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SYSTEMS ENGINEERING NEWSLETTER

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A Quotation to Open On

"No methodology will ever replace bright, dedicated people."

-Brad Parkinson (the father of Global Positioning Systems)

Feature Article

Call to Action: A Vision for Systems Engineering

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*"Engineering can provide a life of genuine satisfaction
in many ways, especially through ministering in a
practical manner to the needs and welfare of mankind."*
Vannevar Bush

Keywords: Systems engineering; project; project success rates; continuous improvement; vision; certification; ROI; earned value; requirements tools; technology; agile; evolutionary development; leadership; empowerment; opportunities for improvement; commitment; effective practices; real requirements; human interaction; communication; rework; defect prevention; partnering; project manager's mindset; emotional intelligence; project success; professional organizations; business analysis; complexity; licensing; call to action; root causes of limited improvement; enlightened workforce management; expectations; teamwork; culture; role of senior management; honesty; openness; human elements; negative information; leaders.

Abstract

A decade ago, I wrote an article that provided my vision for requirements engineering.[1] Over the past ten years, some things have improved - for example, there are new professional organizations that are looking at the issues from a broader perspective; certifications are being offered and earned; research is being done concerning the return on investment of systems engineering; there have been improvements in the availability of useful and effective automated tools; and there have been other technology advances. These initiatives can improve the understanding of what needs to be done. Systems engineers have been working hard to grow and improve the field. Yet, clearly there are ample opportunities for further progress.[2]

Introduction

My vision for the goals for a contributing requirements engineering field in July 2001 was: 1) satisfied customers, 2) systems and software engineers who are fulfilled by their work, 3) trained and experienced requirements analysts, 4) projects completed on schedule and within budget, and 5) less than 15% rework and less than 10% wasted resources on development projects.

The key points of the article included a set of opportunities for requirements engineers and analysts to improve project success rates; suggestions concerning how requirements engineers can help project managers, customers, and developers; the observations that striving for excellence should be our standard for daily living and that we needed to do things differently; and a challenge to readers to make ever stronger efforts to address requirements-related problems.

Systems engineering (SE) 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. SE concerns how to parcel out a huge task into smaller doable pieces so that when they are integrated, they work effectively and a customer and user group find value as a result.

I believe requirements engineering is critical because the requirements provide the basis for all of the other work that is performed on a project. One could argue that if the requirements work is not performed well, there is little chance that a project will be successful. Moreover, we know that the requirements will change while the system is being developed; therefore, we require a methodology that will accommodate requirements changes and new requirements.

Among my goals for this article, the most important is to motivate you to take additional actions to further strengthen and improve the practice of systems engineering.[3] My hope is that this article will stimulate some ideas and that you will be motivated to take action on them.

The Data

One of my mentors emphasizes "Manage by fact". In other words, get data and use it to guide decision-making. If we look at current data concerning the components of my vision, they are not very encouraging:

Trained and experienced requirements analysts: Total number of CSEPs[4]: 802 (as of November 2011)[5]; 25% of the members of IIBA have been business analysts for more than 10 years; 31% have a Masters Degree; 18% have vendor certifications; 10% CBAPs; 10% PMPs; 80% still using MS desktop tools to manage requirements[6].

Projects completed on schedule and within budget: A 1998 Standish Group Report indicated that 26% of projects were successful, 46% were challenged, and 28% failed[7]. Today, for information technology (IT), 37% of projects are successful, and we don't measure business benefit/value/project return on investment (ROI).[8]

Less than 15% rework and less than 10% wasted resources on development projects: Worldwide, we are losing over USD 500 billion per month on IT failure and the problem is getting worse.[9]

Note: Data concerning components 1 and 2 of my vision are beyond the scope of this article. However, my view is that things probably haven't changed much.

Perhaps underlying the fact that not much has changed is that we have approached change as if the program or project manager or program management office can achieve the needed change without a systems approach involving the entire organization. Current project environments are large, complex adaptive systems – it is very difficult to make a difference in a very interconnected and complex (even competing) landscape.

