# Project Performance International

**Systems Engineering**

**Newsletter (SyEN)**

**SyEN #012 - October 8, 2009**

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SyEN is an independent free newsletter containing informative reading for the technical project professional, with scores of news and other items summarizing developments in the field, including related industry, month by month. This newsletter and a newsletter archive are also available at www.ppi-int.com.

**Systems engineering can be thought of as the problem-independent, and solution/technology-independent, principles and methods related to the successful engineering of systems, to meet stakeholder requirements and maximize value delivered to stakeholders in accordance with stakeholder values.**

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We hope that you find this newsletter to be informative and useful. Please tell us what you think. Email to: contact@ppi-int.com.

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# A Quotation to Open On

"Whoever undertakes to set himself up as a judge of Truth and Knowledge is shipwrecked by the laughter of the gods", Albert Einstein

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# Feature Article

## Systems Thinking and Dynamic Modeling Within K-12 Schools: Effects on Student Learning

Anne LaVigne
Systems Thinking in Schools, A Waters Foundation Project
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### Introduction:

In 1988, Massachusetts Institute of Technology (MIT) Professor Emeritus, Gordon Brown, found his way into the classroom of one middle school science teacher in Tucson, Arizona US and shared system dynamics modeling software with him. The teacher saw potential applications for embedding dynamic models into the learning process as a way to enhance and deepen student understanding of science content. He began creating instructional materials that allowed students to learn curriculum from a problem-based, learner-centered approach. For example, as part of an ecological study, students explored interdependent, dynamic relationships while making decisions about where to locate various amenities in a new national park. Students had to consider the impacts their decisions would have on the system as a whole, while operating within a limited financial budget. Young people often don't forget these experiences, since they exemplified meaningful work, and they carry the essence of that learning with them into their adult lives[1].

Over time, Professor Brown and that one middle school teacher directly and indirectly impacted use of systems thinking and dynamic modeling beyond this one classroom - to other teachers in the same school, to other schools in the same district, to other districts in the same city, and to other schools across the nation and in other nations. The increasing trend of use could, of course, not have occurred without a network of educators who saw the benefits for their students and who worked and continue to work on developing capacity to apply systems thinking and dynamic modeling within classroom instruction and organizational learning. Perhaps some important questions to consider are "How and why has it spread thus far?" and "What keeps it from spreading more quickly?" One partial answer begins with yet another question: "After twenty years, what evidence exists that using systems thinking/dynamic modeling[2] (ST/DM) methodologies has a positive, desirable effect on student learning?"

Four areas of evidence are available, each in different quantities and with different measurement criteria. The largest body of evidence is found within the anecdotes of teachers who describe thinking and learning results for their students. Although smaller in quantity, action research (a methodology used to investigate a particular question about learning) and student survey results allow for observation of some general trends relating to student learning/thinking[3]. Finally, empirical research studies are less prevalent, but have occurred within K-12 classrooms.

[1] A longitudinal video study, …that School in Tucson, shows adults reflecting on their learning experiences in middle school. Available from the Creative Learning Exchange at www.clexchange.org/thatschoolintucson

[2] The term dynamic modeling is used in this context to include computer modeling using system dynamics software, such as STELLA or Vensim, as well as other types of models, such as dynamic physical or kinesthetic modeling/simulation.

[3] The stories and research are a result of contributions from many individuals over time. Many thanks to Tracy Benson, Barbara Casanova, Caryl Crowell, Frank Draper, Sheri Marlin, Dave Mason, James Ranney, Joan Scurran, Shea Van Rhoads, and Heng Wenyu whose specific experiences are shared here.

## Anecdotal Evidence:

Although some may not give much merit to anecdotal reports, for teachers in the classroom, often the strongest evidence is what they see unfold over time within their own students. Teachers can see how the use of one methodology versus another produces differing effects on their students' abilities to think and learn about systems being studied. Over the course of an individual day, a unit of study, and a school year, teachers assess student progress toward identified learning goals and modify instruction based on that progress.

Whether the system being studied is characters within a novel, mathematical equations, ecological systems, or the dynamics of music, teachers can see how the use of visual tools can increase student understanding, and they can describe these effects on understanding with clear experiential evidence[4]. A primary teacher (of students ages 5-8) used a simple representation of the number of visitors at the zoo, based on the rates of individuals entering and leaving the zoo. The experience helped her kindergarten students build the foundation for addition and subtraction as well as understand the systems concept of an accumulation that changes over time.

An intermediate teacher (of students ages 8-11) described that being able to represent and discuss change over time when exploring a literary novel helped her students see the whole, rather than just the events of a particular chapter. A middle school science teacher (of students ages 11-14) saw how after kinesthetically experiencing a system and running a computer simulation, students could use an operational understanding of how infections can spread to talk about the trends produced in terms of economic, political and cultural implications. A high school social studies teacher (of students ages 14-18) described how systems thinking strategies he employs within his classroom allowed students to take a look at the bigger picture and realize that there is not necessarily one reason that a problem exists in a particular system.

In addition, teachers have described how students often find ways to connect the learning in the classroom to real-life situations. Primary students saw connections to dynamics on the playground and decided to use systems tools to help them understand what was affecting student and adult satisfaction over time. A middle school student, who had used the escalation archetype to explore patterns during the Cold War, recognized that a similar dynamic was occurring between one of his teachers and himself. The tool became a way to talk about the situation in a non-defensive way and find leverage for improvement. A high school student used his understanding of system dynamics models to study a current local issue, an invasive species in the US Pacific Northwest, and then presented his learning at the International System Dynamics Conference.

