Project Performance International

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Systems Engineering Newsletter (SyEN)

SyEN#036 - September 27, 2011

Brought to you by Project Performance International

Dear Colleague,

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, based on systems thinking, related to the successful engineering of systems, to meet stakeholder requirements and to maximize value delivered to stakeholders in accordance with their 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.

What's Inside:

READ ALL

A Quotation to Open On

Featured Articles -

- Capers Jones - Software Defect Removal Efficiency
  ... Read More

Systems Engineering News

- PMI and INCOSE Align to Help Organizations Improve Program Success
- Resilience Innovation Laboratory and the (Newly Formed) Resilience Engineering Association
- Jon Holt Valorizes MBSE with his Lecture: "Making Houdini Safe"
- Northrop Grumman Information Systems President Neil G. Siegel Awarded Systems Engineering Award
- SPECTRUM WEBCAST: Systems Engineering: Two perspectives on a Domain That is No Longer Optional
- 2011 LMS South American Systems Engineering Conference Held in São Paulo
  ... Read More

Featured Society - SAVE International®

... Read More

INCOSE

- Call for Nominations
- Upcoming INCOSE Events
- INCOSE *INSIGHT*

- INCOSE *eNote*
  ... Read More

INCOSE Technical Operations

- Autonomous System Test & Evaluation Working Group
  ... Read More

Systems Engineering Software Tools News

- Overview of Software Tools Supporting Requirements Management
- Research and Markets: A Practical Guide to SysML. Edition No. 2 is Written by the Leader and Two Key Members of the OMG SysML Standardization Team
- Siemens Says PLM's Matured Into a True Engineering Platform
- BigLever Software and General Motors to Co-Present Product Line Engineering Sessions for IBM Rational's Systems and Software Engineering Symposium Series
- Mentor Graphics SystemVision Wins NI LabVIEW Award for Platform Extension
  ... Read More

Systems Engineering Books, Reports, Articles and Papers

- Systems Engineering Principles and Practice
  ... Read More

Conferences and Meetings

  ... Read More

Education and Academia

- Postdoctoral Research Position at Oxford Brookes University
- Research Associate in Systems of Systems Engineering, Loughborough University
- Philadelphia University Receives Rigorous ABET Accreditation for Engineering, Industrial and Systems Engineering, and Mechanical Engineering Programs
- Scholarship in Engineering Design, Imperial College London and National University of Singapore
  ... Read More

Some Systems Engineering-Relevant Websites

- Leonardo Da Vinci - one of the Original Systems Thinkers
  ... Read More

Standards and Guides

- About ISO
- How International Standards Create Global Confidence
- Announcing IEEE's New Standards Education e-Magazine
  ... Read More

Some Definitions to Close On

- Analytic Hierarchy Process (AHP) and Analytic Network Process (ANP)
  ... Read More

Systems Engineering Jobs

- Systems and Solutions Engineering Manager Tait, Christchurch, New Zealand
  ... Read More

PPI News

- The PPI News in Short
- PPI's 2012 Training Schedule - New Delivery Locations
- PPI LinkedIn Group
  ... Read More

PPI Events

  ... Read More

A Quotation to Open On

“The academic system of measuring performance leads to the creation of large numbers of write-only publications.” - *Ian Sommerville*

Featured Article

Software Defect Removal Efficiency

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Abstract

The most important contributor to the quality of software-intensive systems is the quality of the software components. The most important single metric for software quality is that of defect removal efficiency (DRE). The DRE metric measures the percentage of bugs or defects found and removed prior to delivery of the software. The current U.S. average in 2011 is only about 85% of total defects removed. However, best in class projects can top 99% in defect removal efficiency. High levels of DRE cannot be achieved using testing alone. Pre-test inspections and static analysis are necessary to top 95% in defect removal efficiency.

Introduction

In the 1970's the author worked for IBM. Software applications were growing larger and more complex so quality was becoming a serious issue. IBM began a careful analysis of software quality. Measurements were taken of defects found in software requirements, design documents, source code, user manuals, and also "bad fixes" or secondary defects accidentally included in defect repairs.

At the same time IBM developed the function point metric, because it was necessary to analyze non-coding defects and non-coding development activities as well. After several years of data collection, it was possible to determine the relative contribution of various defect origins on total software defects. The total number of defects from all five sources was termed the "defect potential" of a software application.

Table 1 shows approximate U.S. averages from more than 13,000 projects. Table 1 shows the average volumes of defects found on software projects, and the average percentage of defects removed prior to delivery to customers:

Defect Origins	Defect Potentials	Removal Efficiency	Delivered Defects
Requirements	1.00	77%	0.23
Design	1.25	85%	0.19
Coding	1.75	95%	0.09
Document	0.60	80%	0.12
Bad Fixes	0.40	70%	0.12
Total	*5.00*	*85%*	*0.75*

Table 1: Defect Removal Efficiency by Origin of Defects Circa 2011
(Data Expressed in Terms of Defects per Function Point)

Table 1 is an excerpt from the author's book The Economics of Software Quality, Addison Wesley, 2011.

There are of course fairly wide ranges. The maximum defect potential observed for large applications of 10,000 function points is about 7.0 defects per function point. The minimum number of defects observed for small projects below 1000 function points is about 2.00 per function point. The maximum defect removal efficiency observed is about 99% and the lowest is below 80%.

Both defect prevention and defect removal are important, but this article concentrates on defect removal efficiency because it is a critical metric and fairly easy to measure.

Measuring Defect Removal Efficiency (DRE)

Serious software quality control involves measurement of defect removal efficiency (DRE). Defect removal efficiency is the percentage of defects found and repaired prior to release.

In principle the measurement of DRE is simple. Keep records of all defects found during development. After a fixed period of 90 days, add customer-reported defects to internal defects and calculate the efficiency of internal removal. If the development team found 90 defects and customers reported 10 defects, then DRE is of course 90%.

(Note that the International Software Benchmark Standards Group (ISBSG) uses release plus 30 days for DRE measures. This means that ISBSG DRE measures are higher than the author's due to the 30-day versus 90-day intervals.)

In real life DRE measures are tricky because of bad-fix injections, defects found internally after release; defects inherited from prior releases; invalid defects; and other complicating factors.

Raising Defect Removal Efficiency (DRE) Levels

Most forms of testing are less than 50% efficient in finding bugs or defects. However, formal design and code inspections are more than 65% efficient in finding bugs or defects and often top 85%.

Static analysis is also high in efficiency against many kinds of coding defects. Therefore all leading projects in leading companies utilize formal inspections, static analysis, and formal testing. This combination is the only known way of achieving cumulative defect removal levels higher than 95% and approaching or exceeding 99%.

Table 2 illustrates the measured ranges of defect removal efficiency levels for a variety of reviews, inspections, static analysis, and several kinds of test stages.

Table 2: Pre-Test and Test Defect Removal Efficiency Ranges

Pre-Test Defect Removal	Minimum	Average	Maximum
Formal design inspections	65.00%	87.00%	97.00%
Formal code inspections	60.00%	85.00%	96.00%
Static analysis	65.00%	85.00%	95.00%
Formal requirement inspections	50.00%	78.00%	90.00%
Pair programming	40.00%	55.00%	65.00%
Informal peer reviews	35.00%	50.00%	60.00%
Desk checking	25.00%	45.00%	55.00%
Average	48.57%	69.29%	79.71%

Test Defect Removal	Minimum	Average	Maximum
Experiment-based testing	60.00%	75.00%	85.00%
Risk-based testing	55.00%	70.00%	80.00%
Security testing	50.00%	65.00%	80.00%
Subroutine testing	27.00%	45.00%	60.00%
System testing	27.00%	42.00%	55.00%
External Beta testing	30.00%	40.00%	50.00%
Performance testing	30.00%	40.00%	45.00%
Supply-chain testing	20.00%	40.00%	47.00%
Cloud testing	25.00%	40.00%	55.00%
Function testing	33.00%	40.00%	55.00%
Unit testing (automated)	20.00%	40.00%	50.00%
Unit testing (manual)	15.00%	38.00%	50.00%
Regression testing	35.00%	35.00%	45.00%
Independent verification	20.00%	35.00%	47.00%
Clean-room testing	20.00%	35.00%	50.00%
Acceptance testing	15.00%	35.00%	40.00%
Independent testing	15.00%	35.00%	42.00%
Average	29.24%	44.12%	55.06%

The low defect removal efficiency levels of most forms of testing explain why the best projects do not rely upon testing alone. The best projects utilize formal inspections first, static analysis, of code, code inspections for key features, and then a multi-stage testing sequence afterwards. This combination of inspections followed by static analysis and testing leads DRE in the

range of 95% to 99%. It also leads to the shortest overall development schedules, and lowers the probabilities of project failures.

