproneness while the second set of policies pertaining to the revised model does. This study finds that effect of schedule pressure on software project is non-linear and dynamics of schedule pressure is intricately related to decision making process of the project manager, thus, making software projects management complex and counterintuitive.

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Critical Drivers of Firms' Performance: A Journey Through the Insights and Results Generated by a System Dynamics Project

When business managers drive a company "off the cliff," accelerating as they go, it's a tragic and puzzling event. When they are cheered on by investment analysts saying, "More, more, more!" one can't help but ask: how did they all get it so wrong? The case of Exodus Communications Inc illustrates how this can happen and how clear dissonance can emerge between critical value drivers and the targets pursued by management. The system dynamics technique illustrated in this paper provides insights into how management can better anticipate significant and critical shifts in the metrics they need to watch. It also illustrates how a system dynamics approach can lead to exceptional insights in the data collection phase, when the model is still on paper.

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The Introduction of Mobility Rights: A First Exploration Through the Use of a System Dynamics Model

In this paper the socio-economic effectiveness of transferable mobility rights will be analysed through the use of a system dynamics model. Transferable mobility rights are an innovative solution for mobility problems. The aim is to give a restrictive amount of rights of mobility to the citizens in order to cope with the external effects of transport, such as congestion and emissions. The rights are transferable and as such can also have a redistributional effect. Economical, social, and ecological goals are coming here together. In order to see the complex interaction between these three dimensions and the effect of the introduction of the system of transferable mobility rights a system dynamics model is developed. This model will allow simulation of the impact of alternative policy scenarios on the system. These alternatives include the various possible designs of the transferable mobility rights system.

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New Corporate Strategies: A Comparative Social Cybernetics Analysis of Nokia and British Telecom

In the theoretical discussions on various new global strategies, cultural, networked and innovative ones are complementing or substituting the traditional strategies often focusing on best practice, differentiation, core businesses, economics of scale … In the traditional methodologies for doing strategic analysis the head problem was to make a constructive alignment between resources, businesses and organization, thereby gaining competitive advantage, control and coordination for the corporation in question. By analyzing and comparing the character of management processes used by two different well known global players within the teleindustry, British Telecom and Nokia, the article tries to find out, if other methodological points of departure could be more convenient and constructive. In conclusion, social cybernetics analysis, with its focus on causes for entropy, self-sustaining and reinforcing mental models in use, and systems dynamics … nowadays is often a better guide in the global oriented strategic work than more traditional structural oriented analyses.

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Use of Financial System Dynamics Models in Local Government

While much has been written about the insights that SD modeling can bring to the understanding of complex systems less has been written about the value of SD models as interactive communication devices. The work outlined below focused on this communication aspect of SD models by taking the standard accounting data from the organisations' financial spreadsheets and incorporating them into a model that captures the key dynamics of their long-term financial strategy. Built with the assistance of the accounting staff, the model translated accounting rules into stock/flow language utilising ithink software. The software enabled managers and councillors to explore the consequences of different assumptions and financial strategies. The end result was a much greater understanding of the dynamics of financial performance and an awareness of the levers that influence financial performance. This work is illustrated with extracts from the model used.

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Misattribution in Welfare Dynamics: The Puzzling Dynamics of Recidivism

A recent two-year model-based study of the dynamics of welfare reform in the United States involved more than sixty experts

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from three New York State counties. The initiative resulted in the creation, analysis, and use of a dynamic computer simulation model of more than 400 equations, and the implementation of policy insights from the study. A crucial insight from that large study is captured in this presentation in a tiny model with apparently wide, generic applicability. The presentation will give the context of the work and then explore the puzzling, counterintuitive dynamics of this little generic structure, leading to policy implications and a set of insights about recidivism in complex social support systems.

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ATOMM: Army Transformation Officer Management Model

As the United States Army transforms from a legacy force to the army that fights as part of the future combat system, new methods for modeling and managing officer strength are needed. Currently the Army Personnel Office uses spreadsheet-based models to project and monitor the officer strength of the Army for the execution year and six years into the future. In order to streamline officer strength management and analysis it is recommended that a robust model based on system dynamics should be adopted. The current spreadsheet-based models are not very flexible and do not allow for quick and timely analysis on all officer strength management issues raised by the Department of the Army staff. This research will show the advantages of using system dynamics concepts to model officer strength by outlining a well-defined model which provides the analyst with the capability to compare the effects of proposed policy alternatives.

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Information Systems Implementation, Change Model

This paper describes how systems thinking provided a framework for the development of a Systems Implementation Change Model (SICM). After a period of human resources functional integration, South African Breweries implemented SAP Human Resources as a means of ensuring consistent and real time human resource information that could be used strategically by line managers. As the implementation of SAPHR was seen as a change management intervention rather than an information technology intervention, the implementation process, namely the SICM, was based on John Kotter's eight steps for successful change (Kotter, 1998). This Systems Implementation Change Model draws its key assumptions and principles from system dynamics thinking and has built into the model the capacity for continuous organic growth. Currently this model is used for all systems implementations in SAB (South Africa).

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The Educational Value of Microworld Simulation

Microworlds as computer-based simulations can be important tools to support learning. In this respect, microworld simulation has been said to build substantial synergy between learning to think in systems frameworks and learning to deal with the complexity of actual settings. Since the first microworlds were introduced, their educational value has been accepted as an article of faith. In this paper the implications and results of adopting microworlds are explored in terms of student learning, educational approach and course design. These implications are illustrated with quantitative and qualitative questionnaire data obtained from courses in undergraduate Business programs as well as a post-experience MBA-program. In general, these data suggest that learning processes can be deepened and accelerated by creating effective combinations of lectures, cases, readings and microworlds.

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Community Dynamics: Tools to Understand the Value Drivers of a Community

To make reasonable strategic decisions within a company you need to understand the value drivers. PwC Consulting uses a

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systems approach to understand the value drivers of a business. Understanding the value drivers allows you to understand the business system. Within a business community the complicating factor is the interaction between businesses in the community. Understanding the community drivers is necessary to manage the community and develop a sustainable structure. To understand the community dynamics you need to understand the feedback relationships inherent within the community. To deepen our understanding of the dynamics of a community a quantified model can be developed. A computer simulation of the community dynamics is a powerful tool to explain the benefits of the community to the participants and also a powerful learning tool and change agent. As a summary, the stages of development of a Community Dynamics model are shown.

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The Effectiveness of Using E-Collaboration Tools in the Supply Chain: An Assessment Study with System Dynamics

Developments in information technologies in recent years have enabled major advances in electronic commerce and e-commerce is growing at a very fast pace. Although business-to-consumer (B2C) e-commerce seems to be slowdown due to economic conditions, business-to-business (B2B) e-commerce still represents the next generation of business automation. Taking advantage of new technologies, is nowadays an opportunity, but will be a must in the future. Internet e-collaboration tools show up in this new era, and besides playing a role of "value creation enabler", also generate a wide range of "new business and market complexities" that companies have to face. This paper presents a classification of "managerial spaces" where multiple trading partners share critical information using e-collaboration tools and assesses the possible local and global impact on the supply chain (SC) performance. This is made by means of a conception of a supply chain model and a simulation study with System Dynamics.

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Modeling and Simulation of a Manufacturing Line in an Automotive Components Plant

The aim of this research is the modelling and simulation of an Integrated Manufacturing Line which produces the third idle gear to be assembled in the final product, an automotive speed gear box. The manager of the plant wanted to know the maximum capacity of the line and to make some process improvements leading to a better behaviour of the system. The model

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constructed using system dynamics, in a discrete line, has been validated and is being successfully applied to the plant. (A previous simulation study was conducted using an interactive discrete simulation software.)

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A Historical Fit of a Model of the US Long Wave

This paper refines a theoretical model of capitalist reproduction. A compact state-space form of this model defines a hypothetical Law of capital accumulation. The state variables are the unit wage, employment ratio, gross unit rent, man-made capital-output ratio, natural capital-output ratio, indicated natural capital-output ratio, and unit depreciation of the natural capital. An application of an extended Kalman filtering to the US macroeconomic data 1958-1991 identifies unobservable components of this Law. It is shown that long wave is a dominant non-equilibrium quasi-periodic behavioural pattern of the US capital accumulation. Evaluating the historical fit through appropriate summary statistics and long-range forecasting strengthen confidence in the model.

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Software Technology Transition Model: Dynamical System Model

This paper considers an information theoretic and dynamical systems technology transfer model. The model enables decision-makers to "engineer" resource and risk programmatic issues. Analysis with the model enables prediction and prescriptive action for a research or program manager. The model deals with entropy as defined in information theory. The TechTx Basic Entropy model addresses macro level trends of a technology at the community level. The dynamical systems TechTx Entropy Feedback model is based on non-linear control theory. The paper develops the state quantities to develop state functions for analysis of an evolutionary technology process. This summary paper focuses on the elements required to model the technology transfer process. The result is a rich set of analytical tools previously unavailable to be used for policy and programmatic issues to reduce risk, increase efficiency and accelerate maturation of a desired technology.

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SIMTRANS (Freight Transportation Simulation Model)

The authors have been asked by the French Ministry of Transport to develop a system dynamics model which could help analyze

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the dynamics of the French freight transportation market (road – rail – river). A little later, the model was modified and used to analyze the possible consequences, on that same market, of the Kyoto proposed emission credit policy. Both models are explained here, but in addition we show how an « ex post » causal loop analysis can help, in this context, to have experts understand better the numerous and often contradictory simulation results.

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Office Market Indexes Development Using System Dynamics Models

This paper presents the basis of a Real Estate Office Market indexes development, with its theoretical framework validation been made through the use of a System Dynamics model. The well recognized cyclicality of office markets, along with overbuild as a widespread problem, suggests a fundamental causal mechanism in the office market process itself. Being perceived that information lag is a major variable of the system, the use of System Dynamics models allows a better understanding of the function of each piece of information in the process. The structure and characteristics of each type of necessary information are analyzed. Database completeness and definition problems of the indexes already produced by developers are addressed in the discussion. Results indicate that information should be produced in a way to reflect the true current state of the system. Furthermore, an attempt to expand the model and the construction of a widespread database are proposed.