These stories represent just a few of the “Aha” moments for teachers and students. Over the last 20 years, a multitude of stories have inspired many to see how the visual nature of systems strategies can help scaffold learning for students and help them organize and better communicate their thinking.[5]

[4] Also see the work of Robert Marzano et al, who through a meta-analysis of studies relating to instructional strategies, found that the use of non-linguistic representations was a key strategy for increasing student achievement.

[5] Video Segments of teachers and students describing the rationale for using systems thinking strategies can be viewed at:
http://www.cfsd16.org/public/_century/centSkillVideos.aspx?vid=hydrologyprojectsml&auto=true
http://www.cfsd16.org/public/_century/centSkillVideos.aspx?vid=systemsthinking09&auto=true
http://www.cfsd16.org/public/_century/centSkillVideos.aspx?vid=SystemsThinking.flv&auto=true
http://www.watersfoundation.org/webed/mod1/mod1-5-1.html

## Action Research:

Many of the same teachers who had stories to share wanted to go further in their exploration of how ST/DM affected their students’ learning. They and others took on the challenge of completing one or more action research projects. Classroom teachers first determined and refined an action research question that related to how ST/DM strategies would affect students reaching curricular goals. The question provided a focus for the teachers as they described the desired student learning, the assessment plan to determine whether or not students achieved that learning, and the instructional use of systems strategies. Teachers then collected and analyzed data on student performance levels before and after the use of particular systems strategies as part of instruction. Through this analysis, they could go back to the original question and draw some conclusions, based on noted patterns. Some teachers participated in the action research process in subsequent years to further refine their methodologies and add to the body of results.

Based on a meta-analysis of all action research projects, a few of the initial trends[6] noted were

- Students use systems thinking tools to clarify and visually represent their understanding of complex systems. This visual approach allows the students and others to interact with and explore thoughts, perceptions, and mental models with precision and clarity.
- Systems thinking tools help students make connections between curricular areas and relevant life experiences.
- Students of all ages learn and independently use systems thinking problem-solving strategies.
- When using systems thinking concepts and tools, many students show increased motivation, engagement, and self-esteem.
- Systems thinking concepts and tools help students develop as readers and writers.

For example, the use of ST/DM within the context of reading and writing fostered students’ abilities to deepen understanding of a literary piece. Students used ST/DM strategies to help them retell and summarize a piece of writing. They analyzed character, plot, setting and theme along with the relationships among these literary components, and they identified points of view such as the authors’ and characters' mental models.

This marriage of systems strategies with specific educational standards is one important aspect of an action research project conducted within the classroom. Because the specific skills are directly connected to educational standards of learning that are set and tested at state and federal levels, one question is simply, is the use of ST/DM as an instructional strategy an effective way to learn class material? If the answer to this question is “Yes,” as the trends thus far suggest, then that alone is a compelling rationale for use. To take it a step further, another question to explore is, “Do students learn more using ST/DM strategies than they would have otherwise?” One way to consider this question initially is to engage students in reflecting upon their own learning.

[6] Additional information about the general trends and initial conclusions are available in the research section of the Systems Thinking in Schools, Waters Foundation website: www.watersfoundation.org

## Student Surveys:

Over the course of their 13 years in school, high school students have experienced hundreds, perhaps thousands, of different instructional methodologies. In some ways, we might look to them as experts in the field of learning, since different methods have either helped or not helped them as individuals learn the expected outcomes.

Each year over the course of an eight-year period from 1998-2005, graduating seniors at one high school (HS) were asked to self-assess the impact of using ST/DM tools on learning subject-area content. In addition, data was collected from middle school (MS) students from 2003-05. Students were asked to identify the tools they had used at some point during their school experience from Kindergarten through 12th grade. They also identified contexts in which they recalled using the tools, including specific computer simulations. Data for the last three years for both groups are included in the table below, when these three questions were asked each year.

| Survey Question | Average ‘Yes’ |
|---|---|

| | |
|---|---|
| Was using systems concepts/tools an effective way to learn class material? | MS 64%<br>HS 80% |
| Do you think you learned **more** by using these systems concepts/tools/ simulations than you would have otherwise? | MS 56%<br>HS 59% |
| Have you used or could you imagine using systems concepts/tools at times when not required, either in schoolwork or in social situations with friends/family? | MS 22%<br>HS 31% |

Keeping in mind that students have very different learning modalities, to say that any one instructional strategy is effective for 80% of high school seniors, creates a strong rationale for using that methodology as one way to reach a large percentage of students. Perceptual data, although not always aligned with factual data, can have a powerful impact on action. Although implied in the questions, students who see a strategy as effective will be more apt to be engaged in the learning process while using that strategy.

To further reinforce this premise, a recent high school graduate from Nanjing, China who presented his work at the 2009 International System Dynamics Conference[7] gave some advice to a group of attending K-12 teachers and system dynamicists. His challenge to them was to use systems thinking to engage students, to actively interest them in being involved in their own learning. For him, because his teachers integrated ST/DM through engaging interdisciplinary projects, he became excited about his own learning, and he had the tools needed to explore, process, and connect the subject-area learning to something meaningful. Listening to student perspectives such as these add yet another facet to determining overall effectiveness.