Low Quality Defect Removal Efficiency (DRE) Case Study

Table 3 is a simple case study that illustrates the typical results of four common forms of testing: 1) Unit test; 2) Function test; 3) Regression test; 4) System test. Since testing is not very efficient, the results are not very good. We will also assume a traditional "waterfall" development method.

In this case study let us assume an application of 1,000 function points in size. Let us also assume a defect potential of 5.0 defects per function points. This means that total probable defects in the application will be 5,000. We will also assume that 7% of defect repairs result in "bad fixes" or new defects. Table 3 illustrates a common pattern of fairly low defect removal efficiency:

Table 3: Low Quality Defect Removal Efficiency (DRE) Example		
Size (function points) =		1,000
Defect potential per function point =		5
Defects in application =		5,000
Bad-fix injection =		7.00%
	Defect Removal Efficiency	**Defect Removal Pattern**
Unit test	38%	
Defects found		1,900
Bad fixes		133
Defects remaining		2,967
Function test	40%	
Defects found		1,187
Bad fixes		83
Defects remaining		1,780
Regression test	35%	
Defects found		623
Bad fixes		44
Defects remaining		1,114
System test	42%	468
Defects found		33
Bad fixes		613
Defects remaining		
TOTAL DEFECTS REMOVED		4,178
TOTAL BAD FIXES		292
TOTAL DEFECTS DELIVERED		613
HIGH-SEVERITY DEFECTS DELIVERED		110
DEFECT REMOVAL EFFICIENCY (DRE)		85.32%
POINT		0.61

The case study in Table 3 achieved only 85.32% in cumulative defect removal efficiency prior to delivery. This is because testing with no prior inspections or prior static analysis is not usually sufficient to achieve high levels of defect removal efficiency.

Table 3 is something of a professional embarrassment. No true engineering discipline should deliver a product with only about 85% of known defects removed. But such results are the norm for software applications.

High Quality Defect Removal Efficiency (DRE) Case Study

Because the example in Table 3 was professionally embarrassing, let us see what happens when formal inspections are used prior to testing. Let us also assume the use of one of the more effective software development methods, Watts Humphrey's Team Software Process (TSP). With both TSP and inspections in use, these advantages occur:

1. Defect potentials are reduced.
2. Defect removal efficiency levels are higher.
3. Bad fix injections are reduced.

In this second case study let us assume the same application size of 1,000 function points. However let us also assume a defect potential of 4.5 defects per function points due to TSP. This means that total probable defects in the application will be 4,500. We will also assume that only 3.5% of defect repairs result in "bad fixes" or new defects as opposed to 7% in the prior example.

Table 4 illustrates the results of the new scenario which combines both an effective development method with a more efficient defect removal pattern:

Table 4: High Quality Defect Removal Efficiency (DRE) Example		
Size (function points) =		1,000
Defect potential per function point =		4.5
Defects in application =		4,500
Bad-fix injection =		3.50%
	Defect Removal Efficiency	Defect Removal Pattern
Formal Inspections (Design, Code)	85%	
Defects found		3,825
Bad fixes		134
Defects remaining		809
Unit test	42%	
Defects found		340
Bad fixes		12
Defects remaining		457
Function test	45%	
Defects found		206
Bad fixes		7
Defects remaining		251
Regression test	40%	
Defects found		101
Bad fixes		4
Defects remaining		147
System test	47%	
Defects found	69	
Bad fixes		2
Defects remaining	76	
TOTALDEFECTS REMOVED		4,540
TOTAL BAD FIXES		25
TOTAL DEFECTS DELIVERED		76
HIGH-SEVERITY DEFECTS DELIVERED		14
DEFECT REMOVAL EFFICIENCY (DRE)		98.33%
POINT		0.08

When the results of Table 3 are compared with the results of Table 4, we can see that defect removal efficiency levels have climbed from an embarrassing 85.32% up to a respectable 98.33%.

Not only were inspections very efficient in finding defects, but the combination of inspections plus the formal Team Software Process also raised the efficiency level of each test stage.

Removing 100% of software defects is almost impossible, but achieving defect removal efficiency levels that are higher than 95% should be a minimum professional requirement. In fact such levels of defect removal efficiency should probably be included in software outsource contracts.

Summary and Conclusions

This article illustrates only four test stages plus formal inspections of design and code. Some large systems use inspections of requirements, design, code, and test materials. They also use static analysis tools prior to testing. In addition they may use as many as a dozen test stages rather than the four shown here. This article is intended to explain the basic principles of defect removal efficiency (DRE) but it does not cover every possible combination and permutation.

Complete elimination of software defects is beyond the current state of the art. However elevating levels of defect removal efficiency from today's average of 85% up to more than 95% can easily be achieved. It is only necessary to use a synergistic combination of pre-test inspections, static analysis, and formal testing. But it is also necessary to measure defect removal efficiency (DRE).

Measuring defect removal efficiency (DRE) measurement and topping 95% in cumulative DRE are the signs of a top software production group. Companies that do not measure DRE are usually well below 85% when the author has been called in for an external quality benchmark study.

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Systems Engineering News

PMI and INCOSE Align to Help Organizations Improve Program Success

Program managers and systems engineers each play leadership roles in the design and implementation of key organizational initiatives. These can include rebuilding infrastructure, creating improvements to healthcare delivery, managing equipment acquisition for national defense, delivering competitive new products and properly allocating resources. At times, however, these professionals apply different approaches to initiatives based their own distinct practices, which can delay success.

In order to help organizations overcome the resultant inefficiencies, the Project Management Institute (PMI) and the International Council on Systems Engineering (INCOSE) – two leading professional membership organizations – have

announced a strategic alliance that will enhance overall program success through the improved integration of practices between their professional communities. PMI and INCOSE will work together to provide members with tools to maximize the shared skills and experiences that are essential for successful program execution in this fast paced and continuously changing world. The associations will solidify initiatives that support stronger integration between the two professions, starting with developing case studies on successful collaborative projects and furthering dialogue with their stakeholder communities.

"When it comes to an organization's success, the whole is the sum of its parts," said Mark A. Langley, president and CEO of the Project Management Institute. "Our alignment with INCOSE will help program managers and systems engineers – both critical 'parts' of an organization, strategically and operationally – leverage each other's strengths to deliver improved program results that better support their organizations' strategic goals. In addition, it will foster new skill sets and networking opportunities for the members of both associations, driving professional growth."

"In an environment of increasing complexity, organizations face enormous challenges creating systems that meet performance specifications, on time and on budget," said Samantha Robitaille, President of INCOSE. "By working with PMI, we have the potential to significantly improve performance on these complex programs by establishing an integrated team approach that will ultimately benefit not only the members of both associations, but also the organizations they work for and those organizations' stakeholders."

PMI and INCOSE's first joint initiative produced a white paper, "Toward a New Mindset: Bridging the Gap between Program Management and Systems Engineering," which details the need for better professional integration. In addition, the two organizations will jointly sponsor the following:

- The Program Management Lean Enablers Working Session, which will take place at the PMI® Global Congress 2011—North America on Saturday, 22 October 2011 from 7:30 a.m. – 12:30 p.m. U.S. Central Daylight Time. Along with the Massachusetts Institute of Technology's Lean Advancement Initiative (MIT-LAI), PMI and INCOSE will engage program management professionals in exercises to validate critical program management challenges that can affect delivery of stakeholder value and business results. The participants will then apply MIT-LAI's principles of lean management to those challenges by validating collected lean enablers and identifying additional ones. There is no registration fee to attend this session, but individuals must register in advance by visiting http://congresses.pmi.org/NorthAmerica2011/

- A workshop titled, "Integrating Program Management and Systems Engineering," which also will be held in conjunction with the PMI Global Congress 2011—North America on Monday, 24 October 2011 from 9:30 – 10:45 a.m. U.S. Central Daylight Time. The workshop will explore the unique skills and experiences systems engineers and program managers possess, along with the shared space where they collaborate to drive program team performance and success. This workshop is part of the PMI Congress program, and individuals must register for the full Congress or for the day to attend. To register, visit http://congresses.pmi.org/NorthAmerica2011/

- An article series highlighting effective integration of program management and systems engineering; and

- A research study jointly published with MIT-LAI, which will be available in the first quarter of 2012.

