Project Performance International

http://www.ppi-int.com/newsletter/SyEN-042.php

SYSTEMS ENGINEERING NEWSLETTER

brought to you by

Project Performance International (PPI)

SyEN 42 – March 15, 2012

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

If you are presently receiving this newsletter from an associate, you may receive the newsletter directly in future by signing up for this free service of PPI, using the form at www.ppi-int.com. If you do not wish to receive future SE eNewsletters, please reply to the notifying e-mail with "Remove" in the subject line, from the same email address. Your removal will be confirmed, by email.

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:

• GENESYS - Highly Connected Systems Engineering for the Enterprise
• Aras Product Lifecycle Management (PLM) Software

Read More…

Systems Engineering Books, Reports, Articles, and Papers

• Fuzzy Hierarchical Decision Modeling
• The 77 Deadly Sins of Project Management
• Special Issue of Enterprise Modeling and Information Systems Architectures (EMISA) - An International Journal
• Requirements Network Weekly

Read More…

Conferences and Meetings

Read More…

Education and Academia

• The University of Oklahoma (USA) College of Engineering Adopts New Name to Reflect Expanding Program

Read More…

Some Systems Engineering-Relevant Websites

Read More…

Standards and Guides

• ArchiMate 2.0 Technical Standard Approved
• Accellera Systems Initiative Announces IEEE 1666(TM) SystemC(TM) Language Standard for Electronic System-Level Design

Read More…

A Definition to Close on – System(s) of Systems, System(s) of Systems Engineering

Read More…

PPI News

Read More…

PPI Events

Read More…

Quotations to Open On

"No matter how complex the situation, good systems engineering involves putting value measurements on the important parameters of desired goals and performance of pertinent data, and of the specifications of the people and equipment and other components of the system."
-Simon Ramo and Robin St Clair, The Systems Approach, 1998

"Well, this is one standpoint. Where is the next? One should try all things and choose the best."
-Peer Gynt, Act 5, Scene 5, by Henrik Ibsen

Feature Article

Economic Aspects and Cost Effectiveness Criteria in Systems Engineering

Massimo Pica
Rome, Italy
massimo.pica (at) libero.it

Editor's Note: the SyEN version of this article is abridged. Click here to download in .pdf format the full version of Mr. Pica's article, with full calculations.

The devil is in the cost details. At least, this is the case for systems' users around the world who face the herculean task of procuring, deploying, and maintaining reliable systems, equipment and materiel. If, generically speaking, we refer to a "system" as every type – however complex – of designed asset, system procurement processes are influenced not only by the initial purchasing cost of a system, but particularly by all costs arising before, during and after the system is delivered for operational use. This would also include its respective retirement stage at the end of the system life cycle. The total amount of these costs, for a single system, is commonly defined as **"Life Cycle Cost"** (LCC).
Designing a system, component, or process to meet desired needs is a decision-making process (often iterative) in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs.

Typical users' expectations are for systems that comply with operational needs and are reliable and competitive from the point of view of costs throughout the system life cycle (system Life Cycle Cost (LCC)). This is the dominating value in the selection of affordable systems to be procured and deployed; in fact, this sort of decision is influenced not only by the initial unit acquisition cost but, more significantly, by all subsequent unit costs, including retirement.

In order to evaluate the Life Cycle Cost of a given system, a basic knowledge of the schedule evolution of the life cycle, and of the procedures involved in its management, is required. ISO/IEC 15288, "Systems and software engineering – System life cycle processes", describes stages and processes occurring during the life cycle of systems. One of the basic decisions to be made is to choose between the design of a new system (the make option) and the purchase of a system already deployed and available on the market (the buy option). In the first of the two instances, Life Cycle Cost studies are required, so that the LCC can be quantitatively determined, e.g. for the purpose of comparing alternative solutions or different economic options, thereby aiming at the best choice.

In many cases, LCC studies have to be reiterated along the life cycle, e.g. to support modifications of user requirements or configuration change proposals.

According to ISO/IEC 15288, the life cycle of a generic system is composed of the following stages:

CONCEPT DEVELOPMENT PRODUCTION IN SERVICE RETIREMENT

Figure 1

"The Concept Stage starts after the decision to fill a capability gap with a materiel solution and ends with the requirements specification for this materiel solution. The purpose is to evaluate the needs, potential risks, and cost benefit of a proposed system or a major upgrade of an existing system prior to any commitment of resources. One or more alternative solutions to meet the identified need or concept are developed through analysis, feasibility evaluations, estimations (such as cost, schedule, market intelligence, and logistics), trade-off studies, and experimental or prototype development and demonstration."

The system LCC estimation serves the purposes of (1) ensuring that all costs to be incurred (typically arranged in a Cost Breakdown Structure (CBS) and explained in the CBS dictionary) are correctly accounted for, and (2) obtaining the system LCC as the minimum reasonably possible. The LCC estimate must include all cost elements, with their estimated costs, which are derived from a technical assessment of the system, as well as from schedule elements of interest; all of these are translated into economic values, using appropriate cost analysis techniques. Technical issues are iteratively re-examined in specific design reviews before reaching confidence concerning compliance of basic design requirements, capability requirements, and fitness to operational scenarios, with respect to the assumptions taken into account in the cost estimates. This is when the budget for the system acquisition program can be prepared.

Traditionally, attention has been given primarily to the optimization of system acquisition costs, whereas operating costs (occurring in the Utilization Stage) and maintenance costs (incurred in Support Stage) are not given thorough consideration. Actually, technological innovations characterising advanced systems require a careful balance of the whole acquisition, ownership, and retirement costs, which comprise the Life Cycle Cost, in order to avoid unjustified trends in cost growth.

In budgeting for the LCC, it is appropriate to build up a cost profile, representing graphically the unit cost behaviour along the system life cycle; all costs are expressed as present values, referred to a single initial point in time. In this way, an 'equivalence base' is created, so that LCC values can be estimated and compared for the different alternatives envisaged.

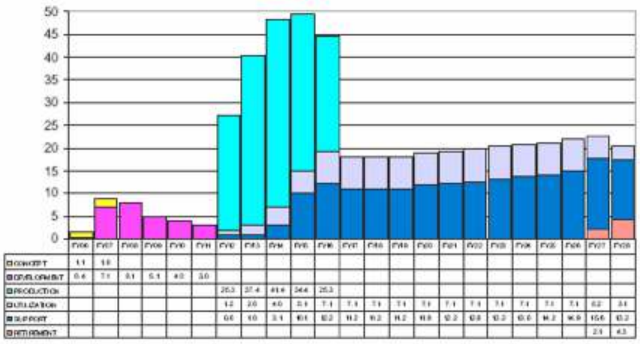


Figure 2

Of course, annual costs are subject to the variable influence of inflation rates; this, in turn, influences the annual expenditure planning, based on the actual value year by year.

Correlation of the following enables the financial analysis to be carried out correctly: i (interest rate or actualisation rate inclusive of inflation), i' (rate neglecting the inflation), and e f (annual inflation rate).
Editor's note: Use the link provided at the beginning of this article for the formulas for the calculations.

We can proceed further to arrive at a typical expression for the Life Cycle Cost. LCC is to be considered, as it actually is, comprised of a certain number of cost elements (Cmn) characterised by a double subscript: m (indicating the cost element category, variable between 1 and M) and n (indicating the year corresponding to the generic cost element, variable between 1 and N). Since the cost values Cmn are future values, they can be actualised using the previous relationships.