[7] See the System Dynamics Society's website for additional information about the conference.

## Empirical Study:

Empirical studies within the K-12 environment have been limited, although a number of studies have been completed at the undergraduate and graduate level[8]. One recent study, *Assessing the effectiveness of systems-oriented instruction for preparing students to understand complexity*, by Richard Plate has been completed within schools supported through the Systems Thinking in Schools, Waters Foundation Project. Plate designed his research to include two studies – one with middle school students and one with undergraduate students. Each study included a group that utilized ST tools (the systems group) along with a group that did not use these methods (the control group). The behavior of the groups was compared to one another as well as to a group of perceived experts within the system dynamics field.

The systems groups were able to develop causal maps that were, "on average, more similar to expert maps than were their respective control groups." (Plate, 2006) Using a scoring rubric, Plate compared the maps based on a number of criteria including identification of key variables and the representation of feedback loops. The systems groups scored more similarly to the expert groups than did the respective control groups in both studies. Plate concluded that, "Systems groups displayed a greater understanding of the situation described in the article than the control groups. While the differences observed are not definitive enough to make strong claims about systems-oriented instruction based only on these studies, they are strong enough to warrant further studies assessing systems-oriented instruction's worth as a pedagogical tool" (Plate, 2006).

As Plate suggests, additional research within K-12 is needed to come to more firm conclusions about the effects of instruction that incorporates systems strategies.

[8] System dynamics related research is available from many online sources, two of which are the Creative Learning Exchange at http://www.clexchange.org/search/cle_docsearch.asp?category=Research and the System Dynamics Society at http://www.systemdynamics.org/society_activities.htm.

## Moving Forward:

The evidence that does exist relating to K-12 use of ST/DM methodologies is not currently available in one easily accessible, central location. One challenge then becomes adding to this body of evidence while making it accessible and transparent to those seeking it. Best teaching practice is rooted in data, whether that data is collected by teachers in a classroom or by researchers in a controlled setting. Having that data accessible potentially removes one barrier to more widespread use of systems thinking and dynamic modeling.

A challenge for future researchers within the K-12 environment is to consider the scope of what to measure along with the potential audience for the resulting conclusions. Do we want to know how ST/DM affects student learning of educational

standards? Do we want to measure understanding of system dynamics concepts, such as accumulations and feedback? Do we want to measure lifetime benefits? During a K-12 educational roundtable at the 2009 International System Dynamics Conference, an interesting mental model surfaced as part of the conversation. The group was discussing the importance of research to validate the effectiveness of ST/DM. One participant contributed that no other field must prove through research that educating students, say in math or science, makes the world a better place. Considering this interesting insight could provide direction for future studies, helping us determine and clarify key research areas that will best communicate the effects over time on student learning and life experience as well as help educators refine educational pedagogy to better meet the needs of students.

The focus of the Systems Thinking in Schools project continues to be building the capacity of educators to deliver academic and lifetime benefits to students through systems thinking and dynamic modeling concepts, habits and tools. Participating educators have worked over time to determine, through anecdotal evidence, action research, surveys, and empirical study, to what degree we've succeeded in achieving that desired mission. Yet, we are still at the initial stages of creating the desired large body of evidence. Twenty years may seem like a long time, yet when compared to development time for other innovations, implementation of systems thinking and dynamic modeling within K-12 education has come a long way within a short period of time in determining what's logistically possible with students as young as 4-years old. So what comes next? For us, it's simply getting back to doing what works with students in classrooms, and when feasible, enhancing the body of evidence for the purpose of sharing that work beyond our own doorways.

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### About the Author


**Anne LaVigne** is a coordinator of the Waters Foundation, Systems Thinking in Schools project. She has worked for the last 14 years to build capacity of educators to use systems thinking and dynamic modeling strategies within instructional and organizational settings. She facilitates professional learning experiences and designs instructional resources and online learning environments that integrate a variety of modalities including visual, auditory, and kinesthetic to meet the individual needs of learners.


With the support of the Waters Foundation, a private, charitable foundation founded in 1957 by Jim and Faith Waters, the work of the Systems Thinking in Schools Project continues through a network of educators who develop the capacity of K-12 educators to apply systems thinking and dynamic modeling within classroom instruction and organizational learning. To learn more about the work of the project and available online resources, visit the project's website. All resources on the website are freely available for non-profit, educational use.

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# Systems Engineering News

## INCOSE Creates the Life Cycle Management Working Group

INCOSE has chartered a working group to improve the use of systems engineering (SE) in the management of program, project and system life cycles. Besides promoting the use of SE principles, processes, techniques and tools in the wide range of activities related to life cycle management (LCM), the working group will act to share SE best practices as they relate to LCM, encourage research in the area, and promote discussions to improve LCM.

More information

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## Griffin to Explore 'Systems Thinking'

Former NASA Administrator Mike Griffin will head a new kind of research center at University of Alabama, U.S.A. (UAH) to study "systems thinking" in government and industry. The new center was approved by the University of Alabama board of trustees, meeting in Tuscaloosa. The Center for Systems Studies will be the first in academia, a UAH statement said, and will involve research into "the many complex ways that technology, nature, people and society interact so that the workings of an engineered solution are more predictable and more desirable."