More information:

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Resilience Innovation Laboratory and the (Newly Formed) Resilience Engineering Association

The latest newsletter for the Resilience Innovation Laboratory (RIL) is available at http://resilience-innovationlab.org

The Resilience Engineering Association has been officially founded—see www.resilience-engineering-asso.org/

Jon Holt Valorizes MBSE with his Lecture: "Making Houdini Safe"

Model Based Systems Engineering (MBSE) meets Science, Technology, Engineering, and Mathematics (STEM) on Pythagoras' Trousers. The worlds of systems engineering and escapology overlap when Dr Jon Holt puts his life on the line recreating and re-engineering Houdini's classic upside down straitjacket escape, but on a burning rope! Jon demonstrates how rigorous engineering techniques can be applied to safety-critical systems (any system where people may be hurt if things go wrong) by

performing this classic stunt. Jon has previously won awards for his original and innovative approaches to teaching and disseminating engineering best practice and this stunt shows his latest, and most spectacular effort to date. Jon, a member of the INCOSE UK Chapter, previously delivered this lecture last year at the international MBSE conference at GMU. You can listen to this lecture now at www.rhysphillips.co.uk/pythagoras-trousers/the-pythagoras-lectures-series-1-episode-7/

Pythagoras' Trousers is a radio show from the South Wales Networks of the Institution of Engineering & Technology and Radio Cardiff. Each week, presenter Rhys Phillips takes a look at stories of interest from the worlds of science, technology, engineering and mathematics, bringing these fields to a wider audience and promoting these subject areas to school pupils.

Northrop Grumman Information Systems President Neil G. Siegel Awarded Systems Engineering Award

Northrop Grumman Vice President and Chief Engineer of its Information Systems sector Neil G. Siegel, has recently been awarded the 2011 IEEE Simon Ramo Medal for his work in systems engineering. IEEE is the world's largest technical professional association.

Siegel is being recognized for his work at Northrop Grumman and helping the firm become a leader in battlefield digitization. The IEEE Simon Ramon Medal honors exceptional achievement in systems engineering and systems science. "By bringing information technology and wireless communications to the battlefield, Siegel has revolutionized the military's response to the war on terror and most importantly has saved lives of U.S. and allied forces," said stated IEEE.

SPECTRUM WEBCAST: Systems Engineering: Two perspectives on a Domain That is No Longer Optional

IBM and International Council on Systems Engineering (INCOSE) delivered a webinar on 20 September, 2011 which provided two perspectives on the market trends in product and systems development which are shaping and accelerating the adoption of Systems Engineering. Greg Gorman is currently the IBM Program Director World-Wide Systems Engineering Strategy and Delivery where he leads both the strategy and development of both the Rational Solution for System and Software Engineering and Rational's Product Line Engineering Solution. John Thomas, a Booz Allen Hamilton Senior Vice President, is the firm's Chief Systems Engineer and an architect of the firm's Systems Engineering and Integration practice. As a globally recognized Systems Engineering leader, he has played an active role inside and outside the firm improving the profession and enhancing opportunities for its professionals.

More Information

2011 LMS South American Systems Engineering Conference Held in São Paulo

The 2011 LMS South American Systems Engineering Conference was held in São Paulo on 13 September, 2011. The conference hosted key speakers from industry who shared their vision and presented the direction they are taking to address their industry's future challenges. One of the most pressing topics addressed was how to balance brand value and customer perceived quality with sustainability. On one hand, the industry in Brasil constantly faces more and more stringent regulations in regards to energy efficiency, safety, noise & vibration and reliability. While on the other hand, both product performance improvements and a customer appeal remain extremely high on the agenda.

Featured Society

SAVE International®

SAVE International® aims to be the premier international society devoted to the advancement and promotion of the value methodology (also called value engineering, value analysis or value management). Value methodology benefits include decreasing costs, increasing profits, improving performance and improving quality.

SAVE International® seeks to:

- promote the benefits of,

- advocate for the practice of,
- certify the competence of value practitioners in; and
- educate individuals in,

function-based, value enhancing methods.

Member benefits of SAVE International® include the Value World journal, Interactions monthly newsletter, access to a Consultants directory, Manuals of practice and access to other resources.

SAVE International® operates a certification program. The highest level of the certification program is the Certified Value Specialist (CVS), which recognizes an individual who has met all certification requirements, maintains those skills and keeps abreast of the continuing growth of value technology. To achieve this certification, an individual must participate in a specified education program, pass a comprehensive examination and provide documented evidence of an achieved skill level. The Certified Value Specialist (CVS) designation is for recognition of the individual whose principal career is VM.

Membership categories include Individual Membership, Student Membership, and Corporate Membership (which provides multiple individual memberships).

The society is governed by an Executive Committee, Board, and Certification Board. SAVE International®'s headquarters is located in Dayton, Ohio, USA. Chapters, approximately thirty and all located in the United States, conduct activities at the local level. The President of SAVE International® is currently Mr. Craig L. Squires, CVS, Managing Partner, nwis.net, LP.

SAVE International® conducts an annual conference over four days, the next being in Orlando in June, 2012.

More information

INCOSE

Call for Nominations
INCOSE

The INCOSE Board of Directors has delegated the responsibility for collecting nominations and identifying suitable candidates to the Nominations and Elections Committee. There are eight positions for which it is possible to still submit nominations (President-elect nominations closed on June 30th). In the fall of 2011, you will have the opportunity to vote for the positions which become vacant in 2012.

Position descriptions can be found on the INCOSE website.

All submissions must be received no later than 1 September 2011. All members may identify INCOSE Member candidates for this election. You may nominate yourself. Please send the name of your proposed candidate to the Chair of the Nominations & Elections Committee, Pat Hale as soon as possible.

Upcoming INCOSE Events

Remember to visit the INCOSE website to check the events calendar periodically for updates on calls for papers, early-bird registrations, and other news!
To submit an event, please send an e-mail to comms@incose.org

September 21 - 23, 2011: INCOSE SA Annual Conference
October 14 - 16, 2011 KSE 2011 Third International Conference on Knowledge and Systems Engineering
October 19 - 21, 2011: Fifth annual Asia-Pacific Systems Engineering Conference (APCOSE)
November 04 - 06, 2011 5th Annual INCOSE Great Lakes Regional conference
December 07 - 09, 2011: Second International Conference on Complex Systems Design and Management (CSDM 2011)

INCOSE INSIGHT

INSIGHT is the newsletter of International Council on Systems Engineering. It is published four times per year (January, April, July, and October). INSIGHT features status and information about INCOSE's technical work, local chapters, and committees and boards. Additionally, related events, editorials, book reviews, trends, and how-to-do articles that are pertinent to the many aspects of a systems engineer's job are also included, as space permits. For upcoming submission deadlines and themes for INSIGHT—see www.incose.org/ProductsPubs/periodicals/insight.aspx Back issues of INSIGHT are available in the Members

and INCOSE Connect, INCOSE's Members Only Collaborative space.

INCOSE eNote

eNote is the electronic newsletter of INCOSE. Published every four to six weeks, eNote is a compilation of INCOSE news, event announcements, and items of interest for our members. Subscriptions to eNote are available to INCOSE members as part of their membership. See www.incose.org/newsevents/enote/index.aspx

eNote features INCOSE information as well as notes from systems engineering and related fields. Questions and comments as well as submissions for future eNotes should be directed to the eNote Editorial Team.

INCOSE Technical Operations

Autonomous System Test & Evaluation Working Group

http://www.incose.org/practice/techactivities/wg/details.aspx?id=aste

Charter

Members intend to develop and promote principles and practices for autonomous systems test and evaluation that produce confident assessment and diagnosis of system(s) capability, whenever and wherever needed.