"PMs (as well as other professionals addressed in this article) are ultimately constrained by obsolete management expectations and politics and are not incentivized or encouraged to embrace and model evolving practices. In fact, I would be so bold as to say they are penalized. Another key factor is that the consumers of the work products are not being trained and expected to evolve their ability to consume. Corporate culture allows adoption resistance to prevail and the other excuse is that "we don't have time to do it right".[10]

Additional Insights

Capers Jones has devoted his professional career to the assessment and improvement of quality. Capers pointed out in 1977 that up to a point, the projects that achieve the lowest defect rates also achieve the shortest schedules, and that most projects can shorten their schedules by focusing on fixing defects earlier.[11] His view is that systems engineering needs added discipline.[12]/

Professional development in the form of certification programs has increased significantly (Table 1). The data reflect intensive efforts by several international systems engineering-related professional organizations to work toward improving systems engineering and business analysis in practice by providing certification programs. The International Council on Systems Engineering (INCOSE) among other professional associations including the Project Management Institute (PMI), International Institute of Business Analysts (IIBA), and The International Requirements Engineering Board (IREB) have initiated and supported certification programs over the past decade (Certified Systems Engineering Professional [CSEP]), Project Management Professional [PMP]), Certified Business Analysis Professional [CBAP] and Certification of Competency in Business Analysis (CCBA)[13], and Certified Professional Requirements Engineer [CPRE]) respectively. This is encouraging. We have witnessed the development and publication of INCOSE's *Systems Engineering Handbook* (SEH), PMI's *Project Management Book of Knowledge* (PMBOK), and IIBA's *Business Analysis Body of Knowledge* (BABOK) and an agile extension to it.[14]

Professional Organization	Professional Publication	Number of Members	Certifications Offered	Number of Members Certified	Percentage of Members Certified
IEEE (1)*	Many	400,000 as of 11/12/11	CBP, CSDA, CSDP, WCDT	970 CSDPs 300 CSDAs	n/a
INCOSE (2)	SE Handbook and others	8,284 as of 11/11/11	ACEP, CSEP, CSEP, ACQ, ESEP	802 CSEPs as of 11/11/11	9.7
PMI (3)	PMBOK and others	368,349	CAPM, PMP, PgMP, PMI-ACP, PMI_RMP, PMI-SP	464,168	10
IIBA (4)	BABOK and others	22,000	CBAP, CCBA	1,502	6.8
IREB (5)	*Requirements Engineering*	12 personal members 36 supporting members	CPRE	6,516 (Foundation Level) as of Q3 2011	90% of Board Members

*Notes:

(1) The Institute of Electrical and Electronics Engineers (IEEE) is the world's largest organization for the advancement of technology. IEEE offers four certification programs: Certified Biometrics Professional (CBP), Certified Software Development Associate (CSDA), Certified Software Development Professional, and Wireless Communication Development Technologies (WCDT). Contact Information: www.ieee.org/index.html, 202-785-0017.

(2) The International Council on Systems Engineering (INCOSE) is dedicated to the advancement of systems engineering and to raising the professional stature of systems engineers. INCOSE offers four certification programs: Associate SE Professional (ASEP), Certified SE Professional (CSEP), CSEP Acquisition, and Expert SE Professional. Contact Information: www.incose.org, 858-541-1725.

(3) The Project Management Institute (PMI) offers six certification programs: Certified Associate in Project Management (CAPM), Project Management Professional (PMP), Program Management Professional (PgMP), PMI Agile Certified Practitioner (PMI-ACP), PMI Risk Management Professional (PMI-RMP), and PMI Scheduling Professional (PMI-SP). The 2010 Pulse of the Profession study found that organizations with more than 35% PMP certified project managers had better project performance. Contact Information: www.pmi.org, 855-746-4849.

(4) The International Institute of Business Analysts (IIBA) offers two certification programs, Certified Business

Analyst Professional (CBAP) and Certification of Competency in Business Analysis (CCBA). Contact Information: www.iiba.org, 866-789-4422.

(5) The International Requirements Engineering Board (IREB) provides a Certified Professional Requirements Engineer (CPRE) certification program intended to improve requirements engineering and business analysis in practice. Contact information: www.certified-re.de/en/home.html. The IREB members are internationally known and respected experts from countries and active supporters of requirements engineering from business, industry, research and education. The certification model "Certified Professional for Requirements Engineering" (CPRE) consists of three levels, Foundation (FL), Advanced (AL), and Expert (EL). The AL and EL certifications are currently being developed. The Advanced Level modules are planned to be available in English in the second half of 2012. A Study Guide for the CPRE Certification is available at http://www.rockynook.com/book/210/requirements-engineering-fundamentals.html.