More information

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## Research Center Established for Systems Thinking

The University of Alabama in Huntsville has created a new interdisciplinary research organization — Center for System Studies — that will address the need for 'systems thinking' in industry and the government. System studies involve research to understand the many complex ways that technology, nature, people, and society interact so that the workings of an engineered solution are more predictable and more desirable.

More information

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# Featured Societies - Korea Council on Systems Engineering (KCOSE)

The Korea Council on Systems Engineering (KCOSE) was established in 2002 under the Presidency of Dr. Jung Uck Seo, then President of SK Telecom. In May 2003, KCOSE affiliated with the International Council on Systems Engineering (INCOSE).

KCOSE has been promoting a systems approach towards national prosperity from its formation until today. Its message: "Identify the right Job and do the job rightly". The organization has been very active, with:

- conferences
- certification activities
- translation of guides and handbooks
- translation of PPI's 5-day systems engineering course notes: Halligan, Robert, "Systems Engineering: From Awareness of Need to Retirement from Use", Institute of Systems Engineering, 2003 (in Korean). ISBN: 89-954265-1-9

PPI Managing Director Robert Halligan is an Honorary Member of KCOSE.

Website: http://kcose.org/

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# INCOSE Technical Operations

## INCOSE Lean Systems Engineering Working Group

http://www.incose.org/practice/techactivities/wg/leansewg/

INCOSE members are invited to visit the INCOSE Connect site of the Lean Systems Engineering Working group (the working site accessed by permission only: www.incose.org; then select Connect on the left hand side, enter your INCOSE user name and password, and finally select the Lean Systems Engineering Working Group).

### LEADERSHIP

**Co-Chair:** Bo Oppenheim, Ph.D., LMU, boppenheim@lmu.edu

**Co-Chair:** Deb Secor, Rockwell Collins, dasecor@rockwellcollins.com

Contact the WG

## MEMBERSHIP

Contact Lean SE Working Group to join this Working Group (all are invited) or for additional information.

## ACCOMPLISHMENTS / MAJOR PRODUCTS

## 1.0 LEAN ENABLERS FOR SYSTEMS ENGINEERING

A collection of 194 do's and don'ts of systems engineering, released as Powerpoint file:

**1.1** Lean Enablers for Systems Engineering, Version 1.01, 02/01/2009 (pdf, 0.764 MB)

**1.2** Lean Enablers for Systems Engineering, full-length article, (accepted for publication in the Journal of Systems Engineering).

**1.3** Lean Enablers for Systems Engineering, five-page summary article from Cross Talk (pdf, 0.80 MB)

**1.4** Lean Enablers for Systems Engineering, short article from INCOSE INSIGHT (pdf, 0.52 MB)

**1.5** Summary text submitted for next edition of the INCOSE Systems Engineering Handbook

**1.6.1** Lean SE Brochure (trifold in LETTER format.pdf, 0.17 MB)

**1.6.2** Lean SE Brochure (trifold in A4 format.pdf, 0.17 MB)

**1.7** LEfSE Quick Reference Guide (8 pages, pdf, 0.27 MB)

**1.8** Book-long collection of one-page-per enabler forms. Each form lists the enabler, the value it promotes, the waste it prevents, explanations and examples, implementation, references (a joint project with France AFIS, due in Spring 2010)

## CHARTER OF THE LEAN SE WORKING GROUP

It is the goal of the Lean SE Working Group to strengthen the practice of systems engineering (SE) by exploring and capturing the synergy between traditional SE and Lean. To do this, the group will apply the wisdom of Lean Thinking into SE practices integrating people, processes, and tools for the most effective delivery of value to program stakeholders; formulate the Body of Knowledge of Lean SE; develop supplements to the INCOSE SE Handbook (and other such manuals) with Lean Enablers for SE; and develop and disseminate training materials and publications on Lean SE within the INCOSE community, industry, and academia.

## HISTORY OF THE LEAN SE WORKING GROUP

The birth of Lean Systems Engineering (LSE) is traced to the first course under that title offered at MIT by Professor Earll Murman at Massachusetts Institute of Technology (MIT) in 2003. The Lean Aerospace Initiative team of Dr. Eric Rebentisch, Dr. Donna Rhodes, and Professor Earll Murman laid theoretical foundations for LSE in 2004. They defined the synergy of Lean and Systems Engineering as (paraphrased): "Systems Engineering which grew out of the space industry to help deliver flawless complex systems is focused on technical performance and risk management. Lean which grew out of Toyota to help deliver quality products at minimum cost is focused on waste minimization, short schedules, low cost, flexibility, and quality. Both have the common goal to deliver system lifecycle value to the customer. Lean Systems Engineering is the area of synergy of Lean and Systems Engineering with the goal to deliver the best lifecycle value for technically complex systems with minimum resources." This synergy gave rise to the subsequent definition of LSE: "LSE is the application of Lean Six Sigma principles, practices and tools to Systems Engineering in order to enhance the delivery of value to the system's stakeholders".

In 2003, the LAI consortium invited universities to join the new LAI Educational Network (EdNet™). The EdNet stated mission is to collaborate on the development and dissemination of lean curricula, and research. Starting with LMU, at the time of this writing the EdNet has grown to 35 United States of America and four non-U.S. universities. EdNet is managed by MIT. The EdNet members soon organized themselves into a number of small working groups, including LSE, intending to develop a community of practice. During the 2004-2006 period, the EdNet LSE group met several times and enjoyed interesting discussions. However, not much progress was made, probably because the faculty members lacked the current industrial SE experience.