Leadership

Co-Chair:	Jack Ring, Educe LLC
Co-Chair:	Americas Thomas Tenorio, ATA
Co-Chair: Quality	Don Greenlee
Co-Chair: Emea	open
Co-Chair: Oceana	open

Accomplishments / Products

Formed IW09
Members conducted tutorials and presented papers at five ITEA and NIST sessions.
Activity Report, INSIGHT, 12/2009

Current Projects

Develop Ontology of Autonomy v.1.
Assess 20 tenets.
Tutorials at ITEA 2010 sessions including LVC, Test Week, Technology Week and annual symposium.
Meetings at INCOSE IW10 and IS10.
Attract members involved in non-DoD autonomy, e.g., a) planetary vehicles, b) medical robotics and prosthetics, c) semiconductor chips, d) nanomachines, e) voting machines, h) spacecraft, i) knowledge webs, j) energy grid, k) GEOSS, l) net-centric warfare, m) cybersecurity, n) intelligent transportation networks, o) transnational financial systems and p) proactive learning environments.

Contact jack.ring@incose.org for additional information or to join this group.

Systems Engineering Software Tools News

Overview of Software Tools Supporting Requirements Management

Tool Name	Website	Comments (if any)
Accept 360	http://www.accept360.com/solutions/accept360-requirements/	Includes RM funct
Acclaro	http://www.dfss-software.com/dfss_specs.asp	DFSS tool with RI
Accompa	http://www.accompa.com/	RM tool
ARCWAY Cockpit	http://www.arcway.com/	Includes RM funct
Avenqo	http://www.avenqo.com/	Includes RM funct
Blueprint Reqs Cntr 2010	http://www.blueprintsys.com/products/	RM tool
Caliber-RM	http://www.borland.com/us/products/caliber/index.aspx/	RM tool
Cameo™ Requirements+	https://www.magicdraw.com/cameoreq	Part of the NoMag
CaseComplete	http://www.casecomplete.com/	RA & RM tool
CASE Spec	http://www.analysttool.com/	Includes RM funct
Cognition Cockpit	http://www.cognition.us/cockpit_overview.html	Includes RM funct
Contour	http://www.jamasoftware.com/contour/	RM tool
CORE	http://www.vitechcorp.com/	Includes RM funct
Cradle	http://www.threesl.com/	Includes RM funct
DevComplete	http://smartbear.com/products/development-tools/devcomplete/	Includes RM funct
DevSpec	http://www.techexcel.com/products/devsuite/devspec.html	RM tool
Dimensions RM	http://www.serena.com/products/dimensions-rm/index.html	RM tool
Dolphin	http://www.getdolphin.com/	RM tool
DOORS	http://www-01.ibm.com/software/awdtools/doors/productline/	Market leader
Enterprise Architect	http://www.sparxsystems.com/platforms/requirements_management.html?gclid=CL-rzfX24aoCFUjt7QodfQ6o7A	Includes RM funct
FeaturePlan	http://www.rymatech.com/about-us/press-releases-and-news/12-press-releases-2010/71-rymas-new-konect-modules-make-featureplan-34-powerful-overall-solution-for-product-planning-teams.html	RM functionality ir
Focal Point	http://www-01.ibm.com/software/awdtools/focalpoint/	Includes RM funct
GatherSpace	http://www.gatherspace.com/	RA & RM tool for
GMARC	http://www.informeng.com/itmidx1.htm	RA & RM toolset
In-Step	http://www.microtool.de/instep/en/index.asp	Includes RM funct
inteGREAT	http://www.truereq.com/	Includes RM funct
iRise	http://www.iRise.com	Includes RA & RM
IrqA	http://www.visuresolutions.com/inicio	RM tool plus basi
jUCMNav	http://jucmnav.softwareengineering.ca/ucm/bin/view/ProjetSEG/WebHome	Free tool for the U (URN)

LeapSE	http://www.leapse.com/index.htm	RA and RM tool
Lighthouse RM	http://www.workspace.com/	Includes RM funct
Mac A&D & Win A&D	http://www.excelsoftware.com/matrix.html	Includes RM funct
MDConnect for DOORS	http://www.dxleditor.com/mdconnect_for_doors	Provides access t Eclipse environme
Micro Focus Optimal Trace	http://www.powertest.com/software-requirements-definition-management-micro-focus-optimal-trace.html	RM plus RA
MKS Requirements	http://www.mks.com/solutions/discipline/rm/requirements-management	Includes RM funct
Modelio Requirement Analyst	http://www.modeliosoft.com/en/modules/modelio-requirement-analyst.html	Includes RM funct
ObjectiF	http://www.microtool.de/objectif/en/anforderung.asp?call=en	More a RA tool th
Objectiver	http://www.objectiver.com/	RM plus RA
OneDesk Enterprise Social Suite	http://www.onedesk.com/	Includes RM funct
Open Source RM	http://sourceforge.net/projects/osrmt/	Open source RM
PACE	http://www.viewset.com/index.php/products-pace-overview	Includes RM funct
PixRef Pro	http://www.pi-shurlok.com/Web/Content/Content.aspx?PageID=75	Traces into conter
Polarion Reqs	http://www.polarion.com/products/requirements/index.php	RM tool
Projectricity	http://www.projectricity.com/specification_tool.htm	RM tool
PTESY	http://www.andromeda-srl.com/	Includes RM funct
QPack Requirements Management	http://www.orcanos.com/Requirements_management.htm	RM Tool
Rally	http://www.rallydev.com/learn_agile/agile_planning/resources/	Minimal RA & RM
RaQuest	http://www.raquest.com/	Integrates with Er
Rational Focal Point	http://www-01.ibm.com/software/awdtools/focalpoint/	Includes RM funct
Rational Requirements Composer	http://www-01.ibm.com/software/awdtools/rrc/	RM tool
Raven	http://www.ravenflow.com/	Not really clear wl
RDD-100 Version	http://www.holagent.com/	Includes RM funct
RDD.COM Version	http://www.holagent.com/	Includes RM funct
ReqLine	http://pragnalysis.com/	Includes RM funct
Reqtify	http://www.chiastek.com/products/reqtify.html	RM tool
Requirements	http://www.workspace.com/	Includes RM funct
Requirements Management Database	http://www.reqdb.com/	RM tool

Requirement Tracing System	http://www.bandwood.com/cms_exec_summary.htm	RM plus CM
Requisite Pro	http://www-01.ibm.com/software/awdtools/reqpro/	RM tool
RESDES	http://www.jenzundpartner.de/repositories/requirements-repository/overview.html	Includes RM func
Rhapsody from IBM	http://www-01.ibm.com/software/rational/products/rhapsody/sysarchitect/	Provides RA func
Rmtoo	http://www.flonatel.de/projekte/rmtoo/	Free open source
RMTrak	https://www.rmtrak.com/home.aspx	RM Tool
Rommana	http://www.rommanasoftware.com/	Includes RM func
RQA (Requirements Quality Analyzer)	http://www.reusecompany.com/	A checking tool th syntactic analysis
Scenario Plus	http://www.scenarioplus.org.uk/	Free RM tools
Serena Dimensions RM	http://www.serena.com/products/dimensions-rm/index.html	RM tool
SoftREQ	http://www.softreq.com/products.html	Still supported?
Software through Pictures (StP)	http://www.aonix.com/stp.htm	Includes RM func
SpiraTest	http://www.inflectra.com/SpiraTest/Features.aspx	Includes RM func
Teamcenter SE	http://www.plm.automation.siemens.com/en_us/index.shtml	Includes RM func
TestTrackRM	http://www.seapine.com/ttrm.html	Stand-alone & int
Tormigo	http://tormigo.modesto.pl/	Transfer of requir
TopTeam Analyst	http://www.technosolutions.com/topteam_requirements_management.html	RA & RM tool.
TrackStudio	http://www.trackstudio.com/	Can be used for F
TRUEreq	http://www.truereq.com/	RM plus issues
VeroTrace	http://www.verocel.com/Requirements_Traceability	RM tool for DO-17
Workspace	http://www.workspace.com/	Includes RM func
Yonix	http://www.yonix.com/	Includes RM func

Research and Markets: A Practical Guide to SysML. Edition No. 2 is Written by the Leader and Two Key Members of the OMG SysML Standardization Team

Fully updated to cover newly released version 1.3, it includes a full description of the modeling language along with a quick reference guide, and shows how an organization or project can transition to model-based systems engineering using SysML, with considerations for processes, methods, tools, and training. Numerous examples help readers understand how SysML can be used in practice, while reference material facilitates studying for the OMG Systems Modeling Professional (OCSMP) Certification Program, designed to test candidates' knowledge of SysML and their ability to use models to represent real-world systems.