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Feedback Complexity of Waterlogging and Salinization on Irrigated Lands

In this paper, we introduce a dynamic simulation model, which represents the major feedback mechanisms in salinization of irrigated lands. The purpose of this model is to provide a comprehensive picture of the problem. The unit of analysis is not the farm-level, but the whole basin where irrigated lands may expand annually. Model analyses provide an assessment of relative efficiencies of water management and drainage alternatives under changing loop dominance. It reveals that the benefit from drainage diminishes as the drainage efficiency is increased. This calls for improved water management strategies rather than the drainage alternative. The model illustrates the condition when reinforcing feedback loops dominate and salinization reach alarming levels. Under this condition, increased drainage yields increased salinization, which is an

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unprecedented result. In future research, this model can be improved to analyze the affect of different water management strategies and farmers' decision rules on salinization.

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Evaluating Economic Feasibility of Environmentally Sustainable Scenarios by a Backcasting Approach with ESCOT (Economic assessment of Sustainability PoliCies Of Transport)

The aim of ESCOT (model for economic assessment of sustainability policies of transport) is to describe a development path towards a sustainable transport system in Germany and to assess its economic impacts as part of the project on environmentally sustainable transport (EST) of the OECD. ESCOT contributes to the backcasting strategy of EST from an identified EST scenario for 2050 to today's situation. ESCOT offers the opportunity to derive the macroeconomic development, considering first-round effects that are in case of a path towards sustainability mostly governed by negative influences like higher prices and restrictions on the demand side. But it also considers structural changes including secondary effects that occur only in the long run. Secondary effects arise because transport is highly interrelated with other social systems. This ability makes ESCOT a powerful instrument for the assessment of large ecological changes.

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Integrating System Dynamics and Agent-Based Modeling

This paper presents an approach to integrate the system dynamics and the agent-based modeling techniques. After reviewing the fundamental principles of the two modeling approaches, an agent-based supply chain simulation model is developed. The model consists of two levels of aggregation; on the macro level a discrete agent-based modeling approach is applied, on the micro, the agent level system dynamics is used to model the agents' internal cognitive structure. The paper concludes with first preliminary simulation results and aspects of future research.

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UML and System Dynamics Modeling

System dynamics models are only rarely used to solve practical problems in commercial enterprises and public administrations. This situation would seem to arise from two causes. One has to do with the development of mental models in general and the other with the way in which system dynamics problems are tackled. This paper will discuss to what extent Unified Modeling Language (UML) could overcome or at least minimize these two

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problems in deploying system dynamics models more widely. Some years ago UML was standardized by combining several methodologies all concerned with the processes and tools involved in software development. By now there are computer systems which facilitate working with UML or are based on it. The body of people who understand the concept and are well versed in its artefacts is being widened daily by including UML in the curricula of all relevant educational and training establishments.

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Guiding New Product Development and Pricing in an Automotive High Tech SME

This paper describes the use of system dynamics in combination with conjoint analysis to assist a high tech SME in evaluating policy options in a context where customer preferences were critical to strategic decision making. Conjoint analysis served an important role in eliciting customers' multi-attribute choice preferences, and had a significant impact on both the structure and parameterization of the final simulation model. The combination of methods was quite powerful in this case and we feel could be successfully applied to a broad class of problems where behavioral policies of decision makers include tradeoffs among multiple attributes. The alternative is to use system dynamics as a stand-alone approach and employ formulations that are not empirically derived or grounded in the extensive choice theory literature. We suggest this alternative is not viable when choice preferences are important for guiding strategic decisions, and more generally we contend that appropriately integrating relevant methods can substantially improve our system dynamics models and policy analysis.

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Short- Versus Long-Term Dynamics: The Example of Ecological Management

The natural environment has become a public issue of high priority. One of the great challenges to the management of firms today is achieving a balance between the economic, social and ecological dimensions. Managers and organizations are learning that dealing with ecological issues seriously is part of their responsibility. In this paper, the inherent rationality of an ecologically oriented approach to management is highlighted. For this purpose, a conceptual framework for a comprehensive fitness of organizations is presented. Based on this framework and on case studies in small businesses a simulation model has been developed. The structure of this model is outlined. Then, on the basis of simulation experiments, several aspects of ecological management are discussed. The focus is on tradeoffs between

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short- and longer term decisions, as well as the role of pre-control, and the vulnerability of one-sided strategies are discussed.

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An Elementary Dynamic Model of a Small Start-Up Firm

A system dynamics model of a small start-up firm is built. It regards assumptions, key variables and causal relations as described in the business economics literature. The main motivation for building this model was to bring a dynamic perspective into university education in the field of business economics, especially management accounting and control systems. Some special assumptions and parameters reflect the specificity of a real start-up firm. The results of the simulation runs with the model show the same growth patterns as have been observed in reality during the first three years of the firm's existence. The model can help the entrepreneur in understanding growth paths in the next years.

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A System Dynamics Modeling for Sustainable Growth in China

Most of the developing countries including China are faced with the problem that how to allocate its limited resource properly to make its economy grows continuously. In this paper, the system dynamics methodology is induced to solve the problem facing China. Based on the deep discussion of the interactive mechanism and interrelations among S&T, education and economy systems, and by SD modeling and simulation, this study gave out the policy advice. For example, It would be a more harmonious strategy in which both input of S&T and education increase at logarithm and education input ahead about 10 years of S&T input.

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Two Strategies for High-Tech Industry Development: Lessons from China

High-tech industry has grown very fast these several years in China, especially in the eastern coast cities like Shanghai and Shenzen, and the capital, Beijing. The high rate of growth of the high-tech industry has brought huge benefits to China's economic condition. The most eminent point shown in the recent several years is giving large impact to the exports of Chinese goods. The weight of high-tech products in the total Chinese export goods has risen very fast in comparison with other export goods in the last three years. The high rate of growth of high-tech

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industry also offers a positive influence on the structural change of the industry – this is one of the important missions facing China. This comparative study focuses on several developed areas. Two paths of high-tech industry development were studied. The balance of resource allocation between these two paths is extremely important for sustainable competence leverage and sustainable competitive advantages.

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Dynamics of High Technology Industry Development in China

The dynamics of high technology industry development (HTID) in the field is influenced by a series of factors. In China, however, these factors are influenced by the behavior patterns of government that have a strong impact on the institutional environment of HTID. Meanwhile, corporate R&D intensity makes a great impact on HTID because of the low technological innovation capabilities of Chinese firms. The motivation that drove the study is to analyze how corporate R&D intensity, and the proportion between corporate internal R&D fee and technology import one have effect on HTID; and how the behavior patterns of government have influence on HTID. To analyze these issues, a formal model was built. This paper presents the policy analysis of the model as follows: (1) How corporate R&D intensity has an effect on HTID; (2) How the proportion between corporate internal R&D fee and technology import one has effect on HTID; (3) How the behavior patterns of government have influence on HTID.

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Systems Thinking by Stealth: How to 'Wash the Great Unwashed'!

Is the systems approach as widely used as one might expect? This paper argues that it isn't. This is not because the approach is flawed or weak. Rather, it is because any hint of portrayal of the systems approach as 'the method to help you change your mental models' is likely to be perceived by successful managers more as a threat than a benefit - many people are happy with their mental models, and just don't want them changed. How can this resistance be overcome? This paper makes a suggestion based on the insight that, before you can adopt a new mental model, you have to discard the old one; before you can learn something new, you must unlearn something old. And in general, unlearning the old is much harder than learning the new. Perhaps we should therefore talk not of 'the learning organisation', but of 'the unlearning organisation'.

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The Role of Group Dynamics in Mental Model Development: An Experimental Comparison of the Effect of Case Study and Management Flight Simulator under Two Levels of Facilitation

Group dynamics is theorized to play a pivotal role in how mental model development occurs as a result of group model building. To test this theory, a two part experimental investigation was conducted. In the first part, mental model development was assessed using two levels of group model building method: case study and management flight simulator and two levels of facilitation: non-facilitation and structured facilitation. In the second experiment, the four experimental conditions were retained and the original sample was divided into fourteen sub-groups that worked together to devise an effective change management strategy. Audio recordings of the activity were analyzed for comments related to strategy, process, rationale and facilitation. A second measure assessed participants' perceived level of agreement with, and input on, their group's strategy. This paper describes the design, procedures and results of this second experiment and discusses the implications of outcomes for research and practice.

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Adaptation and Optimal Control of a Firm and its State and Parameters Estimation at the Change of a Market Situation

The dynamic model of a one-commodity firm is described. For this model the problem of firm adaptation to change of a market situation is formulated and solved. Firm adaptation is realized by change of its parameters that are found as a solution of the optimization problem subject to appropriate funds on it. The problem of optimal control by a firm in conditions of a varied market situation is formulated and solved. The criterion of firm functioning efficiency representing quadratic sum of the particular criteria is constructed. For the formulated quadratic criterion optimal control as a feedback is received. As firm functioning occurs in uncertainty conditions estimation of a firm state and parameters is described according to the information system of the firm. Depending on information assumptions of uncertain factors it is offered to apply algorithms to process the information the Kalman filtrations, the guaranteed and minimax-stochastic approach.

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System Dynamics Modeling in Modern Russia

In many "classical" languages of visual system dynamics modeling now there are not the means to analyze spatially distributed data, and also to investigate optimum control models for which it is important to find the program control trajectory and the appropriate trajectories for the variables describing state of the system. In technical languages of simulating modeling these limitations are overcome by programming necessary tools of the data and models analysis by means of high level programming languages; however, this way is not accessible to many humanitarian experts. Therefore the decision of such problems with use of visual means of system dynamic modeling is more perspective. So the Moscow State University group of scientists under supervision of Vladimir Sidorenko created in 2000-2001 the educational version of software which allows the design and analysis of system dynamics models with spatial dynamics and also solves a set of problems connected with optimum control theory and games theory.