Table 1: International Requirements-related Professional Organizations as of November 2011

INCOSE's Systems Engineering Effectiveness Working Group (SEEWG) under the leadership of Joe Elm is performing insightful and useful research concerning the return on investment (ROI) from applying systems engineering on projects.[15] The results of this research have shown that projects that apply systems engineering best practices effectively are 40% more likely to succeed than projects that do not. Eric Honour has progressed with similar research over a period of 12 years. In prior work, his SE ROI Project reported that effective SE at a level of approximately 16% of a project's cost optimizes cost, schedule, and stakeholder success measures.[16] In current work, Honour identifies the optimum level of SE total and for each of eight SE activities, including mission/purpose definition, requirements engineering, system architecting, system integration, verification/validation, technical analysis, scope management, and technical management/leadership.

Performance Based Earned Value[17] (PBEV) was published in 2007. It was written to advocate a change in industry practice concerning Earned Value Management (EVM), specifically, basing earned value on the successful completion of quality work products rather than on the amount of effort that has been performed. Paul Solomon has continued to advocate strongly for the needed change.[18] Unfortunately, Eleanor Haupt's[19] hope that was expressed in the Foreword of PBEV has not been fulfilled - that "Solomon and Young propose a new approach (to EVM) that relies on system engineering standards and maturity models that enhances the value of EVM through more objective assessment of true work performance and product quality…they have not only advanced the practice of EVM; they have achieved what many have only dreamed of: proving the worth of EVM to the technical community". As a result, millions of dollars continue to be wasted due to deployment and use of ineffective EVM techniques.[20] What is required to address effectively the obviously needed change for which a proven solution has been provided? More generally, why is it that improved practices, information, and tools are not used? Why aren't more effective techniques embraced by practitioners quickly, easily, and enthusiastically? This suggests that an enterprise-wide transformation initiative is required.

Perhaps we are using the wrong mental model for how systems are built. People often refer to it as the "development" process. Perhaps that is too simplistic, and in reality, most of the time it is a "discovery" process instead. "Development" implies that we basically know how everything works, and how to put it together, and it is primarily a problem of assembling the parts, like the construction of a building. "Discovery" implies that there are things that we will uncover as we move forward on the project, and which we could not plan for at the beginning. In fact, the whole "life-cycle" model is based on the traditional model of building a building, which is a development process, not a discovery process. [21]

A key difference is that software engineering, in our current state, is still primarily different from that of building construction has to do with testing. Software has to be tested, extensively, to ensure it works right. In building construction, there is little testing. In other words, when they are constructing a building, they don't have to take each I-beam out and test it to make sure it is strong enough. All of that proofing that the component will work has been done through a very sophisticated set of standards, rules, regulation, and culture. The structural engineer merely does the analysis to determine what maximum loads could be imposed on the structure; then he goes into a table and looks up the I-beam that meets those loads and specifies it to the people doing the construction. He does not need to take the I-beam out and load it with a bunch of sand-bags to prove that it will work, before he can install it in the building. But that is what we have to do every day with software.[22]

Improvements in Automated Requirements Tools

There has been significant improvement in the availability of automated requirements tools over the past decade. A recent issue of *The Systems Engineering Newsletter* (SyEN) published by Project Performance International (PPI) provides a comprehensive list of requirements tools.[23] Ian Alexander provides descriptive information concerning requirements tools on his website.[24] However, in my opinion, leadership, commitment (not just financial), training, and experience in applying automated tools effectively are required to make good use of any tool. There is some evidence that 'heavy' automated tools can make things worse when there isn't a suitable culture in place.[25]

Technology

Among the technology improvements we have witnessed in the past decade are vastly improved collaboration capabilities,

capability to generate, store and use data at lowered costs, development of ubiquitous networks and internal access, mobility (laptops, cell phones, tablets), security (remote network access), and consumerization (personal iphones that enable integration with work lives).[26] Simply put, technology advances should have helped improve the delivery of successful projects – yet we still have an unacceptable number of failed projects a decade later. We still lack the ability in many situations to deploy highly functioning development teams and to deliver the desired results (implement the real requirements, on time, within budget, and in doing so, add value).