At the end of 2005, in order to move the LSE project at a faster pace, Bo Oppenheim proposed to the International Council on Systems Engineering (INCOSE) the formation of a new Lean Systems Engineering Working Group (LSE WG), hoping to draw from the collective wisdom of the large membership of SE practitioners that belong to that professional society. The first meeting drew 30 people. Since that time, the Group has grown to over 100 individuals, all unpaid volunteers, and is currently one of the largest Working Groups of INCOSE.

The LSE WG devoted the first 18 months to conceptual and administrative tasks (creation of the website and mailing list, definitions, recommended readings, and formulation of the charter), as well as presentations and panels devoted to various LSE ideas on how to proceed. The LSE WG has met twice a year, during the INCOSE International Symposia and International Workshops.

During the 2007-2009 period, the Group developed a major product called Lean Enablers for Systems Engineering (LEfSE), released as Version 1.0 on Feb.1, 2009. The product is intended to be updated periodically, based on new knowledge. In 2009, WG members offered a number of workshops about the LEfSE, including: INCOSE-Los Angeles, INCOSE Israel, INCOSE-France, INCOSE-Singapore, and MIT LAI Knowledge Exchange Event.

Other research on application of Lean Thinking into Systems Engineering is ongoing.

### KNOWLEDGE BASE

Lean SE Definitions added 3 May 2007

Links and Resources Related to Lean SE and Related Sites added 4 May 2007

Selected results of Google search for Lean SE added 3 May 2007

Lean SE Reading List added 3 May 2007

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# Article: Systems Engineering and Lean - a View

SyEN is indebted to the INCOSE Lean Systems Engineering Working Group for bringing to this issue of SyEN a point of view which emphasises value delivery, and sharing this perspective with others – thanks a million guys. But the question I ask is “why should this be necessary? Why would any rational human being promote practices that do anything other than maximize value delivery in accordance with the values of the stakeholders being served by the engineering?

Well, clearly the 100 or so members of the INCOSE Lean Systems Engineering Working Group see a need.

My take on this issue is that systems engineering can be practiced well, or it can be practiced poorly. In practicing good systems engineering, people:

- focus on principles
- draw selectively upon tools that contribute to effective implementation of sound principles
- choose to do things, and choose not to do things, for exactly the same reason: the rational expectation of producing a better result
- factor uncertainty into every decision, balancing risk and opportunity.

In practicing systems engineering badly, people have been known to:

- treat systems engineering as a religion
- focus on rules
- do everything all the time, regardless of circumstances
- focus on documents, not on information
- even for sound principles, use ineffective methods of implementation.

Is there a contrast to be made between “traditional SE and Lean”? I’m not sure. What is traditional SE? If we were to ask in the Defense sector we might get one answer, and in the medical sector, a very different answer. Similarly, between enterprises in the same sector. Clear evidence exists, going back hundreds of years and more, of the practice of “good systems engineering” across a variety of sectors.

What is clear to me is that “Lean SE is Good SE”, if by lean we mean doing nothing that, on a balance of probabilities basis, costs more than the value it adds in accordance with the values of the stakeholders being served.

Robert Halligan
Managing Director, Project Performance International

# Systems Engineering Software Tools News

## PivotPoint - Sparx Partnership Promotes Model-Based Systems Engineering with SysML

PivotPoint Technology and Sparx Systems announced a technology partnership to promote model-based systems engineering with the Systems Modeling Language (SysML). SysML is the domain-specific modeling language for systems engineering applications that was adopted by the Object Management Group as OMG SysML™ in July 2006, and is attracting users among systems engineers worldwide.

More information

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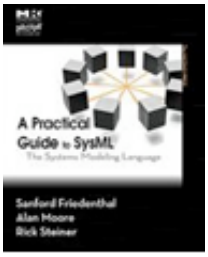
# Systems Engineering Books, Reports, Articles and Papers

## A Practical Guide to SysML (Revised Printing): The Systems Modeling Language




Sanford Friedenthal, Alan Moore, Rick Steiner
Published: August 27, 2009 Publisher: Morgan Kaufmann
ISBN - 10:012378607X
ISBN - 13:9780123786074

### Book overview

Systems engineers and architects must understand how all the parts of a system work together to satisfy its requirements. SysML is a general purpose graphical modeling language used to specify, analyze, and design systems that may include hardware, software, and personnel. It allows engineers to describe how a system interacts with its environment, and how its parts must interact to achieve the desired system behavior and performance. The SysML model provides a shared view of the system, enabling a design team to surface issues early and prevent problems that would otherwise delay development and degrade design quality.

More information

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## The Method Framework for Engineering System Architectures


by Donald G. Firesmith, Peter Capell, Charles B. Hammons, DeWitt Latimer, Tom Merendino, Dietrich Falkenthal
Auerbach Publications; 1 edition (November 20, 2008)
ISBN-10: 1420085751
ISBN-13: 978-1420085754

### Product Description

The architects of today's large and complex systems all too often struggle with the lack of a consistent set of principles and practices that adequately address the entire breadth of systems architecture. The Method Framework for Engineering System Architectures (MFESA) enables system architects and process engineers to create methods for effectively and efficiently engineering high-quality architecture for systems, subsystems, and software components.