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System Dynamics and Marketing Productivity

The marketing function in many companies has come to consume what many believe to be a disproportionately high share of corporate resources, inviting intense scrutiny from corporate cost-cutters. Further, there appears, at a macro level, to be a low correlation between the level of spending on marketing and measures of overall financial performance or competitive position; many firms are getting low, even negative returns on incremental marketing spending. Finally, more than ever, marketing as a corporate function and societal institution is regarded more as a “necessary evil” than a value-creating activity. All of these factors and more have focused renewed attention on the critical issue of marketing productivity. In this paper, we propose that the use of systems modeling could help alleviate the productivity crisis in marketing.

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Dynamic Model for Sediment Transport Due to Volcanic Activities

It is a crucial matter for Indonesia as a country with many active volcanoes that a control system of their activities is made for mitigation. The flow of volcanic sediments like sand is a focus in this paper through which a dynamic control system of sacks called Sabo is to be developed. The dynamic property of the system is the balance between the inflow of sandy materials from volcanic activity and the outflow of the materials due to mining. The optimal size of Sabo is modeled subject to random properties

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of inflow and outflow of sandy sediment. A dynamic control system is developed into a model based on real data obtained from Merapi mountain in Central Java Island which is considered very active, and a simulation is made to predict inflow and outflow in the following years. The model has been simulated and successfully indicated the optimal size of Sabos and their potential location of placement.

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Life Cycle Design and System Thinking

Devising a life cycle design involves a number of systemic variables, interacting over time, within a base structure and flows that by defining the relevant environment mimics the logic of systems yhinking. The possibility to adapt systemic archetypes from systems thinking to life cycle design methodology forms a cultural background that enables the forecast of eventual systemic behaviour linked to the key variables interacting over a predefined time-span. This paper illustrates the potential compatibility and applications of systemic archetypes from "systems thinking" to the drafting of a life cycle design.

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The Changing Role of Simulation Modeling: From a Manufacturing Re-Engineering Project Towards the Corporate Model: A Real Case Study from an Aircraft Manufactuing Company

The study presented in this paper concerns a case study conducted in a medium size aircraft manufacturing company.

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The paper discusses a changing role of a simulation model throughout the lifecycle of manufacturing re-engineering project. The original goal of the study was to gain a deeper understanding of how the existing production line of an executive class turboprop aircraft would respond to an increase in the production rate and use the acquired knowledge to improve the existing manufacturing process. As the final result of the study an interactive learning environment has been produced to stimulate new ideas and improvement initiatives. The modeling study also served as a small-scale prototype project aimed at the design of robust policies for improving the company's performance and reinforcing the organizational learning process. The paper further discusses the lessons learned from the prototype project and sets the framework for the future work.

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Modeling the Product-Process R&D Dynamics

The aim of this paper is to outline the development and use of a framework for studying the complex dynamics of product development, process development and production within in the context of a resource-based view of firm activities. The development process is seen as a system of activities, resources and dynamic capabilities, which are located and take place at different places and time scales. The behaviour of the system is explored through a modular system dynamics simulation model of all inter-related systems, focused on the strategic management of R&D efforts. Specific attention is given to the process development strategy and the interaction between the learning processes which occur before and after a production process starts operation. The proposed model can be used for understanding the complex relationships among the various activities that take place within a firm and the respective strategic decisions, as well as for developing effective R&D strategies.

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The System Dynamics of Knowledge Management

We live in a knowledge-based economy, where the principal factors of production are knowledge/intellectual assets. This session introduces a systems approach to leverage enterprise-wide intellectual assets. The template below integrates multiple management and organizational concepts and practices. It represents interdisciplinary thinking, and incorporates features in systems thinking and systems dynamics. It answers three basic questions: (1) what is the essence of knowledge management (km); (2) how do you engineer a km system; and (3) how do you implement and sustain that system. The template has been used in, and analyzed against, numerous case studies, with a high

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confidence factor. It provides either a template for analyzing an existing organization's km system, or one that guides the km manager and architect in designing and managing the system.

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A Model to Support Stakeholder Evaluation of Transportation Policy Options in Las Vegas, Nevada

This paper describes a model created through a group model building process conducted to help a stakeholder advisory committee develop policy recommendations for a regional transportation agency. Over seven months, we worked with committee members and the transportation authority's technical staff to develop the strategic-level model. The model reflects the group's definition of the problem and collective understanding of the system. The group's goal was to improve traffic congestion, flow and air quality over a 25-year planning horizon at the lowest system cost. Their final recommendation included a mix of policies with an estimated cost of $2.5 billion that achieved the greatest air quality benefit and significantly reduced congestion and increased flow. Participants were very positive about the model-based process, saying it was faster and less painful than similar processes they had participated in. This paper describes the structure of the model and its use in the stakeholder involvement process.

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System Dynamics Modeling in the Legal Arena: Special Challenges of the Expert Witness Role

In the late 1970s system dynamics models began to be employed in legal disputes as a means of proving and quantifying damages due from one party to another, and such use seems likely to increase in the future. But most system dynamics practitioners are unfamiliar with the role of expert witness and the obligations and responsibilities associated with it. Admissibility of the would-be expert's testimony is now more significant a hurdle than ever, under recently established Supreme Court guidelines that lean heavily on the scientific method. System dynamics practitioners providing expert testimony in opposition to that of other system dynamicists face some special challenges. The stakes are high, since upcoming cases are likely to set precedents that will significantly affect future use of system dynamics in the legal arena. In addition, legal admissibility will doubtless impact the more general perceived legitimacy and acceptance of system dynamics in corporate and other non-legal settings.

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Cloudy Skies: Assessing Public Understanding of Global Warming

Surveys show most Americans believe global warming is real. But many advocate delaying action until there is more evidence that warming is harmful. The stock and flow structure of the climate, however, means "wait and see" policies guarantee further warming. We report experiments assessing people's intuitive understanding of climate change. We presented highly educated graduate students with descriptions of greenhouse warming drawn from the IPCC's nontechnical reports. Subjects were then asked to identify the likely response to various scenarios for CO2 emissions or concentrations. The tasks require no mathematics, only an understanding of stocks and flows and basic facts about climate change. Overall performance was poor. Subjects often select trajectories that violate conservation of matter. Many believe temperature responds immediately to changes in CO2 emissions or concentrations. Still more believe that stabilizing emissions near current rates would stabilize the climate. We discuss implications for education and public policy.

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Simulations for Planning Dresdner Bank's E-day

Confronted with the approaching introduction of euro coins and notes, Dresdner Bank's branches had to consider that the cash related transactions between 17th December 2001 and 28th February 2002 would rise much above the normal level. On top of the regular business, they had to cope with an unknown amount of exchange transactions of Deutschmark into euro. To avoid chaotic situations in the branches and high extra costs, the branches had to prepare themselves and had to decide on a couple of measures available. The paper presents how four different scenarios on customer behaviour are developed, and how these scenarios are linked with a queuing simulation model which was able to show the impact of different assumptions on the situation in the branches during the changeover period. Simulation and analysis results showed that Dresdner Bank's branches were facing some challenges during changeover period. Absolute chaos on broad front was however pretty unlikely.

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Decision Rules and Assumptions in Overexploitation of Renewable Resources

Behavior of actors within their specific socio-economic environments differs with respect to their rationality, intentions and perceptions, which results in different decision rules and thus different impacts on the dynamics of the system of which they

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are part. In the area of resource exploitation, fieldwork is an extremely rich source for actual knowledge building. In addition to this, quasi-empirical cases can provide insights through analysis and comparing among different sets of assumptions of the agents and/or of the underlying structures. This should contribute to our understanding of behavioral modes of various classes of systems related to resource exploitation. Furthermore, analysis of impacts of oversimplified assumptions by agents with decision power could be applied for educational purposes as well. In this session we construct a simple predator-prey based reference model as a basis for analysis of thought experiments in the area of exploitation of limited, renewable, resources.

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The Future of System Dynamics and Learner-Centered Learning in K-12 Education

For a week in June 2001, a small group of schoolteachers and professional system dynamicists convened in Essex, Massachusetts under the guidance of Jay Forrester to plan the future of system dynamics in kindergarten through twelfth grade (K-12) education. Based on early experience in schools, the group articulated a vision of what an education based on the principles of system dynamics could provide to students. The group then drew up a strategy to achieve that vision and a detailed plan to implement the strategy. The participants of the Essex session and co-authors were: Dan Barcan, William Costello, Diana Fisher, Jay Forrester, Scott Guthrie, John Heinbokel, Debra Lyneis, Jim Lyneis, Jan Mons, Jeff Potash, Rob Quaden, George Richardson, Barry Richmond, Lees Stuntz, Alan Ticotsky, Larry Weathers, and Ron Zaraza. The following report on the session outlines how system dynamics can fundamentally improve K-12 education.

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Building a Knowledge-Based Strategy: A System Dynamics Model for Allocating Value-Adding Capacity

This paper reports on a project which integrates the pioneering work on 'intangible assets' by Karl-Erik Sveiby with system dynamics based human capital modelling undertaken for the Australian Federal Public Service by the UNSW Centre for Business Dynamics. The project aims to create a dynamic 'management flight simulator' which helps managers understand better the dynamic interrelationships in organisation design and, in particular, the interrelationships between an organisation's profitability (both short-term and long-term) and investment in people competence, internal structure and relationship building measures with customers. The expected use of such a simulator

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is assisting managing partners of professional services organisations to improve the allocation of both their own and their staffs' 'value adding capacity'.

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System Dynamics of Learning Processes: Comparing Apples with Pears

Despite fundamental changes in how people work, live, and entertain themselves, education systems at the beginning of the new millennium would be familiar to anyone who attended school 50-60 years ago. While most of the business world has changed with the introduction of information technology, the academic educational curriculum is remarkably unchanged. This paper presents a model of how learning is influenced by major internal factors such as motivation, metacognitive skills, prior knowledge and external factors such as study time, support, teaching and infrastructure, including information technology. These major internal and external influencing factors are affecting each other in several ways, and the modelling process is forcing and enhancing viewpoints on how they are influencing each other – thus the comparison of apples and pears. The model also suggests how improvements in teaching, support and infrastructure may improve the learning process, including how changes in the infrastructure with the introduction of information technology are affecting the learning process.