From Agile to Evolutionary Development

The Agile Revolution has taken hold worldwide. It has had an impact on expectations, by giving the impression that we can do anything. Or, the other way round, one could assert that our need for instant success has resulted in the agile movement. A long-term result of the agile approach may be a major impact on human factors. For example, over the long term, there may be a loss of knowledge. It seems there is likely to be a convergence over the next five to seven years in the preferred development approach – we may find that agile development is not a panacea. Considering alternative development approaches, it seems likely that evolutionary development (EVO) as advocated by Tom Gilb[27] offers advantage to both customers and developers because the methodology supports discovery, identification, and implementation of the real requirements for a desired capability. Further, it helps us deal with complexity. Although EVO was first described in print in 1988, it is among other rarely used innovations, including risk management planning, JAD sessions, design for change, incremental integration, inspections, and continuous improvement. Most of these innovations have been around for 25 years or more. Why aren't they being used more extensively? We are confronting a problem of slow diffusion of innovation and best practices to the field (everyday practice). We are on the brink of significant improvement, but we aren't there yet.[28]

Leadership

I and others have identified the need for better leadership both as a root cause of the limited improvement we have experienced and as a critical component of the solution. What is meant by "better leadership"? A leaderly executive will take time to figure out where she or he can weigh in and help. She will identify and apply a set of key principles that enable her to craft and communicate a vision, support staff, delegate, motivate, recognize and acknowledge effort, and hold people accountable for desired results. These principles need to address evolving the real requirements for the project, team building and teamwork, empowerment, process improvement, time to delivery, a development approach that engages customers, a development plan for each member of the staff, and proactive steps to constantly improve communications. The program or project manager (PM) must be given the opportunity and responsibility to manage. She should not be expected to also perform marketing, product development, recruiting, and organizational committee tasks, among many other tasks that PMs are often assigned. We often expect more of organizations; however, organizations are powerless without individual leaders.

Empowerment

During my career, I have had the opportunity to participate in and lead empowered teams. My experience is that an empowered team can accomplish anything it sets out to do. In one instance, it was considered impossible to achieve an objective, but the Team underwent an organizational effectiveness[29] process and found that it was able to achieve the objective through effective leadership, commitment, and strong teamwork. One framework that has worked very well in my experience is "partnering".[30] Through use of this technique, we were able to overcome barriers at an important U.S. Federal Government department and to achieve major successes. When project partnering (or "Enterprise Partnering") is not used, "business as usual" continues. The disappointing thing is that project management curriculums in universities and at PMI have not made partnering a distinct part of learning. They must be assuming it is merely good project management so there is no need to do so. Newsflash: if it is not part of the standard lexicon, it will never survive except through a few dedicated and enlightened individuals.

Possible Opportunities for Stronger Improvement

For us to achieve significant changes, an enterprise-wide transformation initiative is required that takes into account the following areas:

1. **Increased Expectations** – of customers, providers, managers, and ourselves. Simply put, the bar is not sufficiently high. Expectations have much to do with results.[31] We need to work smarter to create cultures of excellence.[32]
2. **Stronger Leadership, Increased Responsibility and Accountability, and Greater Motivation** – see Execution: The Discipline of Getting Things Done for help in establishing a set of key leadership principles.[33] Neal Whitten's summary of leadership advice from those who said it best also provides insights into aspects of this root cause.[34] Whitten's "10 Best Practices to Promote the Advancement of Project Management in Your Organization" provides specific suggestions for how to do better.[35] Specifically concerning systems engineering, the ten "Opportunities for Requirements Engineers to Improve Project Success Rates" I provided in the article are still relevant. As I noted then, it is management's job to provide a motivating work environment in which people can be effective and grow. I describe practical application of many of these aspects and provide an extensive set of references in Effective Requirements Practices.