The LCC estimation process offers a number of basic elements to support decisions not only during the early life cycle stages, but in all subsequent periods. Specific decisions are required to manage maintenance policies and to carry out trade-offs between different possible alternatives, until the system life comes to its projected (and perhaps, to some extent, unpredicted) end.

The following relationship: FOM = $\frac{SE}{LCC}$

introduces the helpful quantitative tool called 'Figures of Merit' (FOM), by which any system to be procured can be characterised on the basis of calculated values of System Effectiveness and Life Cycle Cost.

From a quantitative point of view, the effectiveness of a generic system is defined as a function of system performance and mission profile. It has to be considered as a goal to be taken into account since the very early stages of the life cycle, in which a larger degree of freedom is allowed in the implementation of system requirements:
$SE = A_0 * D_0 * C$
Where:
SE (System Effectiveness) is a measure of the ability of a system to achieve a set of specific mission requirements.
A_0 (Operational Availability) is a measure of the degree to which a system is in the operable and committable state at the start of the mission, when the mission is called for

at an unknown (random) time.
D_0 (Operational Dependability) is a measure of the degree to which an item is operable and capable of performing its required function at any (random) time during a specified mission profile, given system availability at the start of the mission.
C (Capability) is a measure of the ability of an item to achieve mission objectives, given the conditions during the mission.

The three components of System Effectiveness, Availability, Dependability, and Capability, are therefore measures of a system's ability to operate (in probabilistic terms of duration, repetition, and efficacy) during a specified operational mission.

Editor's Note: See [URL] for a more detailed version of this paper that includes a case study of System Effectiveness.

System Operational Availability (A_0), which is one of the components of this FOM, is, in turn, a function of the mean time between system maintenance operations and of the maintenance downtime:

$$A_o = \frac{\text{Mean Time Between Maintenance}}{\text{Mean Time Between Maintenance} + \text{Maintenance Downtime}}$$

One of the main design parameters influencing the System Operational Availability is the System Reliability. According to the very basic principles of the Reliability theory, the greater the mean time between system failures (i.e. MTBF), the greater it's Reliability.

Life Cycle Cost
Figures of Merit are also dependent on Life Cycle Cost, so that LCC values, calculated for a range of solutions to be evaluated for their feasibility, will be correlated with the corresponding values of System Effectiveness.

For a given system, Life Cycle Cost can be plotted, for convenience, against system Reliability (or MTBF). This relationship is illustrated in the figure below.

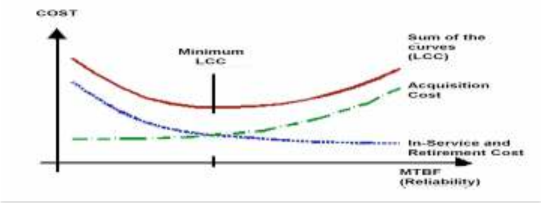


Figure 3

This graphical representation shows that any increase of MTBF (mean time between consecutive failures) requires higher initial investment costs and higher production costs, due to the insertion of more reliable components. This is counterbalanced by lower costs for logistics (equipment and personnel) and maintenance, both corrective and programmed.

Whenever a system becomes unavailable, its LCC can be significantly influenced. Actually, failures or malfunctions require using alternative equipment or terminating a mission, both of which cause an increase in LCC. There is also an analytical correlation between the failure frequency at component level and the mean time to repair the system and restore its functionality (usually abbreviated as MTTR), which, in turn, influences the system downtime.

The unit costs (i.e. costs for each system to be procured), pertaining to the following (indicative) high level cost elements, are taken into account:
CONCEPT, DEVELOPMENT
o Management
o Design
o Test
o Technical documentation

PRODUCTION
o Investments for production facilities
o Manufacture

UTILIZATION & SUPPORT
o Operation

o Support
• personnel
• spares and repair parts
• test equipment
• packaging etc.
• maintainers' training
• support facilities and services
• data management

RETIREMENT
o System shutdown
o System disassembly and removal
o Recycling or Disposal

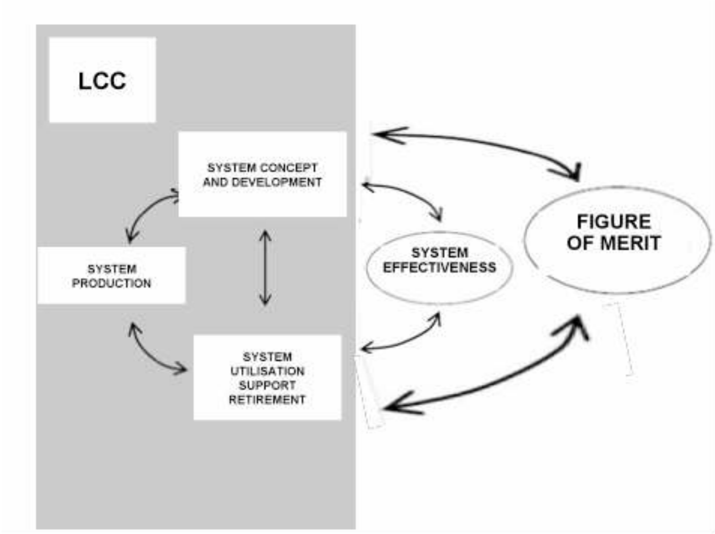


Figure 4

The 'prime factors' of a Figure of Merit are graphically represented in the figure above. FOM is a Cost-Effectiveness parameter synthesising the overall life-long system performance and its corresponding cost, referred to the whole system life cycle; System Effectiveness may be regarded as a collective term used to describe the system availability performance, and its design factors, e.g. reliability, maintainability, and logistic support. Acquisition, ownership, and retirement costs should be estimated as early as possible, so that responsible authorities can find an optimum balance between System Effectiveness factors and Life Cycle Cost.

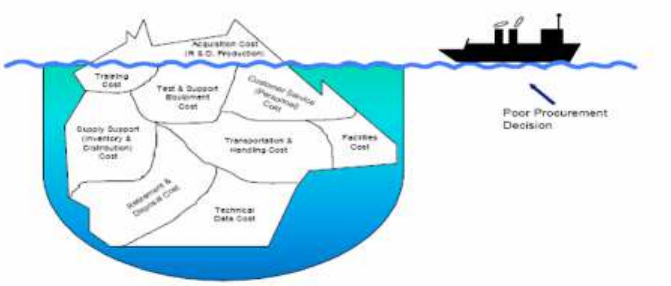


Figure 5

B.S. Blanchard, Professor Emeritus at Virginia Tech, in his bestselling book "Design and Manage to Life Cycle Cost", albeit written more than 30 years ago, and in a number of further publications captured the iceberg picture to represent the contrast between the acquisition costs (relatively well known, hence placed above the water line) and the ownership and retirement costs (largely unknown, therefore represented below the water level). Two main aspects conceptually significant for the life cycle of any (defense) system are emphasised by Prof. Blanchard, namely:

o different "visibility" of Life Cycle Cost components (in accordance with the iceberg metaphor);

o the fact that it is at the early stages in an acquisition program that the greatest gains can be realised in terms of the system Life Cycle Cost (however taking cautiously into account some downstream events that can occur during the life of the system, influencing the Life Cycle Cost itself, e.g.: life cycle schedule slips, changes in quantity of systems to be deployed and/or in their operational conditions; and significant improvement programs).