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Ramon Guardans

System Dynamics Applied to Reconstruct the Dispersal of Modern Man on Earth and Language Patterns During the Last 120,000 Years

Attempts have been made to mathematically model movement of populations and languages in Eurasia. The present study uses model outputs for the time period 120,000 BC-1,500 BC to investigate the relation between the major language families into which a majority of the Eurasian and American languages can be ordered. The mathematical model calculations support the possibility of the existence of linguistic macrofamilies. The integrated interpretation of the modeling study together with linguistic, genetic and archaeological data, indicate that all Eurasian and American languages have sprung from a common root around 80,000 years ago, that language dispersal in archaic time is correlated to ethnicity and gene dispersals, and that language transfer and diversification has been driven by ecological factors. The model calculations suggests that the origin of language is significantly earlier than 100,000 years ago, in Africa.

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The Common Sense of the S-Shaped Growth: Regarding the Exponential Increase

We will propose that the expression "exponential function increase" causes confusion and that such phrases used to describe a state do not serve in modeling the structure of a phenomenon. We will propose that it is necessary to clearly state in detail the rule of the increase when discussing modeling. Our presentation focuses especially on logistic curves and shows that the first increase in this curve is not exponential-like by the fluctuation index which was defined with the purpose of analyzing the instability degree of time series data.

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System Dynamics Modeling in Resource Management: A Sustainable Development Approach to Resource Extraction in Sierra Leone

This paper is a contribution to the urgent need for effective sustainable development strategies within the framework of Agenda 21 put forward at the 1992 World Conference on Environment and Development. It describes the development of a natural resource management model, which is able to capture the economic, social and ecological variables that influence resource management. The model is validated and three policy approaches are analysed: the conservative policy approach, which allows mining activity to continue in its current state, and which is shown to lead to near catastrophic environmental results; the radical policy approach, which would terminate all mining activities immediately, and which is shown not to be economically viable for an economy dependant on natural resources; and the harmonious policy approach, which advocates a gradual reduction of mining activities whilst at the same time investing in intensive agricultural development, with the objective of achieving sustainable development.

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Multi-Agent Simulation of Sustainable Development Scenarios

This work is aimed on fostering the implementation of a new Adaptive Balance of Causes (ABC) method for complex systems modeling and a new multi-agent information technology for system management. We introduce our method with application to the natural resources management problem. We have suggested a new system management approach which enable to solve any complex system management problem in three main steps: 1. Concept management model construction by the use of 6 general system concepts, derived from the system analysis method; 2. Concept model formalization by the ABC method, using a standard module equation to obtain a set of equations being stable by the definition for any complex system. Dynamic and stochastic methods for objective model coefficients determination are suggested also. 3. Creation of an information technology for decision-making support by use of the formal ABC case study model and a new standard "resources market-enterprise-goods market" model based on intelligent agents.

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Modeling the System of Health Care and Drug Addicts

Drug addiction is a very intriguing problem all over the world. In Germany about 2-4% of heroin consumers die every year, although a very differentiated care system is established. For this reason the idea comes up that this system is not organized in a proper way. For further analysis of functionality the tools of mathematical systems analysis seems to be appropriate. Quantitative analysis however must be based on sufficient empirical data. With regard to drug care systems there is a lack of adequate data in epidemiology and in care system's indicators.

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Several methodological problems and theoretical issues of this study are described in the paper. A global model is proposed based on estimation on regional data of the area of Munich (FRG). The model is built by Stella. The problems to establish a valid computer-based model are discussed.

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High-Leverage Changes to Improve Safety Culture: A Systemic Analysis of Major Organizational Accidents

The purpose of this paper is to clarify high-leverage changes indispensable for improving safety culture through organizational learning. Although the concept of safety culture appears to have become increasingly important, there is no established way to improve it. Through systemic analysis and model building of the process of deterioration of safety culture in three recent major organizational accidents, we identified two main root causes: (1) tradeoff between economy and safety and (2) misperception of current reality. The reinforcing feedback loop between 'focus on efficiency' and 'misperception of current reality' created unhealthy safety culture, which undermined safety margin and prepared an environment where a triggering factor can cause an accident. The leverage points for improving safety culture are (1) accurate perception of current reality and (2) adequate open communication. In order to improve safety culture using these two leverage points, we are now designing two gaming/simulations for Tokyo Electric Power Company.

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A Dynamic Simulation Model of Beach Sand Replenishment: A Case Study of Santa Barbara, California

Sediment deprivation from dam installments contributes to beach erosion yet the underlying physical and economic factors linking them together have traditionally been isolated during regional planning. In order to gain a better understanding of the behavior of a managed beach system, a dynamic simulation model was developed incorporating physical and monetary factors influencing the amount of available beach sand. The Santa Barbara littoral cell was chosen as a case study to evaluate the feasibility of beach preservation goals under scenarios in which annual sand replenishment funding, sand prices, or sediment recovery from behind dams were limiting factors to available beach sand. Sources of model uncertainty included limited information on historical sand replenishment costs and true residence time of sand in the littoral cell. Results indicate that with ample sand replenishment funding and moderate annual sand loss assumed, a beach could be maintained at a desired width for several decades.

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Modeling and Analyzing Market Performance in Infrastructures

Accurate and appropriate performance of an infrastructure is important due to society's dependency on its service. This research tries to examine the performance of an infrastructure and the potential causes for its failure. Specifically, the objective is to model the dynamics of an infrastructure market and to examine it with respect to performance criteria. The theoretical and observable dynamics of an infrastructure market are represented as a causal model. In turn, relevant criteria, based upon society's desire, can be used to analysis the performance of the system. This analysis helps to determine the potential performance failures in the infrastructure market. In this paper, a causal model of a generic infrastructure market is presented and analyzed against performance criteria for possible failures. The identified failures from this causal model were supported by illustrations from the California energy crisis.

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Causal Architecture: Aligning Enterprise Strategy and Operational Dynamics with the Enabling Information Technology

In The Squandered Computer, Paul Strassman described how trillions of dollars in annual computer expenditures had resulted in no demonstrable relationship between computer spending and corporate profits. Two promising methodologies are evolving to address these problems: Enterprise Architecture (EA) and the Zachman Framework (ZF). However each has limitations. EAs link business strategies to IT capabilities but do not give guidance on what is most valuable to model. Zachman Frameworks are excellent at organizing EA models but do not indicate the most valuable places to start modeling. To resolve these limitations, a new methodology, Causal Architecture, has been developed. This presentation gives an overview of the EA, ZF and Causal Architecture Methodologies. It describes how Causal Architecture is used to most effectively leverage the Zachman Framework in guiding efficient EA modeling and IT implementation. Two large enterprise Causal Architecture implementation examples are also described.

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A Life-Cycle System Dynamics Model of Aircraft Engine Maintenance

The purpose of this paper is to describe the development and use of a framework for studying the dynamics of the maintenance system of a fleet of military-aircraft engines in a holistic way, as far as both time and place are concerned. The framework is based

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on a modular system dynamics simulation model of all the inter-related systems, which are involved throughout the life-cycle of the engines (preventive maintenance, repair maintenance, factory-level maintenance, maintenance human resources management, spares management and engine disposal). The proposed model can be used for understanding the complex relationships among the systems and their elements, for evaluating vendor proposed maintenance systems, as well as for developing effective maintenance strategies.

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Simulation of Success Stories into Strategic Corporate Planning

Modern management information systems make direct use of data from applications implemented in different functional areas of enterprises. Such applications could be ERP systems as well as legacy systems in functional areas such as a production planning application, an accounting system, a marketing and customer relationship system etc. These sources will be used from management information systems as a consolidated basis for corporate planning and corporate reporting. Until today a simulation of strategic corporate forecast has been possible on a consolidated data basis. By using a XML interface a direct access to different web-based data of functional systems in a client server environment will be created. This will open the way to use the system dynamics methodology to simulate a forecast for product development and their challenges at the market. The main target of this simulation is to make transparent the efficiency of marketing measures and of research and development expenses.

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The Transition from Fossil Fuel to a Renewable Power Supply in a Deregulated Electricity Market

In this paper, we investigate the trade-offs between long-term and short-term effects of energy planning within the context of a deregulated power market. The purpose is to find efficient policies that can aid the transition from a fossil fuelled to a renewable based power supply. Our case study is on the Nordpool power market. The model focuses on the main feedback loops that determine long-term development for new capacity, namely the unit commitment (operational characteristic), capacity acquisition, technological progress and finally resource depletion. We show that the operational

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characteristics sometimes are important to include in long-term analyses. Finally, some simulation runs for two possible policies are presented and discussed.

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A Municipal Fiscal Impact Model: Real-World Policy Modeling

This paper presents a summary of work that was done by the civic governments of Calgary and Edmonton that addressed the question of suburban development, infrastructure growth and rehabilitation and their financing given limited funding. In the 1980's and 1990s, Canadian federal and provincial governments became concerned about the state of their respective finances. They responded by introducing a combination of expenditure reductions, tax increases and higher user fees. Consequently, transfer payments to municipalities were reduced. These measures had a profound impact on the economies of the urban regions affecting the rate of renewal and obsolescence in business, residential and public infrastructures. In this context, the Cities have had to decide how to allocate their limited financial resources between competing needs of further suburban development and growth restricted to the already built up areas. But the Cities' financial ability to expand and to maintain their infrastructures are limited.

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Systems Analysis of Kondratieff Model

Through analysis of the Kondratieff model, this paper discusses the causes of economic fluctuation. The analysis of the model simulating test discovered that two important factors caused the economic long wave. It can be said with certainty that an accidental event consequentially affected the economic long wave. In addition, the social real mode of production leading to the formation of the long wave is proved.

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On Complexity of Emergence, Adjustment and Evolution of Enterprise Network

An enterprise is a dynamic social network and its organization structure is the embodiment of this network. Based on the vision and mission of the enterprise itself, every network point is given the relative right and duty and an enterprise's development plan is also formulated according to its enviroment. In a changing and competitive environment, an enterprise adjusts its network based on changes in environment. This paper, through establishing a

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simple enterprise structure model, studied the emergence of enterprise network and its dynamic adjustment in a changing environment. An exploration of causes of network evolution was given with several cases of structure analysis and evolution.