More information

Siemens Says PLM's Matured Into a True Engineering Platform

Siemens says that product lifecycle management (PLM) software has changed. Back more than a decade ago, the software was widely misunderstood. It was touted as this larger-than-life enterprise application along the same lines as ERP or MRP, but the truth was the system never really broke out of the engineering ranks, according to Siemens. Despite being positioned as a central repository for all types of data throughout all stages of a product's lifecycle, PLM of that era was really nothing more than a glorified replacement for product data management systems.

More Information

BigLever Software and General Motors to Co-Present Product Line Engineering Sessions for IBM Rational's Systems and Software Engineering Symposium Series

BigLever Software(TM), a leading provider of systems and software product line engineering framework, tools and services, announced today that Dr. Charles Krueger, the company's Founder and CEO, will co-present two product line engineering (PLE) sessions with Bill Bolander, General Motors Technical Fellow, as part of IBM Rational's Systems and Software Symposium events were/are September 15th at the Smithsonian Institute Air & Space Museum and October 19th at the University of Michigan.

PLE October Presentation Details:

Wednesday, October 19, 2011 -- 9:30 am to 12:30 pm
Product Line Engineering Executive Roundtable Presenters: Dr. Charles Krueger, BigLever Software; Bill Bolander, General Motors; Greg Gorman, IBM Rational
Venue: University of Michigan -- Ann Arbor, Michigan -- Pierpont Commons, Executive Board Room

More Information

Mentor Graphics SystemVision Wins NI LabVIEW Award for Platform Extension

Mentor Graphics Corporation announced on September 1st that its SystemVision(R) conneXion(TM) (SVX) collaboration environment received the National Instrument's LabVIEW Add-on of the Year Award for platform extension. The LabVIEW Add-on of the Year awards recognize products that have delivered innovative solutions to the marketplace, enabling advances in engineering and scientific applications through a graphical system design approach with LabVIEW system design software. These awards are presented to developers who have created exceptional add-ons or apps in the areas of: Test, Industrial and Embedded, Community, VI Library, Platform Extension, and Innovation. This integration allows cross-disciplinary engineering teams to bridge the gap between design and test, resulting in shortened design cycles," said Jeff Meisel, LabVIEW Partner Program Manager, National Instruments.

More information

Systems Engineering Books, Reports, Articles and Papers

Systems Engineering Principles and Practice

(Wiley Series in Systems Engineering and Management)

by Alexander Kossiakoff, William N. Sweet, Sam Seymour, and Steven M. Biemer
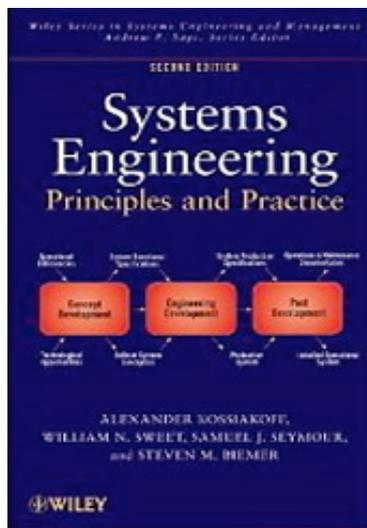
Abstract: Systems Engineering Principles and Practice is a national standard textbook for the study of traditional systems engineering for advanced undergraduate and graduate students. It addresses the need for an introductory overview, first-text for the development and acquisition of complex technical systems. The material is well organized, readable and fundamental to learning how to think like a systems engineer and carry out best practices in the field. Since systems engineering is still developing as a discipline, there have been new concepts and practices that have entered the field since the text was published in 2003. As an increasing number of students have used the text, topics have been discovered that would benefit from expansion, integration and clarification. The second edition (2011) was developed by colleagues of the original authors to upgrade this unique interdisciplinary guide to systems engineering to maintain relevance and currency in this rapidly changing and demanding field.

More information

Conferences and Meetings

NASA Goddard Space Flight Center (GSFC) Systems Engineering Seminar

First or second Tuesday of every month at 1:00 to 3:00 p.m. in the GSFC Building 3 Auditorium

September 13, 2011, 1:00 pm - Small Rocket/Spacecraft Technology (SMART) Platform

November 1, 2011, 1:00 pm - GSFC Science Mission Directorate, Code 600

December 6, 2011, 1:00 pm - NASA Engineering and Safety Center (NESC)

More information

Summer School 2011: Verification Technology, Systems & Applications

September, 19 - 23, 2011, Montefiore Institute (University of Liège), Liège, Belgium

More information

International Conference on Industrial Engineering, Systems Engineering and Engineering Management for Sustainable Global Development

September 21-23, 2011, Spier Hotel and Conference Centre, Western Cape, South Africa

More information

No Magic World Conference

September 25-28, Ft. Worth, TX, USA

SBMF 2011 - 14th Brazilian Symposium on Formal Methods

September 26-30, 2011, Sao Paulo, Brazil

1st World Engineering Education Flash Week

September 27 - 4 October, 2011 - Lisbon, Portugal

Program Excellence: Leading Virtual Teams (Free Webinar)

September 27, 2011 - 2 p.m. - 3:00 p.m. U.S.A. ET

4th Euro Symposium on Systems Analysis and Design

September 29, 2011, Gdansk, Sopot - Poland

XXXIX Brazilian Congress on Engineering Education - COBENGE 2011

October 03-06, 2011, Himmelblau Hotel, Blumenau, Santa Catarina, Brazil

SASO 2011 - Fifth IEEE International Conference on Self-Adaptive and Self-Organizing Systems

October 3-7, 2011, Ann Arbor, Michigan, USA

Enterprise Transformation Conference

October 4-5, 2011, The Westin Buckhead Atlanta, GA, USA

IEEE SRDS 2011 - 30th International Symposium on Reliable Distributed Systems

October 4-7, 2011, Madrid, Spain

AGTIVE 2011 - International Symposium on Applications of Graph Transformation with Industrial Relevance

October 4-7, 2011, Budapest, Hungary

9th International Symposium on Automated Technology for Verification and Analysis

October 11-14, 2011, Taipei, Taiwan

More information

The 12th International Conference on Web Information System Engineering (WISE 2011)

October 13 – 14, 2011, Sydney, Australia

More information

KSE 2011 - 3rd International Conference on Knowledge & Systems Engineering

October 14 – 16, 2011, Hanoi University, Hanoi, Vietnam

More information

MODELS 2011 - ACM/IEEE 14th International Conference on Model Driven Engineering Languages and Systems

October 16-21, 2011, Wellington, New Zealand

More information

APCOSE 2011 - Fifth Annual Asia-Pacific Systems Engineering Conference

October 19-21, 2011, Seoul, Korea

More information

The Program Management Lean Enablers Working Session   NEW

PMI® Global Congress 2011—North America
22 October 2011 from 7:30 a.m. – 12:30 p.m.

Register in advance

Workshop: Integrating Program Management and Systems Engineering   NEW

PMI Global Congress 2011—North America
24 October 2011 from 9:30 – 10:45 a.m.

Register

2011 MIT SDM Conference on Systems Thinking for Contemporary Challenges

October 24-25, 2011, Massachusetts Institute of Technology, Wong Auditorium, Cambridge, MA, USA

More information

Massachusetts Institute of Technology Annual Conference on Systems Thinking for Contemporary Challenges

October 24-25, 2011, Massachusetts Institute of Technology, Boston, USA

More information

2nd Iranian Conference on Reliability Engineering

October 24-26, 2011, Tehran, Iran

More information

NDIA 14th Annual Systems Engineering Conference

October 24 - 27 2011, Hyatt Regency Mission Bay, San Diego, California, USA

More information

SSEE 2011 - Society for Sustainability and Environmental Engineering 2011 International Conference

October 24-26, 2011, Brisbane Convention & Exhibition Centre, Brisbane, Australia

More information

ICFEM 2011 - 13th International Conference on Formal Engineering Methods

October 25 - 28, 2011, Durham, United Kingdom

More information

CEBM 2011 - 2011 International Conference on Engineering and Business Management (CEBM2011)

Oct 28 - 30, 2011, Shanghai, China

More information

The *First* Business Architecture Summit at BBC 2011 - The Benefits of Linking Enterprise Business Models with IT Infrastructure – Beyond the Basics