3. **Stronger and More Effective Teamwork.** I devote a lot of emphasis to this in *How to Save a Failing Project.*[36] As noted previously, if you have experienced the blessing of leading or being a member of an "empowered team" (as contrasted with a dysfunctional team), you know the huge difference this makes. We need to embrace more modern approaches to project team leadership and leveraging entire team competency, for example, allowing the lead requirements/business analyst to serve as a partner of the project manager (and that not be interpreted as the PM being insufficient).

4. **Strengthened commitment of individuals, projects, and organizations to continuous improvement.** We should all aspire and work smarter to become ever better. An example that comes to mind is the general failure to utilize and leverage so-called "lessons learned" – in my experience, lessons are often observed but rarely learned and acted upon.[37]

5. **Stronger senior management commitment.** It has been my experience over 46 years of professional activities that it is difficult to accomplish significant efforts on projects and in organizations without senior management commitment. If one can't gain senior management sponsorship for a significant effort, the probability of successful completion of the effort is limited significantly. Sarah Sheard's article explains what senior management commitment is and also how to achieve it.[38]

6. **Increased Use of Effective Practices, Information, and Tools that are available.** It's not that we don't know or can't find out what to do; it's that we don't do it. It's been my observation over many years that many PMs do not read extensively nor do they take the time and effort to understand, learn, and apply methods, techniques, processes, and tools. In my experience, it is not sufficient for a PM to depend upon staff to provide the leadership to take good advantage of these capabilities. The PM's understanding, leadership, and commitment are prerequisite to effecting positive change.[39]

7. **Investment of additional time and effort up front to evolve the real requirements.**[40] The responsibility here is with customers and managers who are obsessed with getting on with "the real work" (for software systems, coding). Contractors are also responsible to provide informed, honest advice. Individuals are responsible to advocate for improvements. Requirements people need to prevail upon PMs to explain to our customers the value of taking the time and effort to evolve the real requirements before initiating other technical work. Ample evidence is available to make this case.

8. **Increased honesty and openness in human interaction, and better communication management.**[41] Steve Gaffney has devoted his professional career to developing and providing practical ways to address this. He provides seminars that make a difference on projects and in organizations.[42]

9. **Reduced rework.** Industry data indicate that the average amount of rework performed on the typical project is 45-50% of total effort and that this metric has not changed over the past decade.[43] This is an area where the PM and other leaders can foster an environment to chip away at this waste. What approaches might you provide to address this on your project or in your organization?[44] A lucrative place to initiate improvement is at project startup.[45]

10. **Training and implementation of a simple defect prevention initiative/process.** Utilize the extensive knowledge of your devoted project staff by sponsoring a brainstorming session to identify major causes of problems. Multi-vote to determine the groups' sense of their relative importance, impact, and capability to address them. Then brainstorm the group's suggestions for how to address the high priority causes of problems. Your staff has an enormous capability to help you, if only you let them. Undertaking this process can be an effective team building exercise, in addition to enabling removal of defects earlier.[46]

11. **Inculcate partnering into university and PMI Curricula and make them standalone topics of learning.** Without doing this, these techniques will take a backseat and never become mainstream.

12. **Transition of program and project managers' mindset from manager to leader.** PMs need to transition into the role of a leader by strengthening skills such as visioning, relationship building, influencing, negotiating, creative thinking, innovating, communications management, empowering, building teamwork, acknowledging effort, teaching defect removal techniques, mentoring project performers, employing systems engineering effectively, and setting the tone (and the requirement for) excellence.[47]

Needed: A Broader Scope for Requirements Engineering

When I attended the Project World Conference in Orlando, Florida USA in 2006, I became acquainted with another large group that is also working toward improving and utilizing requirements: the Business Analyst Community that has emerged since 2003. The mission of the previously mentioned International Institute of Business Analysis (IIBA) is to develop and maintain standards for the practice of business analysis and for the certification of its practitioners. The IIBA vision is to be the leading worldwide professional association for business analysts. Being an invited speaker, I inquired of my audience of approximately 200 how many would consider themselves aligned with the area of requirements engineering – after explaining what requirements engineering is and what requirements analysts, requirements engineers, and requirements managers do, almost all agreed that the two areas seem very aligned.