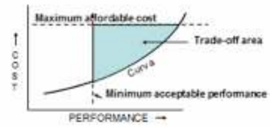


Figure 6

Concerning the cost vs. performance relationship, Augustine's law states that: "The last 10 per cent of performance generates one third of the cost and two thirds of the problems".

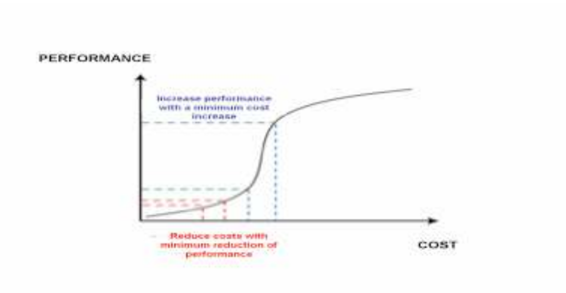


Figure 7

If we need to compare two different solutions (say A and B) to implement a system requirement, the results of a break-even analysis can be useful to illustrate the annual costs of the two configurations and identify the point in time when the costs are equal across the life cycle. This is depicted in the figure below. From the figure, it appears that, if the system is somewhat complex and its life cycle time overcomes a certain duration (10 – 15 years), then Solution A may become preferable.

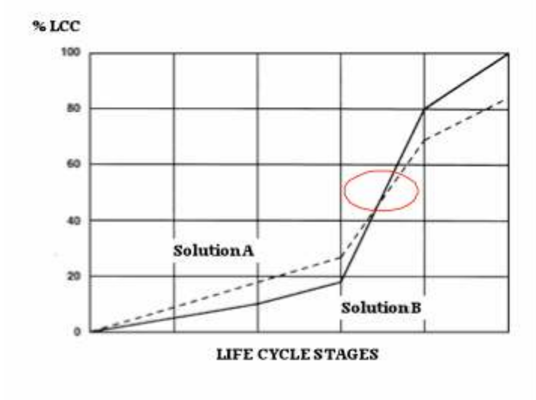


Figure 8

On the other hand, it is possible that specific constraints from the type of system, its mission profile, the embedded technologies, the life cycle duration and the risks of obsolescence dictate the adoption of Solution B, for example, if the life cycle time is shorter.

Editor's Note: See the previously referenced link that includes an example of selection between two alternatives on the basis of LCC, and also provides a sensitivity analysis.

Evaluation of System Economic Life
In several Systems Engineering problems, the evaluation of system economic life is a major economic issue, from the point of view of its applications in optimising the LCC (in compliance with system life cycle planning) and in looking for alternative solutions to arrive at the most suitable configuration(s) on the basis of LCC. The previously referenced longer version of this article includes a discussion of how to evaluate (in theory) a system economic life, taking into account the following necessary information: acquisition cost; annual percent value decrease; annual utilisation and support costs; cost compounding rate.

The Economic Life and the System Replacement Problem
The estimated value of the optimum economic life of a generic system makes it possible, for instance, to determine in which point in time it is best to replace the existing system, in accordance with exclusively economic criteria, with a new system suitable for the same operational profile. In order to achieve this goal, the procedure can be different from the aforementioned method based on annual values. The feasible alternative is based on present economic values.
We can calculate both the optimum replacement period for the system and the life cycle duration for the alternative system by evaluating the Net Present Value (NPV) of each feasible combination of the two life cycles, then choosing the minimum cost NPV (or else, the maximum NPV of net incomes), having noted that this procedure is in principle applicable only if time intervals are the same for the two systems. As a consequence, the first basic problem derives from the different combinations between the durations of the life cycles of the existing system and the alternative system: for example, one year plus four years, versus three years plus five years. Therefore, we can conclude that we have to compare the NPV on a total, respectively, of five and eight years, hence altogether 40 combinations. This complication can be overcome by assuming an infinite series of replacements or, for instance, an existing system for one year of life and infinite replacements with alternative systems, each one for four years of life. This assumption can be compared to assuming a system with three years of life and infinite replacements with alternative systems having five years of life each. The utilization of infinite series is an important method to determine the optimum system life duration: in this case, each combination has an overall life cycle of infinite duration and, therefore, the comparative criteria based on NPV are correctly applicable and, furthermore, the analytical process is much simpler.

Editor's Note: The longer version of this article provides a numerical example appropriate to solve the following problems:
(1) Beginning from now, how long is it convenient to wait before replacing the existing system with an alternative system?
(2) If there is no replacement, what is the optimal remaining life of the current system?
(3) What is the optimal life cycle duration of the alternative system?

Conclusions
Systems of interest to engineers are becoming more and more complex; therefore, it is necessary that engineers have the capability to analyze, synthesise, and design complex systems. Designing a system is a multi-variate challenge, involving complex decisions in selecting among different solutions complying with the same specifications. These decisions are in most cases dictated by economic considerations.

Concerning the most complex cases of Systems of Systems (SoS), as defined by the International Council on Systems Engineering (INCOSE), it should be emphasized that SoS are significantly different from stand-alone systems from the design perspective. For example, in a SoS, composed of interdependent systems connected to one another in order to provide a given performance, losing part of the system will cause a remarkable degradation of the performance of the whole SoS.

From an economic perspective, the choice of applicable cost models is related to a number of discrimination criteria, the major ones being: the SoS stakeholders, the SoS architecture and its lead system integrator, and additionally the degree of independence of SoS components in term of the activities required to them in each life cycle stage. In this respect, for the purpose of useful applications of cost models to SoS, it is essential to refer to strategic objectives of the organization concerned, especially contracting agencies and user communities. Secondly, having defined the identity of lead system integrators, they will be not only responsible for selecting the SoS architecture(s) but also, as a consequence, for the integration and test activities representing significant cost elements to be properly evaluated. Finally, the degree of independence of Life Cycle Management activities for individual components will certainly have an impact on the selection of cost models applicable to CBS elements of the SoS, avoiding overlaps and double counts of the costs.

Realizing a SoS means a trade-off between different systems, both from the point of view of performances and, especially, costs. From the general Systems Engineering perspective, SoS implications with respect to 'elementary' systems can be (indicatively) referred to: broader technical content, higher complexity of integration activities, dynamic and challenging design scope, with significant elements of uncertainty, advanced design optimisation needs, continuous architecture review, sophisticated SoS simulation models, careful interface design and management.

Concerning the prevailing economic issues, cost estimates for a SoS represent complex activities, with respect to simpler systems, noting the extreme variety of possible choices for the overall SoS configuration built on its individual systems. Cost analysts should therefore consider the adoption of more appropriate and advanced estimation methodologies, either analytical methods or, as appropriate, Decision Support methods.

Systems Engineering News

LAI Researchers Receive 2011 INCOSE Working Group Award for Collaboration

Lean Advancement Initiative (MIT, USA) (LAI) researchers Drs. Josef Oehmen and Bob Kenley have received the 2011 INCOSE Working Group Award for Collaboration with the Lean Systems Engineering Working Group. The award recognizes the group's collaborative work with PMI, LAI, and INCOSE Corporate Advisory Board (CAB) companies to bridge the gap between program management and systems engineering.