Oct 30 – Nov 3, 2011, Fort Lauderdale, Florida, USA

More information

IIBA 2011 Conference

Oct 30 – Nov 3, 2011, Fort Lauderdale, Florida, USA

More information

21st Annual Systems Thinking in Action® Conference

October 31-November 2, 2011, Westin Seattle Hotel, Seattle, WA, USA

More information

ER 2011, 30th International Conference on Conceptual Modeling

October 31 - November 3, 2011, Brussels, Belgium

More information

Whole Systems Modelling with iThink and STELLA Workshops   NEW

November 2-3, Brunel University, Uxbridge, UK

More information

PoEM 2011 - The 4th IFIP WG8.1 Working Conference on the Practice of Enterprise Modelling

November 2-3, 2011, Oslo, Norway

More information

5th Annual INCOSE Great Lakes Regional Conference in Systems Engineering: Leveraging Adaptability to Tame Uncertainty

November 4-6, 2011, Dearborn, MI, USA

More information

XVIII SIMPEP - Brazilian Production Engineering Symposium

November 7, 2011, City of Bauru, Brazil

More information

Managing Industrial Engineering

November 7, 2011, Chicago, USA

More information

The 23rd IFIP International Conference on Testing Software and Systems (ICTSS'11) NEW

November 7 - 9, 2011, Paris, France

More information

Whole Systems Modelling with iThink and STELLA Workshops NEW

November 8-9, Conyngham Hall, Knaresborough, North Yorkshire, UK

More information

INCOSE UK Annual Systems Engineering Conference (ASEC) 2011

November 9 - 10, 2011, Scarman Training and Conference Centre, Warwick Conferences, University of Warwick, UK

More information

13th IEEE International High Assurance Systems Engineering Symposium

November 10-12, 2011, Boca Raton Marriott Hotel, 5150 Town Center Circle, Boca Raton, Florida, USA

More information

11th Annual CMMI® Technology Conference and User Group

November 14 - 17, 2011, Hyatt Regency Denver Tech Center, Denver CO, USA

More information

New Zealand Defence Industry Association Forum

15-16 November, 2011, New Zealand

More information

Brazilian Society of Dynamic Systems (SBDS) Annual Conference

16-18 November, 2011, Brasilia, Brazil

Website: www.sdsbrasil.org (under construction)

ICSSEA 2011 - 23rd International Conference Software & Systems Engineering and Their Applications

November 29- December 1st 2011, Paris, France

More information

10th Anniversary & Annual Infrastructure and Regional Resilience 2011 Conference

November 29 December 1, 2011, Gaylord National Hotel & Convention Center in Washington, DC, USA

More information

3rd International Conference on Software & Systems Engineering and Their Applications

November 29 – December 1, 2011, Paris, France

More information

2011 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM)

December 6-9, 2011, Singapore

More information

Haifa Verification Conference 2011 (HVC 2011)

December 6-8, 2011, Haifa, Israel

More information

3rd International Congress on Engineering Education

December 7-8, 2011, Kuala Lumpur, Malaysia

More information

Complex Systems Design & Management 2011

December 7-9, 2011, Cité Internationale Universitaire, Paris, France

More information

2nd IEEE International Conference on Networked Embedded Systems for Enterprise Applications - NESEA 2011

December 8th – 9, 2011, Fremantle, Perth, Australia

The 8th Saudi Engineering Conference

December 10, 2011, Buraydah, Saudi Arabia

6th International Conference on Design Principles & Practices

January 20 - 22, 2012, Los Angeles, CA, USA

INCOSE International Workshop (IW) 2012

January 21 - 24, 2012, Jacksonville, FL, USA

Eighth Asia-Pacific Conference on Conceptual Modelling (APCCM 2012)

January 30 - February 02, 2012, RMIT, Melbourne, Australia

ESSoS12 - International Symposium on Engineering Secure Software and Systems

February 16 - 17, 2012, Eindhoven, The Netherlands

IEEE CogSIMA 2012 – 2nd International Conference on Cognitive Methods in Situation Awareness and Decision Support

March 6 – 8, 2012, New Orleans, LA, USA

16th International GI/ITG Conference on Measurement, Modelling and Evaluation of Computing Systems and Dependability and Fault-Tolerance (MMB & DFT 2012)   NEW

March 19 - 21, 2012, Kaiserslautern, Germany

CSER 2012 – Conference on Systems Engineering Research

March 19-22, 2012, St Louis, Missouri, USA

The 9th ENTERPRISE ENGINEERING Track at ACM-SAC 2012

The 27th ACM Symposium on Applied Computing
25-29 March 2012, Riva del Garda, Trento, Italy

Fifth Edition of the Requirements Engineering Track (RE-Track'12)

Part of the 27th ACM Symposium on Applied Computing (SAC 2012)
March 25-29, 2012, University of Trento, Trento, Italy

More information

2nd International Workshop on Model-driven Approaches for Simulation Engineering NEW

Part of the Symposium on Theory of Modeling and Simulation, (SCS SpringSim 2012)

26-29 March, 2012, Orlando, FL, USA

More information

Symposium On Theory of Modeling and Simulation, TMS'12 NEW

Part of the 2012 SpringSim - Spring Simulation Multi-Conference

26-29 March, 2012, Orlando, FL, USA

More information

2012 SpringSim - Spring Simulation Multi-Conference NEW

26-30 March, 2012, Orlando, FL, USA

More Information

Applied Ergonomics Conference 2012

March 26-29, 2012, Gaylord Opryland Resort and Convention Center, Nashville, TN, USA

More information

The 31st International Conference on Modelling, Identification and Control

April 2 - 4, 2012, Phuket, Thailand

More information

SETE APCOSE 2012

April 30 – May 2, 2012, Brisbane Convention and Exhibition Centre, Brisbane, QLD, Australia

More information

1st Annual Systems Engineering in the Washington Metropolitan Area Conference (SEDC 2012)

May 14 - 16, 2012, George Mason Inn and Conference Center, Washington, USA

More information

IIE Annual Conference and Expo 2012

May 19-23, 2012, Hilton Bonnet Creek, Orlando, FL, USA

More information

12th International Design Conference Design 2012

21 - 25 May, 2012, Dubrovnik, Croatia

More information

Engineering Leadership Conference (ELC 2012)

30 May - 2 June, 2012, Adelaide, Australia

More information

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iFM2012 ABZ 2012 - Abstract State Machines

June 18-22, 2012 , CNR Research Area of Pisa, Italy

More information

PETRI NETS 2012 - 33rd International Conference on the Application and Theory of Petri Nets and Concurrency

June 25–29, 2012, Hamburg, Germany

More information

INCOSE International Symposium (IS) 2012

IS2012 Call for Papers: Deadline for draft papers, and proposals for panels and tutorials for IS2012 is November 8th, 2011.

July 9–12, 2012, Rome, Italy

More information

The World Congress on Engineering and Computer Science 2012   NEW

October 24 - 26, 2012, San Francisco, USA

Education & Academia

Postdoctoral Research Position at Oxford Brookes University

A 3 year postdoctoral research post is available on a project entitled 'A Process for Risk-Driven Requirements Engineering and Analysis (APRES)'. The full advert is available at: https://edm.brookes.ac.uk/hr/hr/vacancies.do?id=13766980

Applicants should have either a PhD in computer science or related discipline or a PhD close to completion; or experience in disseminating research findings through high quality publications and/or conference presentations.

For further information please contact Rachel Harrison

Research Associate in Systems of Systems Engineering
Loughborough University

Department: Electronic and Electrical Engineering
Role Type: Research
Vacancy Posted: Wednesday 24 August 2011
Closing Date: Thursday 22 September 2011
Salary/Benefits: 27,428 to 31,798 per annum

Systems of Systems Management

A Research Associate is required for a European Union project, the aim of which is to analyse international research agendas to prepare concrete joint RD initiatives for international collaboration, with the USA in the area of Systems of Systems (SoS).

The main responsibilities of the post are to analyse current activities in Systems of Systems Management in both the US and European Union, across a range of industrial and commercial sectors, in order to establish research gaps and priorities to be instantiated in the strategic research agenda to be created by the project.

It is essential for candidates to have a good degree in a systems related area, knowledge and understanding of systems thinking and systems engineering approaches and current experience in an academic or industrial environment. Candidates must have good communication skills.

Curriculum Vitae will only be accepted if accompanied by a completed University application form.

Informal Discussions

For informal discussions, please contact Professor Mike Henshaw (Professor of Systems Engineering) by email or on +44 (0)1509 635269

Documentation

Job Description: (257 Kb)

Conditions of Employment: (31 Kb)

Application Form: (1519 Kb) (102 Kb)

Equal Opportunities Form: (22 Kb) (43 Kb)

Printed copies of these documents can be obtained from the contact shown below.