Another of our colleagues, Neal Whitten, has been an advocate of project management best practices for many years. In 1998, Neal wrote an article, "Meet Minimum Requirements: Anything More is Too Much".[48] Neal is associated with PMI. As we know, the goals of effective project management are very similar to the objectives of systems engineering: complete the project successfully, on time, within budget, and add value. Neal maintains a sharp focus on the role of leadership in enabling

successful accomplishment of significant efforts.[49] See his website for additional insights and resources (www.nealwhittengroup.com).

Kathleen Hass, a member of the IIBA Board of Directors, has a consulting business that specializes in business analysis and complex project management.[50] She and other experts have made the case that it is the gap in business analysis and complexity management capabilities and competencies that is the root cause of the inability to deliver successful business solutions.[51] She provides a set of building blocks that she feels will enable us to proceed down the "daunting road ahead" and a BA Practice Maturity Model that she feels provides a framework to move forward more effectively. She advocates forming Business Analysis Centers of Excellence (BACOE) to guide the needed improvement efforts. Hass feels that the BA/Requirements Engineer role will change dramatically once we have wide adoption of tools to manage the fidelity of requirements and keep all requirements artifacts in sync and up to date. "I suspect that BAs spend about 50-80% of their time documenting, managing changes to artifacts, and tracing requirements. Once the tool does that for them, their role will be much more of a change agent, creative leader, innovator, team leader, and influencer."[52] I am not as confident as is Kitty concerning this happening anytime soon. Hass also points out that IT projects are complex, and we don't know how to diagnose, manage, and capitalize on complexity. "Complexity breeds creativity if we know how to leverage it." Hass has developed a Project Complexity Model to diagnose the size, complexity, and risk of a particular project.[53]

Leveraging Others' Efforts

Given that we have many disparate professional organizations and groups advocating and working toward improvement, one of the challenges is the risk of these groups becoming increasingly fragmented. We need to ensure that this doesn't result in more distinct rival blocks – in other words, the organizations and the individuals in them need to "reach out" to others rather than focus inwardly and compete with one another. Related, from my own writing experience, through contacts with many other authors in several countries, I have observed a need for added inclusion and collaboration across geographical areas - we need to be even more collegial in overcoming the islands of the U.S., Europe, Australia, China, Japan, and on, sharing with and learning from one another.

Toward a Profession of Systems Engineering

In 1999, Steve McConnell, a leader in defining software engineering's best practices, authored a book, *After The Gold Rush: Creating a True Profession of Software Engineering* (*ATGR*). My note to myself after reading it in March of 2000 was: "A great book. One of the very best in software engineering." Steve's comment that "the practices needed to create good software are well established and readily available, but there is a chasm between the average practice and the best"[54] applies to systems engineering as well. The theme of Steve's book is how to change. Close to my heart, Steve notes that the most frequent causes of software project failure have to do with requirements problems, which as he notes, were prevalent as early as 1969. Another pearl is that "new tools are useful, but not a substitute for clear thinking." A conclusion is that "despair arises from the fact that some problems have been with us for a quarter century or more and are still common!" We need to address these problems and move forward.

Steve informed me that between publication of *ATGR* in 1999 and *Professional Software Development* in 2004, he came to a better understanding of how licensing will be needed - he now believes that only a tiny percentage of software engineers will need to be licensed, and that several of the of the things he suggested in ATGR apply only to those practitioners who need to be licensed.[55]

Below are the things McConnell suggested in *ATGR* that we can do to achieve a more mature profession of software engineering that apply equally well to systems engineering:
- Implement a mandatory code of ethics/standard of professional conduct, and meaningful enforcement authority
- Have a requirement for initial professional education
- Accreditation
- Skills development
- Raise the average level of practice
- Increase expectations, for example, adopt a code of ethics that imposes higher standards than those normally tolerated in the market place
- Emphasize social responsibility and duty to behave as members of a disciplined and honorable profession
- Require a prerequisite of a license prior to admission to practice, e.g., professional engineer
- Ongoing professional development
- Participation in professional societies
- Organizational certification/independent external evaluation of practices
- Individual certification
- Continuing education
- Thoroughly diffusing best practices into industry

- Management commitment to continuous improvement.