More information

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## Complexity Science and Social Entrepreneurship: Adding Social Value through Systems Thinking

by Jeffrey A Goldstein, James K Hazy, and Joyce Silberstang
ISCE Publishing (July 26, 2009)
ISBN-10: 0984216405
ISBN-13: 978-0984216406

### Product Description

This ground-breaking volume explores social entrepreneurship from the perspective of complexity science and systems thinking. Case studies, models, simulations, and theoretical papers advance both theory and practice, providing an innovative and comprehensive look at these dynamic topics. Written by complexity theorists, international development practitioners, and experts in a variety of other disciplines, this must-have book is mandatory reading for everyone interested in this newly developing field.

More information

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## The Types of Requirements, and Why Would We Care?

by Robert Halligan, Managing Director, Consultant and Trainer,
Project Performance International

The Types of Requirements, e.g. states and modes, functional, performance, external interface, environmental, resource, physical, other qualities and design, are critically important to three roles in engineering: the Requirements Analyst role, the Specification Writer role, and the Designer role...

... In this paper, a soundly-based schema of Types of Requirements is presented, and the significance of each type to each of the three roles of Requirements Analyst, Specification Writer, and Designer is described.

More information

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## The Challenges of Requirements Engineering in Mobile Telephones Industry

Maccari, A

**Abstract:** Requirements engineering ranks as one of the most difficult and error-prone phases in the life cycle of devices such as mobile telephones. It is of critical importance because of the highly dynamic market and the constant evolution of product features. If carried out properly, it shortens development time and allows to build products that respond to the market needs. However, it is too often regarded as useless and overly time-consuming. An outlook on the state of practice allows to identify space for improvement of the requirements engineering process (REP). I propose three main challenges that stand on the way towards an optimal requirements engineering practice in our sector. A higher degree of co-operation between the industry and the research world is essential in order to achieve success in this informal yet critical phase of product development

More information

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# Conferences and Meetings

### Business Analyst World

5 - 6 October, 2009, Denver, USA. More information

5 - 6 October, 2009, Edmonton, Canada. More information
5 - 7 October, 2009, Brisbane, Australia. More information
19 - 22 October, 2009, Boston, USA. More information
26 - 29 October, 2009, Vancouver, Canada. More information
16 - 19 November, 2009, Chicago, USA. More information
30 November - 1 December, 2009, Ottawa, Canada. More information

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### ACM/IEEE 12th International Conference on Model Driven Engineering Languages and Systems (formerly the UML series of conferences)

4 - 9 October, 2009, Denver, Colorado, USA.
More information

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### Educators' Symposium at MODELS 2009

4 - 9 October, 2009, Denver, Colorado, USA.
More information

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### 2nd International Workshop on Model Based Architecting and Construction of Embedded Systems (in conjunction with MODELS 2009)

6 October, 2009. Denver, Colorado, USA.
More information

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### Track Systems Engineering 2009

7 - 8 October, 2009, Munich, Germany.
More information

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### 2009 SEER by Galorath North American User Conference: Best Practices in Project Estimation, Planning & Control

8 - 9 October, 2009. Portofino Hotel, California, USA.
More information

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### International Conference on Man-Machine Systems (ICoMMS)

11 - 13 October, 2009, University of Malaysia Perlis.
More information

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### 7th International Symposium on Automated Technology for Verification and Analysis

13 - 16 October, 2009, Macao SAR, China.
More information

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### Symposium on Automotive/Avionics Systems Engineering SAASE 2009

14 - 17 October, 2009, San Diego, CA, USA.
More information

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### INCOSE Cleveland-Northern Ohio – (Region IV Autumn ’09)

25-26 October, 2009, OHIO Aerospace Institute, 22800 Cedar Point Road, Cleveland, OH 44142
More information

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### 12th Annual Systems Engineering Conference

26 - 29 October, 2009, San Diego, CA, USA.
More information

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### Formal Methods for Industrial Critical Systems (FMICS) 2009

2 - 3 November, 2009, Eindhoven, The Netherlands.
More information

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### 16th International Symposium on Formal Methods (FM2009)

2 - 6 November, 2009, Eindhoven, The Netherlands.
More information

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### FM 2009 Doctoral Symposium

6 November, 2009, Eindhoven, The Netherlands.
More information

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### 28th International Conference on Conceptual Modeling

9 - 12 November, 2009, Gramado, RS, Brazil.
More information

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### Workshop on Requirements, Intentions and Goals in Conceptual Modeling

9 - 12 November, 2009, Gramado, RS, Brazil.
More information

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### Tag des Systems Engineering (Day of Systems Engineering)

Friedrichshafen am Bodensee
12 - 13 November, 2009
More information

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### CMMI 9th Technology Conference and User Group 


11/16/2009 to 11/19/2009, Hyatt Regency Tech Center – Denver

More Information

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### Decision Analysis and Its Applications to Systems Engineering 


17-18 November 2009 at the Omni Hotel in Newport News, Virginia

More Information

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### 1st Annual Global Conference on Systems and Enterprises (GCSE)

2 - 4 December, 2009. Singapore.
More information

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### 4th South-East European Workshop on Formal Methods (SEEFM 2009)

4-5 December 2009, Thessaloniki, Greece
More information

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### International Joint Conferences on Computer, Information, and Systems Sciences, and Engineering (CISSE 09) NEW

December 4 - 12, 2009
Sponsored by the University of Bridgeport - Technically co-sponsored by the IEEE Computer Society, Communications Society and Education Society (Connecticut Section)