Interviews - Tuesday 27 September 2011

Applications

Completed applications (and an equal opportunities form for Loughborough University vacancies) should be sent, by email or post, to the contact shown below. Please quote the relevant job reference in all correspondence.

Human Resources Email: Electrical Engineering, Electrical Engineering, Engineering, Human Resources, Professor, Research Associate, UK, USA

Philadelphia University Receives Rigorous ABET Accreditation for Engineering, Industrial and Systems Engineering, and Mechanical Engineering Programs

Philadelphia University has received accreditation for three engineering programs from the Engineering Accreditation Commission of ABET Inc., which the accrediting association says demonstrates a program's commitment to providing its students with a quality education. PhilaU received accreditation for all three programs for which it applied: B.S. programs in engineering, industrial and systems engineering, and mechanical engineering. In addition, any minors within those programs, such as the University's new concentration in composites, will be covered by the accreditation.

More information

Scholarship in Engineering Design, Imperial College London and National University of Singapore

Imperial College London and National University of Singapore is offering study towards a PhD in Engineering Design, in relation to a PhD funding application for a joint project between Imperial College London and the National University of Singapore. The scholarship is worth £20,000 per year and it will cover the duration of the programme, up to four years. The candidate will register at Imperial College London as his\her host institution and will be exchanged to the National University of Singapore for at least one year after the qualifying exam in Imperial College London. Due to the funding conditions, this opportunity is especially suitable to UK/EU individuals. Application deadline is 14 October 2011.

The project aims to develop effective support for understanding functional relationships in complex systems design. The research will focus on these key areas:
• engineering design
• complex system design
• multi-domain engineering
• decision making (including rationale mapping)
• functional analysis diagramming
• diagramming tool design and implementation
• information management
• TRIZ

Dr Marco Aurisicchio
Department of Mechanical Engineering, Imperial College London
Exhibition Road, South Kensington Campus, London SW7 2AZ, UK
Tel: +44 (0)20 7594 7095, Email: m.aurisicchio@imperial.ac.uk

Dr. Ying Liu
Assistant Professor, Mechanical Engineering
National University of Singapore
Tel: +65-65167812

More information

Some Systems Engineering-Relevant Websites

Leonardo Da Vinci - one of the Original Systems Thinkers
There is much debate surrounding the correlation between systems thinking and the abstract thinking of Leonardo Da Vinci. Some will argue that he was a founder of Systems Thinking while others feel that he was in fact not a Systems Thinker at all. You have to question whether he was a Systems Thinker or just that this way of thinking was not recognized in the time of Da Vinci? When you look at his inventions and his work, it is hard to imagine that he was anything but a Systems Thinker.

http://www.globalast.org/leonardo-da-vinci.html

Standards and Guides

About ISO

ISO (International Organization for Standardization) is the world's largest developer and publisher of International Standards. ISO is a network of the national standards institutes of 162 countries, one member per country, with a Central Secretariat in Geneva, Switzerland, that coordinates the system. ISO is a non-governmental organization that forms a bridge between the public and private sectors. On the one hand, many of its member institutes are part of the governmental structure of their countries, or are mandated by their government. On the other hand, other members have their roots uniquely in the private sector, having been set up by national partnerships of industry associations. Therefore, ISO enables a consensus to be reached on solutions that meet both the requirements of business and the broader needs of society.

Because "International Organization for Standardization" would have different acronyms in different languages ("IOS" in English, "OIN" in French for *Organisation internationale de normalisation*), its founders decided to give it also a short, all-purpose name. They chose "ISO", derived from the Greek *isos*, meaning "equal". Whatever the country, whatever the language, the short form of the organization's name is always ISO.

Standards make an enormous and positive contribution to most aspects of our lives.

Standards ensure desirable characteristics of products and services such as quality, environmental friendliness, safety, reliability, efficiency and interchangeability - and at an economical cost. When products and services meet our expectations, we tend to take this for granted and be unaware of the role of standards. However, when standards are absent, we soon notice. We soon care when products turn out to be of poor quality, do not fit, are incompatible with equipment that we already have, are unreliable or dangerous. When products, systems, machinery and devices work well and safely, it is often because they meet standards. And the organization responsible for many thousands of the standards which benefit the world is ISO.

What's different about ISO 9001 and ISO 14001?

The vast majority of ISO standards are highly specific to a particular product, material, or process. However, ISO 9001 (quality) and ISO 14001 (environment) are "**generic management system standards**". "Generic" means that the same standard can be applied to any organization, large or small, whatever its product or service, in any sector of activity, and whether it is a business enterprise, a public administration, or a government department. ISO 9001 contains a generic set of requirements for implementing a **quality** management system and ISO 14001 for an **environmental** management system.

The website www.iso.org/iso/standards_development.htm provides information about the standards development processes and procedures to be followed by ISO committees for the development and drafting (and subsequent maintenance) of International Standards and other ISO deliverables. You can also find the list of all ISO technical committees with links to their respective working areas on the ISOTC server. Detailed information about the structure, scope of work, participation, etc., of each committee is accessible from this list. Governance of the technical work explains the principles and rules applicable to the standards development process and gives details about intellectual property rights in standards. The section also gives access to the various tools and related supporting services available to facilitate the work of standards developers.

How International Standards Create Global Confidence

In an era of economic globalization, rapid development of information and communication technologies, increase in personal mobility, feelings of uncertainty and the challenge of facing diverse kind of risks, how to remain confident? International Standards are the key to creating confidence globally. The September issue of ISO *Focus+* magazine highlights how ISO standards help create confidence in products, services and in global trade. The articles cover a range of issues from conformity assessment and energy to health and safety and illustrate and support this year's theme of World Standards Day, celebrated on 14 October, which is dedicated to International Standards and global confidence.

More information

Announcing IEEE's New Standards Education e-Magazine

IEEE is launching the *IEEE Standards Education eZine* to keep information in front of those who are interested in education about standards. The topics they intend to address include challenges and opportunities for teaching about standards in engineering curriculum. Though they may focus on and use examples from various IEEE standards, you can apply the same information for other standards such as those from ANSI, IEC or any of the national standards. As a format, it is neither a print-format magazine, nor a periodical that appears all-at-once whether on-line or in print. It is a not a blog by one person, nor is it an exclusive compendium of scholarly articles. They intend to have regular columns, expert views, worthwhile standards experiences from different regions of the world, and information about various conferences, seminars, and workshops that the IEEE Standards Education Committee (SEC) sponsors and participates in. Over time, you will see the *IEEE Standards Education eZine* served in many of these forms, though printing will have to be at your end.

More information

Some Definitions to Close On

Analytic Hierarchy Process (AHP) and Analytic Network Process (ANP)

Analytic Hierarchy Process: The Analytic Hierarchy Process (AHP) is a theory of relative measurement with absolute scales of both tangible and intangible criteria based on the judgment of knowledgeable and expert people.
Source: website of the bi-annual International Symposium on the Analytic Hierarchy Process (ISAHP), http://www.isahp.org/italy2010/index.php

Analytic Hierarchy Process: A framework for solving a problem. The analytic hierarchy process is a systematic procedure for representing the elements of any problem. It organizes the basic rationality by breaking down a problem into its smaller constituents and then calls for only simple pairwise comparison judgments, to develop priorities in each level.

The analytic hierarchy process provides a comprehensive framework to cope with intuitive, rational, and irrational factors in making judgments at the same time. It is a method of integrating perceptions and purposes into an overall synthesis. The analytic hierarchy process does not require that judgments be consistent or even transitive. The degree of consistency (or inconsistency) of the judgment is revealed at the end of the analytic hierarchy process.

People making comparisons use their feelings and judgment. Both vary in intensity. To distinguish among different intensities, the scale of absolute numbers in the table is used.
Scale of relative Importance

Intensity of relative importance/Explanation

1 (equal importance)
Two activities contribute equally to the objective

3 (slight importance of one over another)
Experience and judgment slightly favor one activity over another

5 (essential or strong importance)
Experience and judgment strongly favor one activity over another

7 (demonstrated importance)
An activity is strongly favored and its dominance is demonstrated in practice

9 (absolute importance)
The evidence favoring one activity over another is of the highest possible order of affirmation

2, 4, 6, 8 (intermediate values between the two adjacent judgments)
When compromise is needed

Reciprocals of above nonzero numbers (if an activity has one of the above numbers assigned to it when compared with second activity, the second activity has the reciprocal value when compared to the first)

The analytic hierarchy process can be decomposed into the following steps. Particular steps may be emphasized more in some situations than in others. Also as noted, interaction is generally useful for stimulation and for representing different points of view.