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Threshold Setting and The Cycling of a Decision Threshold

When policy makers use a test result with a cutoff score in a decision, the cutoff threshold may change over time. An example is the threshold of "reasonable suspicion" used to justify a police search. Hammond (1996) postulated that a decision threshold will oscillate over time in response to competing pressures from affected constituencies, as unavoidable cases of false positives (e.g. innocent people searched) and false negatives (e.g. guilty people overlooked) emerge from the uncertainty of using an imperfect test (e.g. level of evidence) to predict the actual measure of interest (e.g. guilt). The structural underpinnings of a cycling threshold are analyzed in this theory-building article. First, we present a simplified converging model of Hammond's initial insight. Then, we present three alternative models: one with integral control representing the historical dissatisfaction of competing constituencies; a second model with delays in policy maker responsiveness; and a third with stakeholders shifting constituencies.

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Implementing the Trojan Horse Strategy: Process and Techniques for Accelerating the Rate at Which System Dynamics Penetrates the Mainstream Education System

By recommending the infusion of system dynamics concepts into the type of curriculum materials that educators currently seek, the “Trojan Horse Strategy” aims to accelerate the rate at which the mainstream education system adopts system dynamics. Drawing on principles from lesson plan development, system dynamics, and application design, “Implementing the Trojan Horse Strategy” describes process and techniques for helping teachers build student understanding of subject matter and system dynamics simultaneously. This practical guide for educators includes an overview of the strategy, an analysis of the activities space within which these tools must operate, and a presentation of a four-step process for building educational tools that support the strategy.

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Interactive Model of Business Cycles

This presentation previews a research project to evaluate whether system dynamics business cycle models, when used as

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instructional tools in undergraduate macroeconomics courses, can enhance student understanding of business fluctuations. First, we will demonstrate a system dynamics model of the standard economics textbook diagram of the circular flow of national income and national product. A working model of the circular flow is useful for revealing patterns of multiplier effects of injections and leakages of spending and income. Yet, even a dynamic circular flow model is still fundamentally an accounting tool when standing alone. As we progressively add links from behavioral models of business cycle sub-systems, however, the circular flow model behaves more like a real economic system. Conference participants can interact with a microworld version, examine changes as behavioral models are successively linked to the accounting model, and test alternative assumptions and policy scenarios.

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Control Strategies for Inventory Management

This paper describes a control systems approach to the management of inventory. Normal inventory operation is an example of proportional control. Several control algorithms including Pseudo-Derivative Feedback (PDF), Proportional, Integral and Derivative (PID) and Feedforward control are used in this paper to produce a more sophisticated form of inventory operation that can easily reduce stock levels by up to 80% compared to 20-30% with MRP and hence reduce cost. Settling times are reduced by a factor of 50%. Modelling was achieved using the Simulink simulation package using equations developed by Ferris and Towill for a single level industrial system model rather than a conventional System Dynamics computer package. The best controller is shown to be a PID controller with Feedforward. This controller did not cause any significant oscillatory inventory level changes. These techniques compare well with other investigators using control strategies. This has special significance for JIT and MRP methods.

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Integrating System Dynamics Modeling and Case Study Research Method: A Theoretical Framework for Process Improvement

Research designs that extensively combine both system dynamics modelling and case study in requirements engineering process modelling are rare. Triangulation of methods, while not new, has not been applied in requirements engineering process modelling and improvement research. This paper aims to provide a useful and systematic reference point for researchers who wish to work in RE process improvement and generally to encourage careful work on the conceptualisation and execution of Dynamic Synthesis methodology in RE process and a wider software

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process modelling field. The paper addresses the philosophical and theoretical issues concerning the nature of combining the case study and process simulation research approaches, and methodological issues on conducting and reporting of this type of research design. The paper suggests that the potential usefulness of the Dynamic Synthesis methodology is in aiding researchers in improving both building and testing theories in requirements engineering process modelling and improvement.

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Operational Improvements in the Supply Chain: Who Benefits? Who Loses?

This study applies system dynamics simulation to investigate the impact of operational improvements in a supply chain, which is at one of three stages of sharing demand information: the traditional scenario in which no information is shared; vendor managed inventory in which the vendor receives customer demand information to manage warehouse inventory; and collaborative planning, forecasting and replenishment, in which information is shared throughout the supply chain. The impact of five operational improvements, resulting in reduced transit and production lead times, is investigated for each scenario. The impacts are assessed by calculating the average inventory level and inventory variability for each partner in the supply chain. The results of this study indicate that some partners benefit more by certain improvements, whereas others benefit less, and that reduced fluctuations in inventory depend on the type of improvement, the level of supply chain integration, and one's position in the supply chain.

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Knitting and Deep Niches: The Importance for SME's of Focus in R&D and Product Development

Small and Medium-sized Enterprises (SME's) face major challenges in trying to remain competitive in the global market place. An identified strategic ploy to maximise effectiveness in product design and R&D is the 'deep niche strategy'. This paper demonstrates the use of system dynamics diagramming processes in articulating this strategy, as observed in case studies of two very high-tech SME's and a niche lingerie company, and in conveying the critical importance of this ploy to SME entrepreneurs, consultants and academics.

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Transcendental Feedback Phenomenology (TFP)

TFP is a method for examining core consciousness during traumatic experiences, including uncovering subtleties of consciousness and meaning. It applies system dynamics to convert Husserl's Transcendental Phenomenology into a relatively simple formalized science. This methodological advance positions TFP as a new source for implementations in phenomenology, consciousness studies, and deep psychotherapy. Key reasons why TFP succeeds are: 1) The epoche: brackets-out extended consciousness and focuses on core consciousness. 2) Structures consciousness as a multiloop nonlinear feedback system, the same structure as the neurophysiological system underlying consciousness. 3) Utilizes Forrester's 5th principle of system dynamics, quantification of unmeasured but important concepts and relationships, and his method for geometrizing differential equations. TFP's use is illustrated by applying it to recall, analyze, and resolve a traumatic 16-hour religious experience. Thus, TFP implements the search for the deepest truths of the inner life and the quest for permanent foundations for science, philosophy, and religion.

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System Archetype Analysis on Corporate Restructuring

This thesis uses system archetypes to analyze and explain the features unique to corporate restructuring (CR) in China the reform era and the strategic plan underlying them. The thesis begins with the review of three developing stages of CR in China, focusing on the characteristics and problems of CR, especially CR concerning listed companies on China's newly developed securities market. Using System Archetype I - "Shifting Burden," the thesis highlights the causes and results of cash trading or strategic CR, as well as the differences and relationship between them, with the attempt to curb cash trading and promote strategic CR. The paper describes the process of strategic CR, assets rearrangement and synergy creation with System Archetype II - "Limits to Grows." Motivated by strategic development and based on performance improvement, strategic CR promotes the efficiency of companies through successful assets rearrangement and synergy creation and maximizes the value of listed companies on the securities market in China.

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Innovation Management in Virtual Enterprise

The idea of virtual enterprises is to implement modern management-trends like "concentration to key operations,"

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"distributed production," "establishing core competence," and "maximal customer orientation" with the support of advanced computer and telecommunication systems. An important feature of virtual organization is a distinctive form of network organization in combination with a high degree of organization flexibility. The organization concept of virtual enterprises can be interpreted as an intermediate form between the poles: market and hierarchical structured enterprises. In this context transaction costs are helpful criteria for the definition of the structure of virtual enterprises. A virtual enterprise is a complex system. How to manage virtual human resources and virtual R&D? How to manage the operation from R&D to commercialization? Based on core competencies and transaction costs, the paper establishes a system dynamics model for innovation management of virtual enterprises and provides some suggestions for managing virtual enterprises.

The Analysis of Coordination and Sustainable Development in a Knowledge Economy

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How can long-term needs really be balanced with short-term imperatives, especially when change is so unpredictable? In effect, social, environmental and economic issues of almost unprecedented complexity need to be tackled at several levels in ways that are not merely conceptually neat, but that also encourage significant behavioral and institutional change. A strategy for sustainable development should be seen as a set of coordination mechanisms and processes to help society work towards sustainable development – not as 'master plans' which will get out of date. The paper provide a complex system including social, technology, economy, education and ecology subsystems, and interaction between these subsystems. The authors establish a system dynamics model to simulate the behavior of the system. To China, the paper suggests that the rate of education investment should be bigger than investment in R&D, and 10 years sooner. The paper also suggests the rate of the internal education structure and internal R&D structure.

A System Dynamics Approach for Community of Practices

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In now turbulent business environment, organizational learning and knowledge management capability has become the requisite competences to survive and win the fiercely competitiveness. Managing organizational learning effectively is the main challenge for most organizations. Community of Practices (CoPs) is one of the most effective organizational learning if organizing well. However, group learning in social interactive environment is very complex. In fact, CoPs are very complex

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system in which the members interact each other. Using system dynamics model to simulate the process of the members learning is a useful approach to explore the learning mechanism in CoPs. In this article we will disclose the key factors for organizing CoPs successfully based on simulation.

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System Dynamics Modeling of a Firm's Technological Competence and Capital Accumulation

In this paper, the system dynamics model of technological competence of the firms and capital accumulation was set up. By computer simulation and policy analysis of this model, the interaction and dynamic development of technological competence and capital accumulation was worked out. Furthermore, the optimal ratio between importing and indigenous R&D expenditure as well as optimal rate of capital accumulation was obtained.

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The Change of Corporate Governance in Transitional China by System Dynamics Modeling

Most large and medium-sized enterprises in China have transformed to stock companies and established a corporate governance structure. The old leading system in enterprise, including the Party community, the employee representative committee and the labor union, seems to be replaced. However, the change of institutional and cultural context is a hard and slow process, especially in China, which makes the status of corporate governance in transformation more complex and multileveled. This paper aims to apply system dynamics modeling to find a reasonable solution and make suggestions about further development. A rational structure of corporate governance in China should be a modified version of the new system. The higher the degree of party and employee participation in corporate governance, the better governance effect can be got. Therefore, a certain degree of joint use of the new system and the old will greatly benefit governance performance for Chinese companies.