More information

OneThing35: National Systems Thinking Weeks

National Systems Thinking Weeks will be celebrated annually across the United States, commemorated by government decrees in core regions, feted by civic forums where a critical mass exists, and embraced by grade and high schools throughout the United States over 5 - 20 May, 2012.

More Information

Need to Refresh Engineering Curricula

Delivering the inaugural address at a seminar "ICTACT BRIDGE 2012", organized by ICT Academy and the National Association of Software and Service Companies (NASSCOM), Kiran Karnik said industry has failed take up the need for modifying curricula as needed. Stating that only 25 per cent of graduates graduating from engineering colleges were directly employable every year, Karnik said, "That is a startling fact. Students invest time and money in education. Graduates have knowledge and skills, but they do not correlate well with industry requirements".

More information

The Importance of Emotions in Software Engineering

A recent study by the Carlos III University of Madrid (UC3M) investigates the importance of emotions in software engineering. In the study, requirements engineering is considered. There is a good reason for this specific focus. The scientists have applied a tool of social psychology, the affect grid invented by J. A. Russel. As the authors of the studies explain, this instrument provides emotional outlines for different versions of the requirements, in addition to facilitating an analysis of the emotions of those involved in the development of the system. The results of the study show that emotions need special consideration when negotiating and establishing requirements.

More Information

Solving Your DAM Problems: Why Lean, Six Sigma, and TOC Methodologies DAM Up Your Company

Lesson to be learned: We should be open minded to the ideas contained in methodologies and realize we aren't perfect; likewise, we should not expect the methodologies people come up with to be perfect. What we should focus on is designing our own constructs that engage people productively into solving complex problems (Summary provided by Alwyn Smit).

More Information

Modeling and Simulation for U.S. Navy Test and Evaluation Technical Forum

The future of modeling and simulation (M&S) in test and evaluation of surface ship integrated warfare systems was the subject of a U.S. national technical forum sponsored by the Program Executive Office for Integrated Warfare Systems (PEO IWS) at Naval Surface Warfare Center (NSWC) Port Hueneme, USA, Jan. 30 - Feb. 2. The biggest lesson shared during the forum was that efficiencies in M&S, as well as test and evaluation, can be achieved through a shared knowledge of methodologies, assets, resources and data. These efficiencies can make systems cheaper to procure, reduce risks in development and execution, and speed capabilities to the warfighter.

More Information

IIBA Reaches 25,000 Members

The International Institute of Business Analysis (IIBA®) has announced achievement of a major milestone, having reached the 25,000 member mark. Congratulations to the IIBA!

IIBA® is the independent non-profit professional association for the growing field of business analysis. Its goal is to create greater awareness of the BA profession and recognition of the value of the business analyst role. Its publication A Guide to the Business Analysis Body of Knowledge® (BABOK® Guide) is the industry standard for the BA profession, and with content that aligns strongly with systems engineering principles and practice. The organization also publishes a Business Analysis Competency Model, and operates a professional certification scheme, conferring the Certification of Competency in Business Analysis™ (CCBA®) designation.

More Information

Featured Societies

The International Requirements Engineering Board (IREB e.V.) and the Requirements Engineering Qualifications Board (REQB®)

The International Requirements Engineering Board (IREB e.V.)

The International Requirements Engineering Board (IREB e.V.) aims at providing a certification model with syllabi and exams, thus fostering further education within the field of requirements engineering. The overall objective is to improve requirements engineering and business analysis in practice. The focus is on requirements engineering for software products, with the generally non-separable system view considered.
IREB's concept comprises:

- stipulation of a three-tier certification model referred to as "Certified Professional for Requirements Engineering";
- definition of syllabi for related levels of certification;
- elaboration of exams for achieving the certificate of the respective level;
- collaboration with certifiers to ensure an internationally unified exam procedure; and
- recognition of training providers that commit themselves to conduct training in line with the respective IREB syllabi.

The Members of the IREB are independent individuals. Membership as representative of an organization or a company is not possible. IREB is supported by supporting members worldwide, with groups in France, Brasil, Sweden, Poland, Spain and the USA.

IREB GmbH, based in Karlsruhe, Germany, was founded on April 1st, 2011 to run the operational business of the IREB.

More information

The Requirements Engineering Qualifications Board (REQB®)

The Requirements Engineering Qualifications Board (REQB®) is operated by gasq Service GmbH of Bamberg, Germany. The organization offers a REQB Certified Professional for Requirements Engineering certification by examination. Two levels of certification are offered, Foundation and Advanced. Training is delivered by accredited training providers, of which eight in various countries are listed on the REQB website.

More information

INCOSE Technical Operations

Measurement Working Group

Charter
Promote shared understanding, education and advancement of measures, measurement practices, measurement tools/support, and the overall measurement process as applied to systems engineering.

Leadership
• Chair: Paul J. Frenz
• Co-Chair: Open

Members
48 Members

Accomplishments / Products
Published Products
• Measurement Primer 2010
• Technical Measurement Guide 2005
• SE Handbook (Chapter 5, Sec 3) 2010
• SE Leading Indicators V2 2010
• Academic COSYSMO – 2006
• PSM Guide, Chapters 1 & 2

Current Projects
• PSM Guide (the Systems part), revision to Chapters 1 & 2 - 2012
• INCOSE Joint Project with Knowledge Management Working Group to develop Wiki and search capability – In Progress
• Joint Affordability Working Group Effort

More information

Systems Engineering Tools News

Additions to the PPI Requirements Management Tools List

Specification Tool	http://www.projectricity.com/specification_tool.htm	RM Tool
LiteRM	http://www.literm.com/	RM Tool
Aras	http://www.aras.com/	PLM inc. RM

Vitech Corporation Initiates e-News

Vitech Corporation announced on 24 Feb 2012 that it will be sending issues of "e-News" approximately every 45 days to provide news on what's happening at Vitech and across the systems engineering community. Also provided in every issue will be Vitech's upcoming webinar schedule and information concerning their latest service packs. If there is a topic you'd like to see addressed, send an email to support (at) vitechcorp.com subject=E-Note Suggestion.

More information

Requirements Assistant™

Requirements Assistant™ by requirements expert Herman Driessen is a text analysis tool that is designed to help achieve complete, consistent, feasible and unambiguous requirements, using text in natural language (English) as input. Requirements Assistant™ analyses requirements at sentence level, it also reviews paragraphs, and reviews the document as a whole.
Some examples:
1. Appropriate system standards shall be used where necessary.

Remarks of The Requirements Assistant™:
a. appropriate – What is appropriate?

b. standards – Specifically which standards are required?
c. where necessary – Under what conditions will these standards be applied?

2. It is required that the red light be illuminated once temperatures exceed about 25 degrees.

Remarks of The Requirements Assistant™:
a. It is required – Is this a requirement?
b. Illuminated – Is this for a certain duration?
c. Temperatures – temperatures of..?
d. About – accuracy?
e. Degrees – Celsius, Fahrenheit?
f. Is there also a requirement how/when the red light will be switched off?

3. Off-line tooling allowing the end-user to manipulate … in order to… compensate for … stability.

Remarks of The Requirements Assistant™:
a. manipulate – exactly what is manipulated?
b. In order to – this is not a requirement but a goal.
c. Compensate for – how much?