Adapting Steve's generalization concerning software developers, we can observe that systems engineers obtain our occupational education from the school of hard knocks; experience can be a good teacher, but it is also slow and expensive. In summary, we are in a position to transform average practice into best practice.

Call to Action

As Neal Whitten so aptly observes, "If you want to make things happen, do not rely on others to lead the way. Leadership is not only about the ability of those around you to lead, it's also about your ability to lead despite that which is happening around you." Organizations need leaders who speak for and insist on improvement.

The concerns and suggestions to deal with them that I discussed in my July 2001 article are as valid today as then in order to continue the progress that has been made. Talented and experienced practitioners, academicians, researchers, contractors, customers, developers, vendors, and authors have offered advice concerning how things can be done better. It seems clear that in order to make progress more quickly, individuals and groups need to address the root causes of limited improvement over the past decade that have been identified in this article. During my career, I have experienced highs and lows in the effectiveness and success of the projects in which I have been involved or led. The highly successful efforts were characterized by strong leadership and the other aspects that I have discussed in this article. If we are to achieve higher rates of improvement, we need to act more deliberately in the areas identified. Also, we need enlightened workforce management practices - there is a lot of talk about empowerment and personal initiative, but in reality, this is very much a function of enterprise maturity.

Conclusion

In this article, I have taken a broader perspective concerning my vision for systems engineering than I did ten years ago. I have proposed opportunities to achieve stronger improvement. Much more significant improvement can be achieved by raising expectations, stronger and more understanding leaders who are able to lead and facilitate the work of others, stronger and more effective teamwork, establishing a culture of continuous improvement, strengthened senior management sponsorship, increased use of effective practices, information, and tools that are available, investment of time and effort to evolve the real requirements before other technical work is initiated, added honesty and openness, communications management, reduced rework, strengthened commitment, bolder actions, deployment and use of a simple defect prevention process, project managers taking the time and effort to learn and apply practices, information, and tools that are available, inculcating requirements engineering and partnering into university and PMI curricula and making them standalone topics of learning, and transition of program and project managers' mindset from manager to leader.

Perhaps our efforts to improve systems engineering have not paid enough attention to the human elements that cause projects to fail, for example the management support issues noted above. However, it seems that the problem goes deeper and we need to identify more clearly what causes our best intentions to go astray. The field of behavioral economics may provide insights that will help.[56]

John Moore has observed that people deal differently with negative information (mistakes, defects, and errors) than they deal with positive information (successes, accomplishments, and achievements). Since systems engineering is still primarily a "discovery" process, there will be lots of opportunities for the organization to have to deal with negative information. Perhaps our "development" oriented processes don't take fully into account this human dynamic – we sometimes try to impose a success and goal-oriented model on a process that will, by nature, involve the uncovering of many problems, mistakes, errors, and misunderstandings. If the organization and its processes cannot deal positively with this negative information, then there is great potential for dysfunction and failure. This is an area that requires more exploration.

Are you ready? In other words, are you willing to rededicate yourself to taking added actions toward the identified opportunities to achieve stronger improvement? For it is only if we individuals ("leaders" [all of us] in Whitten's context) take actions that the rate of progress will increase. The references provided in this article offer a wealth of ideas, suggestions, recommendations, and advice concerning actions that will help executives, project managers, systems engineers, and business analysts. One can strengthen continuous improvement by making good use of any of them.

Acknowledgements

Among those who have contributed to this article and stimulated my thinking are Ian Alexander, Anne Hartley, Kitty Hass, Capers Jones, Charles Markert, Joe Matney, Steve McConnell, John Moore, Asif Sharif, and Neal Whitten.

References:

1. The article is available at http://www.resg.org.uk/images/6/65/RQ24.pdf, pp. 3-6.
2. In this article, I make generalizations. Also, I suggest that people need to act differently; however, it is not my intent to imply that professionals in the systems engineering field are less capable than those in other fields. In addition, I have

not provided suggested solutions in all cases (although the information in the provided references should be helpful). I do not pretend to have all of the answers. My intent is to reflect thoughtfully on what I have learned with the hope that some of the ideas will be helpful for others to explore and apply, resulting in improvement in the practice of systems engineering.