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System Dynamic Modeling and Policy Analysis of Regional High-Tech Industries Development: An Empirical Study of Hangzhou City

With the coming of the knowledge-based economy, high-tech industries such as ICT's, biotechnology, new materials and so on are becoming more and more important for a region's economic growth and competition advantage. According to our literature

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review and empirical surveys, development of a region's high-tech industry is mainly affected by several key factors. The interaction mechanism among these factors is nonlinear and very complex. To foster and promote the rapid development of high-tech industries, the decision-makers of the region should think of these key factors, and try to optimize dynamic resource allocation. System dynamics methodology, which has proved to be very useful and feasible, is one of the good scientific tools to analyse and simulate a complex system. Choosing Hangzhou City as an empirical case, this paper models the dynamic interaction among these factors. The authors try to give some policy analysis and suggestions, which may be very useful for decision-makers.

A System Dynamics Approach to Assessing the Effects of Electronic Commerce on Local Economy in Korea

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The advent of a nearly ubiquitous information infrastructures is raising two conflicting hypothetical economic points of view. The one is that cyberspace, a parallel electronic world as a laboratory of new social and commercial practices, will eventually resolve the problem of economic disparity by presenting equal opportunities to both the haves and the have-nots through the removal of barriers of time and space. The other is that the problem of economic disparity will be amplified by the new rule 'winner gets the most,' which would perhaps be unavoidable in a digital economy. By introducing systems thinking and adopting the system dynamics simulation technique, this paper attempts to find some tentative answers to questions raised about the impact of electronic commerce on local economy, on which little research has been conducted so far. The general scheme is the dynamism of systems where two groups of electronic malls compete with each other.

Risk Management Strategy in the Australian Federal Government: Critical Analysis with a System Dynamics Approach

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Risk Management Strategy provides an overview of the processes directed at reducing risk and capturing opportunities. It outlines processes and techniques to enhance the efficiency of risk management. A formalised, well-structured and systematic approach to risk management is essential to ensuring continuing success and the achievement of programme objectives. Managing risk is an integral part of sound management, and fundamental to achieving programme objectives. Risk management activities take many forms, and although most managers do not use the term 'risk' when they undertake these activities, the concept of

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risk is central to what they are doing.In this sense, this paper examines the concept of risk, the objective and policy of risk management, the strategy and the generic procedure. As a case study, the Risk Management Strategy of the Tax Concession Program in the Australian Federal Government is analysed with a system dynamics perspective.

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A Dynamic Alignment Approach to Leverage Design in System Dynamics Models: Stratagem-2 as an Example

This paper attempts to develop a dynamic alignment approach to leverage design of system dynamics models. The approach developed in this research is a flow-based design, different from traditional macro designs of aggregated system structures or loop analysis. It is grounded on some major concepts in Synchronous management at plants and uses the Drum-Buffer-Rope (DBR) system to align the various operations of rate decisions. We take the famous long wave model (Strategem-2) as an example to examine the performance of the proposed leverage design method. The redesigned system shows that the original oscillation behavior is eliminated. By better alignment and streamlining of flows, the discrepancy between the production rate and desired production in Strategem-2 is dramatically reduced, even in higher degree than some previous leverage design approaches proposed by other system dynamists (e.g., Sterman (1989), Ozveren and Sterman (1989)).

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An Experiment of Teaching and Learning System Dynamics with Aids of Action Research Tools

This paper introduces an experiment we conducted in teaching system dynamics at an undergraduate (junior) level at the Department of Business Management, National Sun Yat-sen University. A step-by-step feedback-learning concept is employed. We guide the students into the field of system dynamics gradually and make the learning environment quite enjoyable and challenging for learning. In our design, besides learning in class, students can also enhance their learning after classes through the environment of the Cyber University here, and it can increase the quality of education and students' interests dramatically. From the process of actions and self-examinations, we have continued to improve our teaching and raise students' interests and enhance their learning effects. In our teaching activities, we set up very challenging learning goals, identify questions and provide proper assistance to improve their performances. Finally, we check the results of action and introspect the actions of the whole process.

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Model Conceptualization in Group Model Building: A Review of the Literature Exploring the Tension Between Representing Reality and Negotiating a Social Order

There is a growing practice of building system dynamics models directly with groups. This paper traces a genealogy of group model building (GMB) along two stream of thought. It focuses upon exploring the tension between modeling as a representation of reality, and modeling as a tool for negotiating a social order. The literature is organized into five clusters that roughly represent the members of a genealogy tree. A description of GMB is developed to fit an ideal type conceptual dichotomy. Findings are summarized in tables, mostly quoting directly from surveyed authors. The paper offers supporting evidence to the thesis that there are two intertwined threads in the group approach to system dynamics modeling. GMB interventions strive both to create a shared understanding of an interpersonal or inter-organizational problem, in the form of a "boundary-object" model, and to build a "micro-world" type model that is useful in terms of organizational redesign.

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Is Your Personality a Sign for your Leadership Style?: A Model Proposal to Personality and Leadership Relationship

Research findings show that "personality" is one of the important

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factors which affects leadership style. The purpose of this study is to build a model representing “personality-leadership” relationship and to reveal which personality characteristic is related with which leadership style. A literature survey is made to reveal some empirical findings on "personality" and "the role of personality on leadership performance".This article covers an application made to reveal the relations between occupational personality dimensions and leadership styles. The data is obtained by using "SHL-OPQ / Occupational Personality Questionnaire" in two different cultures (United Kingdom and Turkey). The total number of managers is 273 composed of 126 from United Kingdom and 147 from Turkey. The collected data is analyzed by using ANOVA and Spearman correlation methods. Important differences and similarities are found between cultures. By using these findings, a model is built which shows the relationships between the “occupational personality characteristics” and “leadership styles”.

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The Performance of the Relationship Between Domestic Product and Unemployment

The paper concerns the characteristics of conditions and processes which permanently influence unemployment, as the result of domestic product fluctuation. Economic reality determines the character of the relationship between domestic production and the labour market as the system. It signals that the connection between the two variables depends not only on the domestic product change, but also on a wide spectrum of factors. The variables representing factors are categorized into groups. Criteria of the division are the affected object - employer and employee, and the size of the object. For the system analysis, the system dynamics method has been applied. This method allows an investigation of a high number of simultaneously operating and related processes, which regulate the reaction of unemployment to domestic product changes.

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Special Sessions

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This session is sponsored by IBM.

The Dynamic Concept of an Enterprise; and, Managing and Leading Organizations as Communities

Russell L. Ackoff and Peter M. Senge will speak on THE DYNAMIC CONCEPT OF AN ENTERPRISE and MANAGING AND LEADING ORGANIZATIONS AS COMMUNITIES respectively. Conceptual transformations to management and organizations in an enterprise, and the evolving qualities of organizations as human communities, will be discussed. Russell L. Ackoff is Anheuser-Busch Professor Emeritus of Management Science at The Wharton School, University of Pennsylvania, an author and co-author. Peter M. Senge is a Senior Lecturer at the Massachusetts Institute of Technology and Founding Chair of the Society for Organizational Learning (SoL), author and co-author.

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System Dynamics and Applications of Optimization

From the fifties, numerous optimization methods have been proposed and have increasingly obtained successes so as to become an essential component of support decision systems in many areas, including, among others, economy, control, and telecommunication. Many numerical packages for optimization are available and have reached a wide diffusion in all the scientific communities. This context has suggested to focus on the role of optimization in system dynamics. Optimization in system dynamics is used for two main purposes, i.e., model identification and policy gauging. Optimization allows one to deal with difficult problems for which exact analytical solutions are hard to find for theoretical and practical reasons. In this prospect, the session aims at bringing together different experiences gained in facing some of these problems regarding system dynamics' applications.

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Environmental issues in Commercial Exploitation

When it comes to renewable resource management, Earth's human inhabitants act as if we have never heard of 'management' before. Yet, our system dynamics management technology shows how basic laws of biology, economics and physics render time

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delays long in environmental issues. And the wait-and-see attitude of our global conventions (e.g. Kyoto) and initiatives (e.g. Clear Skies) stretch Nature's time delays to unthinkable proportions. When will this planet get tired and spit us out? The session's papers show specific examples of how good we have all become at destroying our environment. From bypassing Indonesia's Log Export Ban to overharvesting clams in Spain to overmining in Sierra Leone, commercial exploitation reigns supreme. But not all is lost. The papers also show how we can still harmonize ourselves with our habitat when we finally learn to control environmental degradation through sustainable development. The reward is bigger than clams, forests and mines. It is our life. Prep Source: <http://www.io.com/~hcexres/tcm1603/acchtml/oral.html>

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System Dynamics in Finance

The session will include speakers whose research is concentrated on finance and economics issues studied by using system dynamics theory. Theoretical as well as empirical papers are welcomed to the session. Finance problems such as dynamics within financial institutions, contagion effects between countries, interaction between different types of traders in the marketplace and many other situations in the modern financial markets are inherently dynamic. However, current approaches grounded in finance and economic theory impose static assumptions and try to find equilibrium solutions represented in a closed form. A system dynamics approach introduces more realistic assumptions. System dynamics also provides a ground for a dynamic analysis that leads to insights into important financial problems.

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Consultant's Roundtable

This year's Consultant's Roundtable will follow a new format, focusing on questions of interest to consultants, and what consultants know that would be useful for academic and corporate practitioners. A lively (but moderated) panel of consultants will discuss questions submitted in advance.

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Oil and Gas Industry

The oil and gas industry is highly capital intensive, risky, and competitive. In order to establish and maintain respectable growth rates relative to their competitors, companies must continuously strive to improve their performance. This session will address the role of system dynamics methods and tools for achieving these higher levels of performance. Each of the applications included are mostly practical in nature, providing insight into the strengths and weaknesses of specific approaches implemented by real companies. Major topics include: an example of repeated overshoot and collapse behavior; an overview of past applications and emerging trends for managing a variety of market, business, and project dynamics; and finally, a practical example of an alternative modeling approach that addresses the tradeoffs between facility availability and capital investment.