4. Remarks of The Requirements Assistant™:
No requirements on reliability, safety and EMC were found in the set of requirements.

More Information

GoedelWorks

GoedelWorks is a web based environment to be released in March 2012 by Altreonic NV, supporting the systems engineering process. The framework is provided by the formalized systems engineering methodology of Altreonic, researched for 4 years at Open License Society. This framework is combined with the specific process flow an organization has adopted. As a result, a specific process is created serving multiple purposes:
• Knowledge management
• Requirements and specifications capturing
• Architectural modeling
• Work plan creation
• Task partitioning
• Project management: development, verification, test and validation
• Awareness of safety engineering standards like IEC61508, ISO26262 and others
• Generation of dependency and precedence trees
• Export to and import from OpenVE
• Export to the MAST scheduleability analyzer.

GoedelWorks goes beyond requirements management by using an internal meta-model that allows traceability from top level requirements to implementation entities. Optionally, a safety standards based flow (up to 355 predefined work packages) can be followed as well.

Altreonic has also published a booklet: "Trustworthy Systems Engineering with GoedelWorks" which explains how the high level framework Altreonic applies to the domain of systems engineering. It discusses a generic model that applies to any process and project development. It explains the 16 necessary but sufficient concepts. This model was applied to the import of the project flow of the ASIL (Automotive Safety Integrity Level) project of Flanders's Drive whereby a common process was developed based on the IEC-61508, IEC-62061, ISO-DIS-26262, ISO-13849, ISO-DIS-25119 and ISO-15998 safety standards covering the automotive on-highway, off-highway and machinery domain.

This booklet is the first of the Gödel Series, with the subtitle "Systems Engineering for Smarties". The aim of this series is to explain in an accessible way some important aspects of trustworthy systems engineering, with each booklet covering a specific domain.

More Information
http://www.altreonic.com/sites/default/files/Systems Engineering with GoedelWorks.pdf

---

Papyrus Engineering Tool Development

In the context of a French collaborative project, CEA LIST, the LISE (laboratory of model driven engineering for embedded systems), aims to extend and consolidate the Papyrus open-source tool. The project targets the creation of a generic system engineering tool, based on a model-oriented concept, for use in the development of complex, critical systems.

More Information

CORE Supports Project Outcomes through Integrated Modeling

CORE® is a comprehensive modeling environment built for complex systems engineering problems.
CORE's integrated modeling capabilities can be used to assess and control risk of design or program origin. By linking all elements of a system through a central model, visibility into drivers for risk may be achieved. CORE provides:
• Integrated requirements management
• Fully executable behavior modeling
• Architecture development tools
• Validation and Verification (simulation)
• Comprehensive system documentation.CORE Support.jpg

[More Information](#)

GENESYS - Highly Connected Systems Engineering for the Enterprise

Vitech's GENESYS brings together a model-centric approach to systems engineering with an enterprise-ready architecture, with the intention of providing the ability to deliver model-based systems engineering (MBSE) seamlessly and consistently across a project team.

[More Information](#)

Aras Product Lifecycle Management (PLM) Software

Aras offers PLM software that addresses a range of strategic business interests across the product life cycle, including program management, product engineering and quality planning.

Aras offers three types of PLM software solutions:
• Aras Managed Solutions — fully OSI-compliant and freely available for download under an enterprise open source format;
• Aras Community Solutions — developed and contributed by Aras Community members, and available on the Aras Community Project Site; and
• Aras Commercial Solutions — developed by Aras and Aras partners. License fees may apply.

The Aras PLM suite includes:
• Configuration Management
• Document Management
• Engineering Change Management
• Lean Product Development
• Part Traceability
• Product Data Management
• Product Engineering
• Product Lifecycle Management
• Program Management
• Project Management
• Requirements Management
• Risk Management
• Systems Engineering
amongst many other aspects of PLM.

[More information](#)

Cradle 6.6 Requirements and Systems Engineering Tool Has Been Released

3SL has announced the release of version 6.6 of Cradle, its requirements management and systems engineering software tool with lifecycle management and providing end-to-end traceability.

[More information](#)

Systems Engineering Books, Reports, Articles and Papers

Fuzzy Hierarchical Decision Modeling

Michael Khader

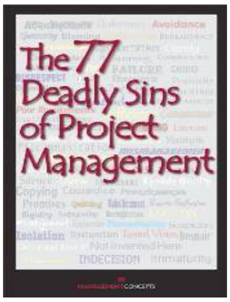
Lambert Publishing Company
Fuzzy Hierarchical Decision Modeling by NJIT Associate Professor Michael Khader has been re-issued by Lambert Publishing Company in a soft-bound text. The book, originally published in 2009 by Walden University, focuses on applying decision modeling rooted in fuzzy theory and hierarchical analysis to complex problems in networks'

design and acquisition. The book features the analytical hierarchy process (AHP) and fuzzy sets which can be used to deconstruct a complex decision with incomplete information into a set of factors and solutions. The factors and solutions are based on business-related goals and objectives to fit business growth and continuity in changing markets. This is especially believed to be true in the telecommunication market, where established players are leaving and new ones entering. Using the described model allows key decision-makers to arrive at conclusions with a high degree of confidence although the information used in the decision-making process remains uncertain. The model is designed for a single decision and group decision-makers. The model is important because, unlike other models based on well-defined factors and well-defined solution alternatives, this model is based on incomplete and uncertain information. The model's use is not limited to the networking and telecommunications fields, but also can be applied to areas of business and social significance such as choices of alternative energy, real-time fuzzy control, as well as budget and resource allocations.

More information

The 77 Deadly Sins of Project Management

by Several experienced project managers



From a review at Amazon.com:
The 77 Deadly Sins of Project Management offers a compilation of contributions by experienced project managers who discuss common 'sins' that hinder, stall, or throw projects off track. From personal experiences and historical events to the costs of failing to understand these project management challenges, this book is a 'must' for any technical library strong in project management guides.

More Information

Special Issue of Enterprise Modelling and Information Systems Architectures (EMISA)

An International Journal

This Special Issue is dedicated to capturing the current state-of-the art in the area of modelling tool research with a focus on methodical development of modelling tools. We strongly encourage submissions that go beyond 'yet another modelling tool' and invite submissions that address research challenges and direct further research. It is expected that the submissions are based on sound methodical, theoretical, conceptual-analytical and, where appropriate, hermeneutic and/or behaviouristic approaches (e. g. case study-based research). Submissions may not have been submitted or be under consideration elsewhere and must constitute original work. It is possible to submit a major revision of a manuscript already published in workshop or conference proceedings given that the earlier publication is properly referenced. In addition, it must be clearly described and/or marked which parts of the manuscript have been revised and of what nature the changes are.

More Information

Requirements Network Weekly

The Requirements Networking Group (RQNG) is offering a new online publication, "Requirements Network Weekly." In this online newspaper, you will find articles, videos and blog posts related to gathering requirements.