1. Define the problem and determine what knowledge is sought.

2.   Structure the hierarchy from the top (the objectives from a broad perspective) through the intermediate levels (criteria on which subsequent levels depend) to the lowest level (which usually is a list of the alternatives).

3.   Construct a set of pairwise comparison matrices for each of the lower levels, one matrix for each element in the level immediately above. An element in the higher level is said to be a governing element for those in the lower level since it contributes to it or affects it. In a complete simple hierarchy, every element in the lower level affects every element in the upper level. The elements in the lower level are then compared to each other, based on their effect on the governing element above. This yields a square matrix of judgments. The pairwise comparisons are done in terms of which element dominates the other. These judgments are then expressed as integers according to the judgment values in the table. If element A dominates element B, then the whole number integer is entered in row A, column B, and the reciprocal (fraction) is entered in row B, column A.

4. There are $n(n − 1)/2$ judgments required to develop the set of matrices in step 3, where n is the number of elements in the lower level.

5. Having collected all the pairwise comparison data and entered the reciprocals together with n unit entries down the main diagonal, the eigenvalue problem $Aw = \lambda_{max} w$ is solved and consistency is tested, using the departure of λ_{max} from n (see below).

6. Steps 3, 4, and 5 are performed for all levels and clusters in the hierarchy.

7. Hierarchal composition is now used to weigh the eigenvectors by the weights of the criteria, and the sum is taken over all weighted eigenvector entries corresponding to those in the lower level of the hierarchy.

8. The consistency ratio of the entire hierarchy is found by multiplying each consistency index by the priority of the corresponding criterion and adding them together. The result is then divided by the same type of expression, using the random consistency index corresponding to the dimensions of each matrix weighted by the priorities as before. The consistency ratio should be about 10% or less to be acceptable. If not, the quality of the judgments should be improved, perhaps by revising the manner in which questions are asked in making the pairwise comparisons. If this should fail to improve consistency, it is likely that the problem should be more accurately structured; that is, similar elements should be grouped under more meaningful criteria. A return to step 2 would be required, although only the problematic parts of the hierarchy may need revision.

Source: McGraw-Hill Science & Technology Encyclopedia: Analytic hierarchy, http://www.answers.com/topic/analytic-hierarchy

Analytic Network Process: The Analytic Network Process (ANP) is a general theory of relative measurement used to derive composite priority ratio scales from individual ratio scales that represent relative measurements of the influence of elements that interact with respect to control criteria. Through its supermatrix whose elements are themselves matrices of column priorities, the ANP captures the outcome of dependence and feedback within and between the cluster of elements. The Analytic Hierarchy Process (AHP) with its dependence assumptions on clusters and elements is a special case on the ANP.

Source: "Fundamentals of the Analytic Network Process", Thomas L .Saaty, Proceedings of ISHAP 1999, Kobe, Japan

Comment from Robert:

The AHP, when used skillfully, provides a useful means of developing weights for use in the Multiple Attribute Utility Theory (MAUT) approach to the conduct of trade studies: evaluation of solution alternatives, and the conduct of design optimization. Skillful use of AHP requires that the AHP value questions be framed with respect to defined improvements in pairs of Measures of Effectiveness (MOEs), not with respect to the MOEs themselves. The latter practice is a fundamental flaw in AHP as AHP is widely represented. Many other aspects of AHP also give cause for concern. An excellent overview of the many issues with AHP, by Lewis Warren of the Defence Science and Technology Organization, Australia, is at http://dspace.dsto.defence.gov.au/dspace/handle/1947/3553.

ANP can be used as an alternative to AHP where there is value coupling between MOEs. However, the better approach is to identify and correct the reason for the coupling, which is usually either:

- double-counting, e.g. Life Cycle Cost and Investment Cost as peer MOEs; or
- MOE's that do not represent individually valued outcomes, e.g. Reliability and Maintainability, where the real concern is say Achieved Availability.

ANP is best used only with extreme care by individuals with a thorough understanding of underlying concepts. The mixing of problem and solution, the separation of cost from other MOEs, and the way in which risk is treated, all create major challenges for the unwary in the use of ANP, beyond the already substantial issues of AHP.

Systems Engineering Jobs

Systems and Solutions Engineering Manager Tait, Christchurch, New Zealand

Tait Radio Communications is a truly global company, with tens of millions of people around the world depending on Tait-enabled technology to keep their lights on, cities flowing and communities safe. Emerging digital platforms, converging communications technology, cutting-edge engineering solutions make this a great time to join forces with Tait

You will be rewriting the rules for mission critical wireless communications in the public safety and utilities markets around the world. Reporting directly to the COO, you will lead a highly experienced team of senior technologists, the "alpha" engineers who lead our solutions implementation projects within engineering. Working closely with Marketing, Product Management, and our Global Services, you'll build rock-solid new platforms and solutions as we surf the communications technology wave.

More information

Project Performance International News

The PPI News in Short

Dear PPI friends, there are no big PPI news items for this edition of SyEN, but there are several smaller ones:

- PPI's famous OCD & CONOPS 5-Day Course & Workshop is being delivered over 3 - 7 October 2011 in Brasília. We are proud to announce that the course is being hosted by the Brazilian Army.

- PPI is excited to announce the delivery for the first time of our famous Systems Engineering 5-Day Course & Workshop in Hamburg, Germany- the course will be delivered over 27 February - 2 March, 2012.

- PPI is also pleased to announce the delivery of our OCD & CONOPS 5-Day Course & Workshop that will be delivered in Las Vegas over 16 - 20 July, 2012.

PPI's 2012 Training Schedule - New Delivery Locations

PPI will be presenting some of our most popular training courses in additional locations in 2012, including:

- Townsville, Australia
- Newcastle, Australia
- Darwin, Australia
- Wellington, New Zealand
- Auckland, New Zealand

- Ankara, Turkey
- Austin, TX, USA
- Buenos Aires, Brazil
- Santiago, Chile
- Bristol, UK
- Manchester, UK
- Vienna, Austria

More details to come on our website

PPI LinkedIn Group

PPI now has a group on LinkedIn for past course delegates: Project Performance International - Past Delegates. The group provides a space for discussion of course content and a way for course delegates to connect and interact with each other, from all over the world.

If you are a past delegate of one of our training courses and would like to join our LinkedIn group, you can do so here: http://www.linkedin.com/groups?gid=1820744&trk=hb_side_g

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Project Performance International Events

Systems Engineering 5-Day Course

Upcoming locations include:

- Munich, Germany
- Sydney, Australia
- London, UK
- Stellenbosch, South Africa
- Las Vegas, USA
- São José dos Campos, Brazil

View 2011 Systems Engineering Course Schedule

Requirements Analysis and Specification Writing 5-Day Course

Upcoming locations include:

- Adelaide, Australia
- Melbourne, Australia

View 2011 RA&SW Course Schedule

Systems Engineering Management 5-Day Course

Upcoming locations include:

- Amsterdam, The Netherlands
- Las Vegas, USA

View 2011 Systems Engineering Management Course Schedule

OCD & CONOPS in Capability Development 5-Day Course

Upcoming locations include:

- Brasilia, Brazil

View 2011 OCD/CONOPS Course Schedule

Software Development Principles & Processes 5-Day Course

Upcoming locations include:

- Sydney, Australia

View 2011 Software Development Principles & Processes Course Schedule

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PPI Upcoming Participation in Professional Conferences

PPI will be participating in the following upcoming events. We look forward to chatting with you there.

- ISEM 2011
  Exhibiting | Stellenbosch, South Africa (21 - 23 September)

- NZDIA 2011
  Exhibiting | Wellington, New Zealand (15 - 16 November)

- I/ITSEC 2011
  Exhibiting as part of the Team Australia booth | Orlando, FL, USA (28 November - 1 December)

- INCOSE IW 2012
  Exhibiting | Jacksonville, FL, USA (21 - 24 January, 2012)

- INCOSE IS 2012
  Exhibiting | Rome, Italy (9 - 12 July, 2012)

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