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Military Roundtable

Despite the fact that US, NATO and allied military forces have had a profoundly systemic approach to training and operational planning for some three decades, the system dynamics modelling approach has had limited success in gaining the status of "orthodoxy." The Military Roundtable will seek ways to increase awareness within military circles of the utility of system dynamics modelling. The Roundtable will focus on three issues: A. The state of awareness of senior defence executives re system dynamics modelling: Practitioners will present approaches found to be effective in marketing system dynamics modelling and identify defence-specific "mental models" that militate against widespread acceptance of the system dynamics modelling paradigm. B. Significant system dynamics modelling projects undertaken for Defence agencies: Practitioners will present overviews of projects, commenting on the outcome and identifying specific system dynamics modelling consulting lessons learnt. C. Ways to promote system dynamics modelling in Defence.

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This session is sponsored by HVR Consulting Services Ltd.

An Expert View of the System Dynamics Modeling Process: Concurrences and Divergences Searching for Best Practices in System Dynamics Modeling

We intended this research both to discover a set of core practices in the system-dynamics modeling process and to identify the best of them according to the knowledgeable opinion of a recognized group of experts in the field. The paper addresses two questions: (1) What aspects of the system dynamics modeling process are common to all model building regardless of the modeler, the model, the type of practitioner, the tool used or the purpose of the model? (2) Which of these areas can be described as "best practice"? We used a multi-method approach starting with interviews, then two virtual meetings with former presidents and award winners from the System Dynamics Society to elicit best practices and, lastly, a discussion of the results and the implications for further research was conducted. The paper identifies 71 'best' practices grouped into six categories. More importantly, the study also identified 13 practices in which experts appeared to disagree.

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Modeling Assistance Workshop

Modeling assistance is available at the conference to enable modelers to discuss their specific modeling questions with modeling coaches. Modeling assistance opportunities include two workshops, as well as the possibility of assistance at any time during the conference. Assistance is available for modelers with all levels of modeling ability, from beginner to advanced. Modelers' questions range from a specific model that modelers are developing or studying, to something that modelers don't understand in one of the system dynamics textbooks or software packages. Questions range from problem articulation, formulation of a dynamic hypothesis, formulation of a simulation model, model testing, or policy design and evaluation. Modelers bring whatever materials they need to describe their modeling question, including pencil and paper, books, posters, or laptop computers. Spectators are welcome to observe modeling assistance coaching sessions.

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Electricity Based Energy

The energy sector has a long and serious modelling tradition. Models have served the need to evaluate the impact of different policies in areas such as pricing, economical growth, environment and resources. The system-oriented perspective has been useful because of the long time scales involved, the

Author Index

environmental and economical impact and the potential alternative energy sources available. The modelling of energy sector has experience an increased interest in later years. This has been a result both from the growing concerns of environmental issues like global warming and from a worldwide trend away from national planned energy policy to liberated, market-oriented structures. "Electricity Based Energy" will gather a number of presentations within this field with a special focus on generation, distribution and consumption of electricity based energy.

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System Dynamics of Strategy: Multiple Dimensions, Multiple Insights

System-driven complexity arises across multiple dimensions of strategy. First, it afflicts all levels of business strategy, whether single function concerns, whole business units or the multi-business firm. Complexity arises too across the dimension of widening competitive scope - whether we are concerned to build a sustainable business in its own right, in competition with defined rivals, or within a broad arena of multi-firm rivalry. Thirdly, though, strategy and policy must adapt to a third dimension - that of passing time, and the changes to the business environment wrought by political, social, economic and technological change. This session brings together three papers that illustrate these multiple dimensions of strategic challenge, from a single enterprise being established in a relatively stable environment, through a competitive situation facing a multiplicity of firms seeking advantage in a continuing, but cyclical sector, and finally a context of rapid evolution brought about by substantial technological change.

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Research and Practice Issues in System Dynamics for Small and Medium-sized Enterprises

Despite early hopes and views that system dynamics would become as valuable an aid for SMEs as for larger organisations, it appears that this is not yet the case. The reasons why the application of system dynamics in SMEs is often difficult are well rehearsed: it can be an inherently costly approach, it can be data-demanding, people exposed to its ideas are more likely to seek careers in larger organisations, SME entrepreneurs do not have time to invest and no in-house analysts, etc. This special session at the conference will hear six short presentations discussing aspects of this issue, open discussion to the floor, hoping answer: (i) What can be done in practical terms to encourage and enhance the practice of system dynamics in smaller firms? (ii) Is there an agenda for essential research into the field of system dynamics in smaller firms?

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Workshops

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Methods to Make Your Simulation Run on the World-Wide Web

Simulations need to engage the user, be accessible in multiple formats, be simple to navigate, and correspond to the user's learning objectives. When simulations are used in workshops or facilitated by the model creator, modeling experts can compensate for user interface design problems by directly interacting with the users. But on the web, this is impractical. Usability design is critical to create simulations that will be used by a diverse, global audience with limited knowledge of simulation, short attention spans, and unarticulated use objectives. 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. Michael will provide handout booklets, sample simulations, and sample HTML pages that can be used to create your own first web simulation.

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Matching System Dynamics with Accounting Models to Enhance Performance Evaluation in Companies Coping with Major Change

This workshop will be show how interactive learning environments including system dynamics and accounting models can substantially help decision makers in drawing up business plans based on an improved awareness of the relevant system, to define sustainable growth policies, both in the short and long run. Main issues covered in the workshop will be: start-up and growth in SME's; balanced scorecards in public utilities; and managing intellectual capital in the telecommunication industry. Matching system dynamics with accounting models into ILE's is likely to improve management control systems, as decision makers can be supported in better understanding the impact of soft variables on company performance, and exploring trade offs between sort and long-term. Such an approach has been applied by the authors to build dynamic scenario plans whose simulated results are depicted according to the 'lens' of accounting models.

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Developing Causal Loop Diagrams Using Group Model Building Methods

There are a number of methods available for building causal loop or influence diagrams for the conceptualisation stage of system dynamics modelling study or a systems thinking project. This introductory workshop will demonstrate a group model building approach, based on the use of hexagons as a facilitation tool. The workshop will use materials from the book "Systems Thinking & Modelling: Understanding Change & Uncertainty" by K.E.Maani and R.Y.Cavana (Prentice Hall, Auckland, 2000).

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Starting a System Dynamics Program in Your School for Students in Grades K through 12

The workshop will demonstrate a multi-faceted approach to the problem of starting a system dynamics program in a K to 12th grade school environment. Hands-on activities will be provided for the participants to help them understand what methods might work to influence teachers to try this experiment. Student work will be demonstrated. A CD containing training materials used in the National Science Foundation CC-STADUS/CC-SUSTAIN Project will be available (at no cost) for all participants. These materials have been developed over the eight-year history of the project, training high school and middle schoo math, science, and social studies teachers to create STELLA models and curricular materials to use in their classroom. The CD will also contain teacher-created project modules that have been edited. The workshop will also introduce materials developed in Carlisle, Massachusetts for younger students in kindergarten through eighth grade.

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Using System Dynamics in Six Sigma/Quality Improvement Programs

Corporations set goals to reduce costs, increase revenues and customer satisfaction, yet despite the applicability, system dynamics has long struggled to become adopted as a mainstream business practice to help achieve such goals. Six Sigma is a mainstream quality improvement practice that is focused on achieving these goals through the application of statistical tools combined with process mapping, structured project management, financial measurement, and management accountability. While Six Sigma implicitly recognizes the inter-dependency of processes, it has limited understanding of feedback loops. Six Sigma would benefit by adopting system dynamics and system dynamics would benefit by working to incorporate itself into Six Sigma. This workshop will give you a brief introduction to Six Sigma Quality Improvement methodology, show the common linkages between Six Sigma and systems thinking that can be exploited to gain

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acceptance of system dynamics methods and will present examples of the use of system dynamics methods in Six Sigma Quality improvement programs.

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Digest Workshop: Automatic Detection of Most Influential Structure in a System Dynamics Model

Digest is an experimental piece of software that reads the text version of most any system dynamics model and automatically detects and displays the most influential structure for any given variable in that model. Bring your laptop to this half-day workshop and you will gain a running beta test version of the software, copies of several models that you can work with, plus training in how to load models and use the software to detect dominant structure in your model. This workshop is designed for researchers and skilled modelers who are seeking a chance to work with Digest in the beta test stage of its development. We are actively seeking user feedback on their experiences using this new approach to detecting dominant structure.

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How to Inject System Dynamics Successfully into Your Curriculum

An increasing number of educators and management development professionals are looking to introduce system dynamics into their programmes. Many practical examples now exist of high-quality educational modules, simulators and microworlds being used to complement learning across all sorts of subject areas for high-school students, undergraduates, graduates and experienced professionals. In this workshop several leading educators will relay their experiences of injecting system dynamics into their own programmes. By design these educators come from different subject disciplines, thereby enabling workshop attendees to appreciate the range and versatility of modelling and simulation in higher education. The workshop ends with a facilitated discussion in which attendees can discuss their own curriculum innovation needs as well as sharing educational experiences of using modelling and simulation (both the good and the not-so-good!).

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Modeling Complex Enterprises: Combining the Strengths of Cybernetics and System Dynamics

Today's markets are open, heavily regulated, serviced by many players and greatly influenced by world economies. This dynamic manifests itself by a market behaviour that is both highly erratic and uncompromising. How can the various management sciences be used to aid businesses to manage these situations? This workshop will look at the strengths of bringing together cybernetics, chaos theory, object modelling and system dynamics into a framework that can be used to significantly enhance organisational effectiveness. A case study of

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J. Meek

British Telecom's public payphone service will be used as an working example of how these methodologies can be brought together to solve complex business problems. The workshop aims to bring together interested parties to explore these ideas. It is not expected that interested parties have a detailed knowledge of each discipline.

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Where the Model Meets the User: An Interface Design Workshop for Creating Effective Learning Environments

Even well-crafted models with fancy front-ends will be flatly rejected if the user interface is hard to navigate, non-functional and fails to be engaging. To enable a better understanding of the dynamics behind the model-user interface, this workshop presents a number of principles and guidelines drawn from the fields of computer-human interaction and information architecture. The use of story-telling, visual/behavior cues, affordances and metaphors, together with illustrations and critiques of actual model interfaces are just some of the topics that will be explored during the workshop. Tips on the do's and don'ts of data design and display will be presented along with advice on how to avoid information overload and cognitive dissonance. In addition, workshop attendees will be given short exercises that will show them the basics of how to establish atmosphere, use color effectively, and create suspense, illusion and/or visual momentum.