More Information:

Conferences and Meetings

2nd International Requirements Engineering Efficiency Workshop (REEW 2012)
March 19, 2012, Essen, Germany
More information

16th International GI/ITG Conference on Measurement, Modelling and Evaluation of Computing Systems and Dependability and Fault-Tolerance (MMB & DFT 2012)
March 19 - 21, 2012, Kaiserslautern, Germany
More information

CSER 2012 – Conference on Systems Engineering Research
March 19 - 22, 2012, St Louis, Missouri, USA
More information

The 9th ENTERPRISE ENGINEERING Track at ACM-SAC 2012
March 25 - 29, 2012, Riva del Garda, Trento, Italy
More information

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

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

Symposium On Theory of Modeling and Simulation, TMS'12
Part of the 2012 SpringSim - Spring Simulation Multi-Conference
March 26 - 29, 2012, Orlando, FL, USA
More information

Software for Theory of Modeling & Simulation at TMS/DEVS'1 2
March 26 - 29, 2012, The Florida Hotel, Orlando, FL, USA.
More Information

2012 SpringSim - Spring Simulation Multi-Conference
March 26 - 30, 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

Fourth NASA Formal Methods Symposium (NFM 2012) NEW
April 3 - 5, 2012, Norfolk, VA, USA
More Information

9th IEEE International Conference and Workshop on Engineering of Autonomic and Autonomous Systems (EASe 2011)
April 11 - 13, 2012, Novi Sad, Serbia, Europe
More Information

Workshop on Requirements Engineering (WER'12)
April 24 - 27, 2012, Buenos Aires This workshop will be held in parallel with CIbSE'12 and ESELAW'12.
More information

International Conference on Industrial Engineering and Systems Management (ICIESM) 2012 NEW
April 25-26, 2012, Paris France
More information

CMMI Made Practical 2012
April 26 – 27, 2012 London, UK
More information

SETE APCOSE 2012
April 30 - May 2, 2012, Brisbane Convention and Exhibition Centre, Brisbane, QLD, Australia
More information

Software Engineering Institute Architecture Technology User Network (SATURN) 2012 Conference
May 7 - 11, 2012, St. Petersburg, FL, USA
More Information

Lean Software and Systems 2012 NEW
May 13-18, 2012, Boston, MA USA
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

2012 Industrial and Systems Engineering Research Conference
May 19 - 23, 2012, Orlando, Florida
More information

Risk Engineering Society Conference: RISK 2012
May 23 - 24, 2012, Lovedale, NSW, Australia
More information

12th International Design Conference Design 2012
May 21 - 24, 2012, Dubrovnik, Croatia
More information

Systems thinking for solving complex problems NEW
May 24, 2012, James Cook Hotel Grand Chancellor Wellington, New Zealand
More information

Australian System Safety Conference 2012
May 23 - 25, 2012, Brisbane, Australia
More information

12th International SPICE Conference on Process Improvement and Capability determination in Software, Systems Engineering and Service Management
May 29 - 31, 2012, Palma de Mallorca, Spain
More Information

Engineering Leadership Conference (ELC 2012)
May 30 - June 2, 2012, Adelaide, Australia
More information

International Conference on Software and Systems Process (ICSSP) 2012

June 2 - 3, 2012, Zurich, Switzerland (co-located with ICSE 2012)
More Information

119th American Society for Engineering Education (ASEE) Annual Conference & Exposition
June 10 - 13, 2012, San Antonio, Texas, USA
More information

Kongsberg Systems Engineering Event (KSEE) NEW
June 14-15, 2012, Høgskolen i Buskerud, Kongsberg, Norway
More information

The Third International Symposium on Engineering Systems - CESUN 2012
June 18 - 20, 2012, Delft, The Netherlands
More information

iFM2012 ABZ 2012 - Abstract State Machines
June 18 - 22, 2012, CNR Research Area of Pisa, Italy
More information

12th International School on Formal Methods for the Design of Computer, Communication and Software Systems: Model-Driven Engineering (SFM-12:MDE) NEW
June 18 - 23, 2012, Bertinoro Italy
More Information

International Conference on Business Process Modeling, Development, and Support (BPMDS 2012), the 13th edition of the BPMDS series, held in Conjunction with Conference on Advanced Information Systems Engineering (CAiSE'12)25-26
June 25-26, 2012, Gdansk, Poland
More information

3rd IEEE Track on Collaborative Modeling and Simulation (COMETS 2012)
June 25-27, 2012, Toulouse, France
More information

EuroSPI 2012 Conference/19th EuroSPI Conference - European Systems and Software Process Improvement and Innovation
June 25-27, 2012, Vienna University of Technology, Austria
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

12th International Conference on Application of Concurrency to System Design (ACSD 2012)
June 27 - 29, 2012, Hamburg, Germany
More Information

Eighth European Conference on Modeling Foundations and Applications (ECMFA) NEW
July 2 - 3, 2012, Technical University of Denmark (DTU), Kongens Lyngby, Denmark
More information

8th European Conference on Modelling Foundations and Applications
July 2 - 5, 2012, Technical University of Denmark, Denmark
More information

The World Congress on Engineering 2012
July 4-6, 2012, London, United Kingdom
More information

INCOSE International Symposium (IS) 2012
July 9 - 12, 2012, Rome, Italy
IS2012 Call for Papers: Deadline for draft papers, and proposals for panels and tutorials for IS2012 is November 8th, 2011.
More information

Interdisciplinary Network for Group Research (INGRoup) - Seventh Annual Conference
July 12 - 14, 2012, Chicago, IL, USA
More information

IEEE SOSE 2012 7th International Conference on System of Systems Engineering
July 16 - 19, 2012, Genoa, Italy
More information

International Conference of the System Dynamics Society, 2012
July 22 - 26, 2012, St. Gallen, Switzerland
More Information

4th Improving Systems & Software Engineering Conference (ISSEC) 2012
August 15 - 16, 2012, Melbourne, Australia
More information

Workshop on Model-Driven Engineering for Networked Ambient System (MDE4NAS) NEW
August 27-29, 2012, Niagara Falls, Canada
More information

18th International Symposium on Formal Methods
August 27 - 31, 2012, CNAM, Paris, France
More information

Sixth IEEE International Conference on Self-Adaptive and Self-Organizing Systems (SASO 2012)
September 10-14, 2012, Lyon, France
More information

International Workshop on Enterprise Integration, Interoperability and Networking (EI2N'2012) NEW
September 12-13, 2012, Rome, Italy
More information

10th International Conference on Formal Modeling and Analysis of Timed Systems (FORMATS 2012)
September 18-20, 2012, London, United Kingdom
More information

20th IEEE International Requirements Engineering Conference (RE12)
September 24 - 28, 2012, Chicago, Illinois, USA
More information

MODELS 2012, ACM/IEEE 15th International Conference on Model-Driven Engineering Language & Systems
September 30 - October 5, 2012 - Innsbruck, Austria
More Information

World Engineering Education Forum (WEEF12) NEW
October 15-18, 2012, Buenos Aires, Argentina
More information

Human Factors and Ergonomics Society HFES 2012 Annual Meeting
October 22 - 26, 2012, Boston, MA, USA
More information

The World Congress on Engineering and Computer Science 2012 NEW
October 24 - 26, 2012, San Francisco, USA

Building Business Capabilities (BBC) 2012
October 28 - November 2, 2012, Fort Lauderdale, FL, USA
More information

3rd International Conference on Complex Systems Design & Management (CSD&M 2012)
December 12 - 14, 2012, Cité Internationale Universitaire, Paris, France
More information

Education and Academia

The University of Oklahoma (USA) College of Engineering Adopts New Name to Reflect Expanding Program

The department, part of the College of Engineering, is now the Department of Industrial and Systems Engineering. As part of the name change and new focus, the college has added courses to teach students more about decision making and critical thinking with systems. The college also offers graduate courses in systems engineering to teach a systems perspective to students with other undergraduate degrees. It has a master's program with Tinker Air Force Base to teach airmen about systems techniques.