More Information

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### INCOSE 2010 International Workshop

7 - 10 February, 2010. Phoenix Marriott Mesa, Mesa, Arizona.
More information

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### 1st Workshop on Semantically-Enabled Systems Engineering (SENSE-2010)

15 - 18 February, 2010. Andrzej Frycz Modrzewsk Cracow College, Krakow, Poland.
More information

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### IESS 1.0: First International Conference on Exploring Services Sciences

17 - 19 February, 2010. Geneva, Switzerland.
More information

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### CSER 2010 8th Annual Conference on Systems Engineering Research

17-19 March, Honoken, NJ, USA
More information

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### Track on REAL-TIME SYSTEMS at ACM SAC 2010

21 - 26 March, 2010. Sierre, Switzerland.
More information

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### The Third Edition of the Requirements Engineering Track (RE-Track'10)

22 - 26 March, 2010. Sierre, Switzerland.
More information

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### Symposium On Theory of Modeling and Simulation - DEVS Integrative M&S Symposium (DEVS'10) NEW

April 11 - 15, as part of the 2010 Spring Simulation Multiconference at the Florida Mall Hotel and Conference Center in Orlando, FL, USA

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### WER'10: 13th Workshop on Requirements Engineering NEW

April 12-13, 2010 - Cuenca, Ecuador

More Information

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### Agent-Directed Simulation Symposium (ADS 2010)

12 - 15 April, 2010, Orlando, Florida, USA.
More information

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### COFES: Congress on the Future of Engineering Software (COFES) 2010

15 - 18 April, 2010, Scottsdale, Arizona, USA.
More information

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### 22nd Annual Systems & Software Technology Conference (SSTC 2010)

26-29 April 2010, Salt Palace Convention Center, Salt Lake City, Utah
More information

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### Systems Engineering and Test & Evaluation (SETE) 2010

3 - 6 May, 2010, Stamford Grand, Adelaide.
More information

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### EuSEC 2010: Systems Engineering and Innovation

23 - 26 May, 2010, Stockholm, Sweden.
More information

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### The 22nd International Conference on Advanced Information Systems Engineering (CAiSE'10)

07-11 June 2010, Hammamet, Tunisia
More information

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### PETRI NETS 2010

21-25 June, 2010, Braga, Portugal
More information

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### 20th Annual INCOSE International Symposium (IS10)

11 - 15 July, 2010, Rosemont, IL, USA.
More information

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### Fourth Asia-Pacific Conference on Systems Engineering (APCOSE 2010)

11 - 13 September, 2010. Keelung, Taiwan.
More information

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# Education & Academia

### Post-Doc Position near Paris, Complex Systems

The laboratory LISE (Model Driven Engineering Laboratory for embedded and real-time systems), part of the CEA LIST (450 researchers in the field of complex systems, see http://www-list.cea.fr/) has an open position for a research assistant.

Within a project of this type, the lab seeks to study parts of systems described with Matlab/Simulink in the context of automotive applications. Because existing tools are not clearly adapted to validate such complex systems, one of the objective of the project is the creation of a validation platform.

More information

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### Post-Doc Position at CEA LIST: Model Driven Integration Testing

The laboratory LISE (Model Driven Engineering Laboratory for embedded and real-time systems), part of the CEA LIST (450 researchers in the field of complex systems, see http://www-list.cea.fr) has an open position for a research assistant.

The VERDE project focuses on the definition of design techniques for component oriented systems. More precisely defined techniques will make collaborating modelling techniques and testing techniques in order to ease the definition and implementation of correct systems. In this context the laboratory LISE propose to define a solution based on the UML coupled with symbolic execution based testing tools. The focus will be made on integration testing.

More information

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### Postdoctoral Research Associate in Controls Engineering - Oak Ridge National Laboratory

The Energy and Engineering Sciences Directorate/Measurement Science and Systems Engineering Division (MSSED) has openings for postdoctoral research fellowships in Control Systems Engineering to support program activities related to the design, analysis, development, testing, and fielding of advanced control devices, networks and systems. Areas of specialization include a combination of some or all of the following: modeling and analysis of new control techniques and algorithms, systems engineering; embedded controls; process controls (including closed loop applications); programmable logic controllers; high speed diagnostics; sensors and instrumentation; documentation (including requirements specifications, test procedures, user's guides, and design documents); and safety systems.

More information

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# Some Systems Engineering-Relevant Websites

http://www.webel.com.au/

This website of Dr Darren Kelly contains some unique material on SysML.

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http://standards.ieee.org/

This is the website of the IEEE Standards Association.

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http://www.asd-ste100.org/

ASD-STE100 is a set of writing rules and basic vocabulary for writing technical documentation in English, so that it is easy to understand by all users and avoids misunderstandings, especially amongst those whose first language is not English.

ASD-STE100 has a set of approximately 60 Writing Rules that range from rules about the use of words to rules about layout, sentence length, and how to write Warnings and Cautions. The basic vocabulary contains general words, such as "disconnect", "general", "hold", and "sharp", that are needed to make sentences. Besides these general words in the Dictionary, two additional families of words, called "Technical Names (TN)" and "Technical Verbs (TV)" can be used.

ASD: the AeroSpace and Defence Industries Association of Europe, represents the aeronautics, space, defence and security industries (in Europe) in all matters of common interest with the objective of promoting and supporting the competitive development of the sector.