Dennis Sherwood
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Creativity Workshop

Creativity - the ability, and confidence, to generate new ideas – is an integral aspect of much of systems thinking and system dynamics modelling. We all do this intuitively – but is creativity necessarily an intuitive process? Or can it be made deliberate and systematic? And can people be trained to become more creative? In this highly interactive and energising workshop, Dennis Sherwood will argue – convincingly – that the answer these questions is 'no', 'yes' and 'yes' respectively. To prove the point, he will show you how to use his InnovAction!TM process - and you will be amazed how many new ideas you will be able to discover!

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Fast Track Strategic Modelling Workshop

Scenario planning is, arguably, the most powerful of the strategic planning methodologies, and system dynamics modelling is a wonderful way to simulate the dynamic behaviour of any scenario. Strategy planning models, however, are complex, and since each business is different, we are always starting from scratch. But is this necessary? Are there ways of making strategic modelling a much more generic process? In this workshop, Dennis Sherwood will describe some work he has been doing recently in creating a generic strategic modelling structure. Of course, this is not a complete answer to all

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strategic modelling problems, but Dennis feels that the structure he will be describing is a very useful core. Dennis will much appreciate your views!

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Introduction to the Feedback Phenomenological Method, As Illustrated by Its Application to a 10-Hour Religious Experience

TFP is a system dynamics-based method for converting Husserl's important, but difficult, transcendental phenomenological method into a relatively simple formalized science. TFP analyzes consciousness and imagination to resolve traumatic experiences. The key reason TFP succeeds is it structures consciousness as a multiloop nonlinear feedback system, the same structure as the neurophysiological system underlying consciousness. Thus, TFP opens up phenomenology, consciousness studies, and deep psychotherapy as new territories for system dynamics applications. Focus of the one hour workshop will be on my ISDC 2002 conference paper on TFP. The method will be illustrated by its application to a 16 hour religious experience. An integral part of the workshop will be questions and criticism from attendees. System dynamicists at all levels, phenomenologists, psychotherapists, and other scholars are invited to attend, but I hope most of those who wish to comment will download my paper, carefully read it, and then bring it to the workshop.

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To help you get around Palermo, we have noted MAJOR roads and the conference venues.
Please consult city maps, Sicilia Dreams Tour Desk or Tourist Information for detailed maps and further information.
MAP IS **NOT** TO SCALE.

Gulf of Palermo

Palermo

North

Via Papa Sergio
Salita Belmonte
Via Comte Gull
Via Cardinale Rampolla
Via Ammiraglio Rizzo
Via Monte Pellegrino
Molo S. Lucia
e
Foro Italico
Corso Vittorio Emanuele
Via IV Aprile
Via Della Vetreria
Via S.M dello Spasimo
Via Abramo Lincoln
Piazza Ucciardone
Via Francesco Crispi
Via Emmerico Amari
Via Roma
Via Cavour
Via Roma
Via Della Liberta
Via Ruggero Settimo
Via Maqueda
Via XX Settembre
Via Volturno
Via Latini

Grand Hotel Villa Igiea
Salita Belmonte, 43
(at intersection with Via Pappa Sergio and Via C. Rampolla)
Phone: +39 091 54 37 44

In case you need more help call:
Enzo: +39 338 43 81 446, or
Gianni: +39 339 42 90 802, or
Gianly: +39 33 55 28 38 98

Grand Hotel et Des Palmes
Via Roma 398
(between Via M. Stabile and Via P. Granatelli)
Phone: +39 091 60 28 111

ASSINDUSTRIA
Via XX Settembre 64
(between Via Trapani and Via Siracusa)
Phone: +39 091 72 11 100

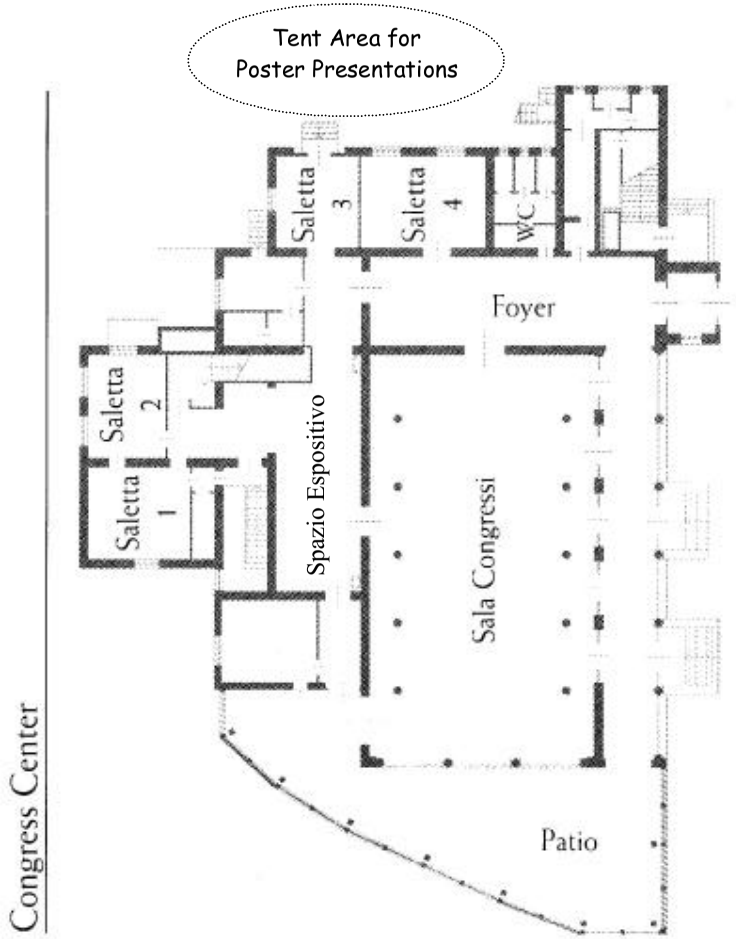
Residenza D'Aragona
Via Ottavio D'Aragona 25
(between Via M. Stabile and Via Bentivegna)
Phone: +39 091 66 22 222

Palazzo Steri
Piazza Marina 61
(near the north end of Corso Vittorio Emanuele)
Phone: +39 091 611 1365

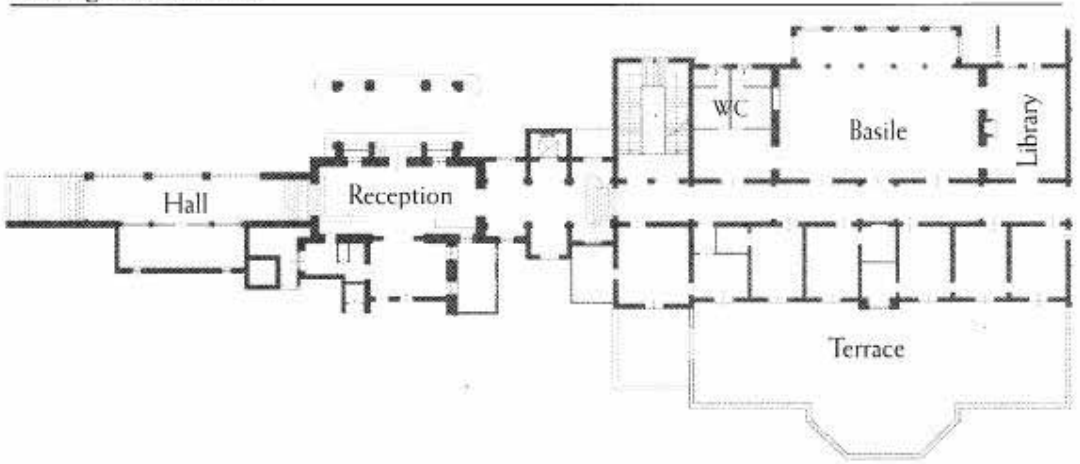
Ch Dello Spasimo
Via Santa Maria dello Spasimo 13
(between Piazza Magione and Via Torremuzza)
Phone: +39 091 61 6186

Entrance

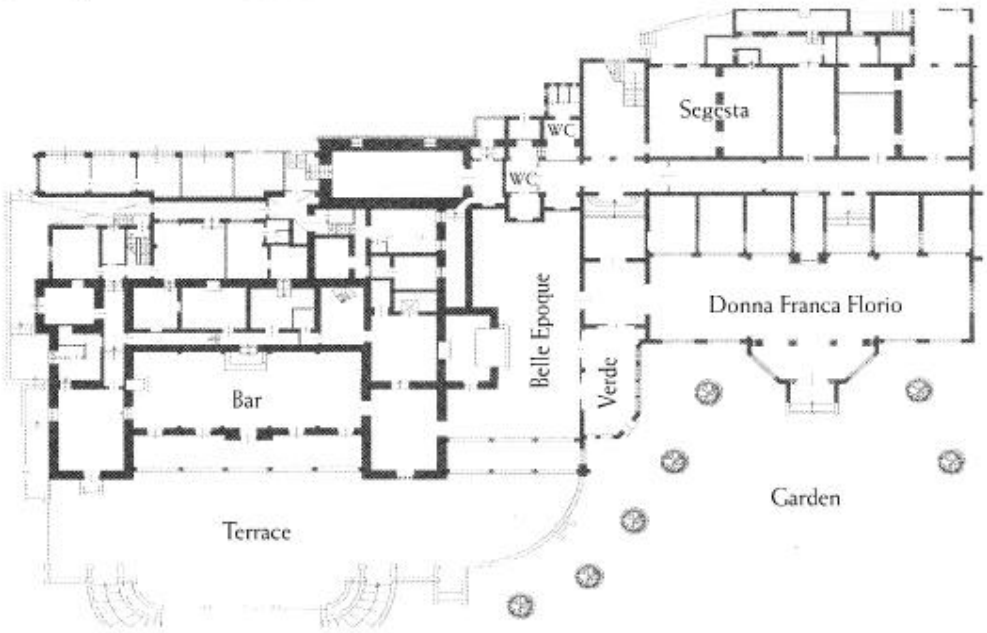
Salita Belmonte



Villa Igiea First Level



Villa Igiea 0 Level



Grand Hotel Villa Igiea