More Information

Some Systems Engineering-Relevant Websites

---

http://www.youtube.com/watch?v=Eap9kmlz_6k
This YouTube link presents an entertaining, short (three minute) video introduction to systems engineering.

http://www.requirementsassistant.nl
This is the website of Herman Driessen, a genuine expert on requirements. The website describes Requirements Assistant (a software tool), and contains useful information and links regarding requirements engineering.

http://research.it.uts.edu.au/re/re-OldArchive/
This is the home page for an archive of Requirements Engineering Online (re-online) posts from Feb 28 1997 to May 26 2000. The archive contains 792 posts.

http://research.it.uts.edu.au/re/re-archive/
This is the home page for an archive of Requirements Engineering Online (re-online) posts from Nov 15 2001 to Mar 22 2005. The archive contains 2123 posts.

http://proxy-feit.eng.uts.edu.au/pipermail/re-online/
This is the home page for an archive of Requirements Engineering Online (re-online) posts, arranged by month, from March 2005 to date.

http://proxy-feit.eng.uts.edu.au/mailman/listinfo/re-online/
This is the subscription page for re-online.

http://discuss.it.uts.edu.au/pipermail/planetkr/
This is the home page for an archive of posts used to distribute official announcements of KR Inc. about knowledge representation-related activities. The archive dates from July, 2003 to now.

http://research.it.uts.edu.au/magic/Mary-Anne/
This is the website of Mary-Anne Williams, a Research Professor and Director of the Innovation and Enterprise Research Laboratory of the University of Technology, Sydney, in Australia. The site provides insights into aspects of innovation, on which systems engineering is so dependent for creation of better systems.

http://www-staff.it.uts.edu.au/~didar/
This webpage describes current research projects in requirements engineering of Professor Didar Zowghi of the University of Technology, Sydney, in Australia. Projects include research into an interactive computer game-based teaching and learning environment for Requirements Engineering, and field investigations of requirements engineering in geographically distributed software development organizations.

http://www.reqbib.com/index.htm

This site provides a searchable bibliography of 6002 requirements-related papers and books.

http://www.rspa.com/spi/reqmengr.html
This site of Roger Pressman contains links to a wide range of requirements engineering resources.

http://www.goldpractices.com/
This site provides information about software acquisition and development 'best' practices that may have a positive impact on program risks and ROI. The DACS is the U.S. Department of Defense (DoD) Information Analysis Center (IAC). As an IAC, the DACS is a Center of Excellence, and technical focal point for information, data, analysis, training, and technical assistance in software related technical fields. Areas addressed include architecture-first approach, formal inspections, formal risk management, Integrated Product and Process Development (IPPD), requirements management and requirements trade-off/negotiation.

Standards and Guides

ArchiMate 2.0 Technical Standard Approved

ArchiMate is The Open Group's open and independent modeling language for enterprise architecture, supported by different tool vendors and consulting firms. ArchiMate supports enterprise architects in describing, analyzing, and visualizing the relationships among business domains in an unambiguous way. ArchiMate offers a common language for describing the construction and operation of business processes, organizational structures, information flows, IT systems, and technical infrastructure. This insight helps stakeholders to design, assess, and communicate the consequences of decisions and changes within and between these business domains.
ArchiMate(R) Version 2.0 Technical Standard was approved by the Board of the Open Group, during its Jan-Feb 2012 conference in San Francisco. The ArchiMate 2.0 technical standard represents the ArchiMate language definition as it exists today. The language definition of version 1.0 resulted from the ArchiMate project, and was initially maintained by the ArchiMate Foundation. The ArchiMate 2.0 standard provides a tighter alignment with TOGAF, while still ensuring backward compatibility to the pre-existing ArchiMate 1.0 standard.
The ArchiMate standard is hosted by The Open Group's ArchiMate Forum, which is actively working on the dissemination and further development of ArchiMate. The standard can be downloaded from The Open Group's ArchiMate Forum website.

More information

Accellera Systems Initiative Announces IEEE 1666™ SystemC™ Language Standard for Electronic System-Level Design

Announced by the IEEE-SA in November 2011, the revised version of the IEEE 1666 specifies the SystemC™ standard, a high-level design language used in the design and development of electronic systems. The new version encompasses many enhancements, notably support for Transaction-Level Modeling (TLM), a critical approach to enable high level and more efficient design of complex ICs and SoCs. Beginning immediately, companies, universities, research institutions, and individuals worldwide can freely access the standard and develop applications for SystemC-based tools and technologies. The IEEE 1666 is available as a PDF formatted document. To download a copy, please visit http://standards.ieee.org/about/get/index.html.

More Information

A Definition to Close on

System(s) of Systems, System(s) of Systems Engineering (SoSE)

System of Systems: Modern systems that comprise system of systems problems are not monolithic; rather they have five common characteristics: operational independence of the individual systems, managerial independence of the systems, geographical distribution, emergent behavior and evolutionary development:
Source: Sage, A.P., and C.D. Cuppan. "On the Systems Engineering and Management of Systems of Systems and Federations of Systems," Information, Knowledge, Systems Management, Vol. 2, No. 4, 2001, pp. 325-345.

System of Systems: System of systems problems are a collection of trans-domain networks of heterogeneous systems that are likely to exhibit operational and managerial independence, geographical distribution, and emergent and evolutionary behaviors that would not be apparent if the systems and their interactions are modeled separately.
Source: DeLaurentis, D. "Understanding Transportation as a System of Systems Design Problem," 43rd AIAA Aerospace Sciences Meeting, Reno, Nevada, January 10-13, 2005. AIAA-2005-0123.

Robert's Comments: I like the above definitions of system of systems a lot, because they make a useful distinction between systems in general, and systems, the engineering of which gives rise to particular challenges and emphases, because of the distinguishing features stated in the definitions. Of course, in a purely literal sense, almost any system is a system of systems (things constructed of two or more interacting parts).

System-of-Systems Engineering (SoSE): System-of-Systems Engineering (SoSE) is a set of developing processes, tools, and methods for designing, re-designing and deploying solutions to System-of-Systems challenges.
Source: http://en.wikipedia.org/wiki/System_of_systems_engineering
Robert's Comments: The above definition of System-of-Systems Engineering (SoSE) sits perfectly with the two definitions of system of systems.

System-of-Systems Engineering (SoSE): System of Systems (SoS) Engineering is an emerging interdisciplinary approach focusing on the effort required to transform capabilities into SoS solutions and shape the requirements for systems. SoS Engineering ensures that:
• individually developed, managed, and operated systems function as autonomous constituents of one or more SoS and provide appropriate functional capabilities to each of those SoS
• political, financial, legal, technical, social, operational, and organizational factors, including the stakeholders' perspectives and relationships, are considered in SoS development, management, and operations
• a SoS can accommodate changes to its conceptual, functional, physical, and temporal boundaries without negative impacts on its management and operations
• a SoS collective behavior, and its dynamic interactions with its environment to adapt and respond, enables the SoS to meet or exceed the required capability.
Source: Systems of Systems Engineering Center of Excellence

Robert's Comments: The first bullet point above seems to capture the essence of System-of-Systems Engineering (SoSE). Regarding the second bullet point, one would hope and expect that applicable political, financial, legal, technical, social, operational, and organizational factors, if any, including the stakeholders' perspectives and relationships, are considered in system development without exception, regardless of the system. To do otherwise is bad systems engineering. The third bullet point seems obtuse. The last bullet point would seem to apply to every engineered system, no exceptions.