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http://www.system-modeling.com/sysml_example.html

This website promotes the book "Systems Engineering with SysML/UML - Modeling, Analysis, Design, The OMG Press, by Tim Weilkiens. The site also provides a sownload facility for SYSMOD, an approach for the analysis and design of systems. A Car Access System Example SysML Model is also available for download at the site. There is a version of the site in German: http://www.system-modellierung.de/

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http://bulldozer00.wordpress.com/uml-and-sysml/

This site contains a useful overview of, and comparison between, UML and SysML.

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http://www.geraldmweinberg.com/Site/Home.html

This is the site of Gerald M. Weinberg, writer, consultant, and author of many highly regarded books, including "An Introduction to General Systems Thinking", "General Principles of System Design", "Exploring Requirements: Quality Before Design", The

Handbook of Walkthroughs, Inspections, and Technical Reviews", "Rethinking Systems Analysis and Design", "Roundtable on Technical Leadership: A SHAPE Forum Dialogue (co-editors: Marie Benesh and James Bullock), and Roundtable on Project Management: A SHAPE Forum Dialogue (co-editors: Marie Benesh and James Bullock). The site contains includes detailed descriptions of each of his books.

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# Standards and Guides

## IEEE-SA's New Industry Connections Program Enables Uniquely Efficient and Economical Industry Collaboration

The IEEE Standards Association (IEEE-SA) announced the formal launch of its new Industry Connections program, designed to help like-minded companies to quickly and cost-effectively come together in the early stages of collaborative work in a technical area. Groups have the unique opportunity to leverage IEEE and IEEE-SA resources in a customized format and produce varied content, such as proposals for standards, white papers, specialized tools, online databases, data feeds and/or video.

More Information

# Some Definitions to Close On - Baseline

### Baseline:

A set of specifications or work products that has been formally reviewed and agreed on, which thereafter serves as the basis for further development, and which can be changed only through change control procedures.
Source: CMMI for Development V1.2

### Configuration baseline:

The configuration information formally designated at a specific time during a product's or product component's life. Configuration baselines, plus approved changes from those baselines, constitute the current configuration information.
Source: CMMI for Development V1.2

### Product baseline:

In configuration management, the initial approved technical data package (including, for software, the source code listing) defining a configuration item during the production, operation, maintenance, and logistic support of its lifecycle.
Source: CMMI for Development V1.2

Comment by PPI: This last definition is unusual and problematic. The definition is inconsistent with the definition of "Product Baseline". Limiting Product Baseline to the *initial* approved technical data package may be inappropriate, since this limitation effectively precludes re-baselining to incorporate approved changes with reference to the previous Product Baseline.

# Project Performance International News

## PPI's Cognitive Systems Engineering Course

Last week, the first delivery of PPI's new, 5-day "Cognitive Systems Engineering" course (CSE5D) was delivered in Adelaide, Australia. This course, developed and presented by Dr. Gavan Lintern, focuses on the techniques for optimising the performance of the human as a part of a system. Although general in application, CSE5D is most valuable where human performance governs success, failure or disaster, for example:

- air traffic control systems
- air transportation systems
- land transportation systems, e.g. cars
- power generation systems
- war-fighting systems
- medical systems
- industrial process systems.

The techniques of Cognitive Systems Engineering also have direct application in securing the commercial success of products, where ease and reliability of operation are important differentiators.

After an impressive career with organisations such as the University of Illinois (as Associate Professor), General Dynamics (as Chief Scientist) and DSTO Australia (as Head of Human Factors), Dr. Lintern is now a member of PPI's dynamic team of expert trainers.

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## Tainá da Costa Silva Joins PPI

PPI welcomes Tainá da Costa Silva to its Melbourne-based team. Tainá is a Carioca, a person born in Rio de Janeiro, Brasil. Tainá will be liaising with PPI's Brazilian clients.

# Project Performance International Events

### Systems Engineering 5-Day Courses

Upcoming locations include:

- Rio de Janeiro, Brazil
- Cape Town, South Africa
- Las Vegas, USA
- Singapore
- Amsterdam, The Netherlands
- London, UK

View 2009/2010 Systems Engineering Course Schedule

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### Requirements Analysis and Specification Writing 5-Day Courses

Upcoming locations include:

- Amsterdam, The Netherlands
- Las Vegas, USA
- Melbourne, Australia
- Cape Town, South Africa

View 2009/2010 RA&SW Course Schedule

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### OCD/CONOPS 5-Day Courses

Upcoming locations include:

- Las Vegas, USA
- Pretoria, South Africa
- Adelaide, Australia

View 2009/2010 OCD/CONOPS Course Schedule

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### Software Engineering 5-Day Courses

Upcoming locations include:

- Amsterdam, The Netherlands
- Melbourne, Australia
- Pretoria, South Africa
- Las Vegas, USA

View 2009/2010 Software Engineering Course Schedule

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### Cognitive Systems Engineering 5-Day Courses

Upcoming locations include:

- London, UK
- Las Vegas, USA
- Melbourne, Australia
- Adelaide, Australia

View 2009/10 Cognitive Systems Engineering Course Schedule

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## PPI Upcoming Participation in Professional Conferences

- 26 - 29 October, 2009 - **12th Annual Systems Engineering Conference** - San Diego, CA, USA (Exhibiting)

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Kind regards from the SyEN team:
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