System-of-Systems Engineering (SoSE): System of Systems (SoS) Engineering deals with planning, analyzing, organizing, and integrating the capabilities of a mix of existing and new systems into a SoS capability greater than the sum of the capabilities of the constituent parts.
SoSs should be treated and managed as a system in their own right, and should therefore be subject to the same systems engineering processes and best practices as applied to individual systems.

Differs from the engineering of a single system. The considerations should include the following factors or attributes:
• Larger scope and greater complexity of integration efforts;
• Collaborative and dynamic engineering;
• Engineering under the condition of uncertainty;
• Emphasis on design optimization;
• Continuing architectural reconfiguration;
• Simultaneous modeling and simulation of emergent System of Systems behavior; and
• Rigorous interface design and management.
Source: Defense Acquisition Guidebook (DAG) - 2006 Definition of SoSE

Robert's Comments: The above definition of System of Systems (SoS) Engineering would seem to apply to the engineering of all systems. Of the list of so-called differences, the first is arguable; continuing architectural reconfiguration may or may not apply to any system depending on circumstances, and the rest of the alleged differences would seem to be factors in engineering of any system.

I am not convinced that a differentiation of "system of systems engineering" and "systems engineering" is helpful, at least with respect to choice of words. However, recognition of the specific additional challenges of engineering systems from subsystems that are subject to operational and managerial independence, may be geographically distributed, and may well exhibit evolutionary behaviors not under the control of the developers of the parent (SoS) system – that is extremely valuable. Research in this area from participants such as Purdue University's College of Engineering (USA), National Centers for System of Systems Engineering (Old Dominion University – USA), and others will contribute to mankind's ability to successfully engineer complex socio-technical systems.

PPI News (see www.ppi-int.com)

Downloads Available at PPI Website

We've added to the PPI website a number of valuable downloads:

FILE NAME	DOWNLOAD FILE
Presentation: The Business Case for Systems Engineering	PDF (Size 10.6 MB)
Presentation: The Business Case for Requirements Engineering	PDF (Size 5.3 MB)
Presentation: Systems Engineering in a Research Environment	PDF (Size 8.6 MB)
Short Paper: Functional Analysis - An Overview	PDF (Size 44 KB)
Short Paper: Requirements Analysis that Works!	PDF (Size 900 KB)
Paper: Types of Requirements	PDF (Size 76 KB)
DID - Systems Requirements Specification (SRS)	PDF (Size 192 KB)
DID - Software Requirement Specification (SRS)	PDF (Size 184 KB)
DID - Interface Requirements Specification (IRS)	PDF (Size 132 KB)
DID - Verification Requirements Specification (VRS)	PDF (Size 120 KB)
DID - Operational Concept Description (OCD)	PDF (Size 208 KB)
DID - System/Subsystem Design Description (SSDD)	PDF (Size 156 KB)
DID - Concept of Operations (CONOPS)	PDF (Size 100 KB)
DID - Interface Design Description (IDD)	PDF (Size 228 KB)
DID - Systems Engineering Plan	PDF (Size 256 KB)
Application Guidance for ISO/IEC 15288: 2008, "Systems and software engineering - System Life Cycle Processes"	PDF (Size 192 KB)

Robert Halligan's INCOSE SA Talk in May

PPI Managing Director Mr. Robert Halligan will speak in Pretoria, South Africa, 10 May 2012, on "The Business Case for Systems Engineering". The event is conducted by INCOSE-South Africa. In this presentation and discussion, Robert will make the business case for systems engineering as a tool for reduced costs, shorter timescales and increased product value delivery, embracing the results of a number of recent, soundly-conducted studies on the subject.

Informaton about the INCOSE South Africa Chapter can be found here: http://www.incose.org.za/

PPI Events (see www.ppi-int.com)

Systems Engineering Public 5-Day Courses

Upcoming Locations Include:

• London, UK
• Stellenbosch, South Africa
• Las Vegas, USA
• São José dos Campos, Brazil

Requirements Analysis and Specification Writing Public Courses

Upcoming Locations Include:

• Brisbane, Australia
• Melbourne, Australia

• Amsterdam, The Netherlands
• Adelaide, Australia

Software Engineering Public 5-Day Courses

Upcoming Locations Include:

• Sydney, Australia
• Pretoria, South Africa
• Amsterdam, The Netherlands

OCD/CONOPS Public Courses

Upcoming Locations Include:

• Pretoria, South Africa
• Las Vegas, USA
• Brasilia, Brazil

Cognitive Systems Engineering Courses

Upcoming Locations Include:

• Adelaide, Australia
• Las Vegas, USA

CSEP Preparation Course (Presented by PPI subsidiary Certification Training International)

Upcoming locations include:

• San Diego, USA
• Washington, USA
• Amsterdam, The Netherlands
• San Jose, USA
• Las Vegas, USA

PPI Upcoming Participation in Professional Conferences

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

• The 10th Annual Conference on Systems Engineering Research (CSER 2012) | Participating | Rolla, MA, USA (19 - 22 March 2012)
• WASET 2012 | Participating | Madrid, Spain (28 - 29 March 2012)
• INCOSE LA Mini-Conference | Las Angeles, CA, USA (31 March)
• Australian EW, IO & Cyber Convention 2012 | Participating | Brisbane, Australia (15 – 17 April 2012)
• ST&T 2012 | Participating | Charleston, SC, USA (17 – 18 April 2012)
• SETE/APCOSE 2012 | Exhibiting | Brisbane (30 April – 2 May 2012)
• 12th International Design Conference 2012 | Participating | Croatia (21 – 24 May 2012)
• ICOMS Asset Management Conference | Participating | Hobart, Australia (4 – 8 June 2012)
• INCOSE IS 2012 | Exhibiting | Rome, Italy (9 - 12 July, 2012)
• Land Warfare Conference 2012 | Exhibiting | Melbourne, Australia (22 - 26 October, 2012)

Kind regards from the SyEN team:
Robert Halligan, Managing Editor, email: rhalligan@ppi-int.com
Ralph Young, Editor, email: ryoung@ppi-int.com
Stephanie Halligan, Production, email: shalligan@ppi-int.com

Project Performance International
2 Parkgate Drive, Ringwood, Vic 3134 Australia
Tel: +61 3 9876 7345
Fax: +61 3 9876 2664
Tel Brasil: +55 11 3230 8256
Tel UK: +44 20 3286 1995
Tel USA: +1 888 772 5174
Web: www.ppi-int.com
Email: contact@ppi-int.com

Tell us what you think of SyEN: email to contact@ppi-int.com

If you do not wish to receive a copy monthly of SyEN in future, please reply to this e-mail with "Remove" in the subject line. All removals are acknowledged; you may wish to contact PPI if acknowledgement is not received within 7 days.