3. A new organization, the Americas Requirements Engineering Association (AREA), is dedicated to this goal. See www.a-re-a.org. Tom Love shares his article, "Sorting Out the Terms" there – the article provides useful insights concerning agile, requirements, collaborative, and lessons learned.
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11. Applied Software Measurement: Assuring Productivity and Quality, 2nd ed., 1977. 80% of all product defects are inserted in the requirements definition activities as documented in Effective Requirements Practices, p.79.
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14. IIBA's draft for public review of its Agile Extension to the BABOK Guide, November 2011 is available at www.iiba.org.
15. See INCOSE's Systems Engineering Effectiveness Working Group (SEEWG) website, http://www.incose.org/practice/techactivities/wg/seewg/. Mr. Elm is performing this research in coordination with the National Defense Industrial Association (NDIA), the IEEE Aerospace and Electronic Systems Society, and Carnegie Mellon University (CMU).
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27. See www.gilb.com/Blog.
28. Steve McConnell, After The Gold Rush, pp. 144-147. See also Everett M. Rogers' Diffusion of Innovation and Geoffrey Moore, Crossing the Chasm.
29. See http://swat.gis.ksu.edu/documents/org_effectiveness.pdf for a thorough discussion of this powerful technique and references.
30. See www.facilitationcenter.com/ to learn more about facilitated partnering. Contact Charles Markert (Charlie@FacilitationCenter.com) to discuss using this powerful technique.
31. See Roger Connors and Tom Smith, How Did That Happen: Holding People Accountable for Results the Positive Principled Way for powerful insights. The Penguin Group, 2009.
32. Actually, Steve McConnell provided an insightful description of a recommended pathway forward twelve years ago. See After The Gold Rush: Creating a True Profession of Software Engineering, Microsoft Press, 1999. The second edition of this book has a different title, Professional Software Development: Shorter Schedules, Better Projects, Superior Products, Enhanced Careers; Addison-Wesley, 2004. See also www.stevemcconnell.com/.
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Additional Article

Cynefin and Systems Thinking – Center for Learning & Organizational Change

Review by Jack Vinson

Bill Dettmer, author of a number of great TOC books, including *The Logical Thinking Processes* (review here), has brought together his long view on systems thinking in general with Dave Snowden's Cynefin Framework in a new article, Systems Thinking and the Cynefin Framework: A Strategic Approach to Managing Complex Systems (pdf, local copy – it will be posted to Dettmer's website in a few weeks). From the abstract:

Systems and their external environments can be classified as simple, complicated, complex, and chaotic. This taxonomy is known as the Cynefin Framework. It provides an orderly way to evaluate the interaction of organizational systems, their external environments, and the myriad of management methods and tools available to decision makers. A significant number of organizations today qualify as complex. Their environment may change in short but irregular, unpredictable cycles, requiring the organization to adapt internally accordingly to avoid degradation. But the majority of available management methods and tools have been designed to succeed in simple and complicated domains, not complex. The failure to identify and understand the underlying assumptions about these methods made this limitation inevitable. That is about to change.

And the reason this "is about to change" is that the Cynefin Framework provides a better way of thinking about our situations and the assumptions behind various management methodologies.

The first half of the paper provides a lot of background, both for management thinking & tools in general and then on the Cynefin Framework specifically. Dettmer talks about management tools in their evolution and some of the assumptions that underlie them: like the assumption of analytical thinkers that the whole can be understood by understanding all the parts. This overview and that of the Cynefin Framework were very familiar to me. I've been listening and reading Snowden for many years, but it was good to read Cynefin from a slightly different perspective that Dettmer brings to it.

The interesting-to-me material resides in the second half of the article: thinking about the implications of Cynefin for management thinkers and people who deploy management tools. The short version is something Dettmer highlights as he summarizes Cynefin:

Consequently, the tools and methods that work well in the simple and complicated domains tend to be less effective (or

completely ineffective) in the complex and chaotic domains.

Cynefin gives us a way to look at the world and ask questions. Where does my current situation fall in the framework? Be careful not to categorize here, as the lines between the various elements of the framework are blurry, and it is easy to shift from one region to another – sometimes without noticing. What would it take to shift the current situation into another region? What would make it become more chaotic? What might push the situation to something in the complicated or simple regime? Would that be a good thing?

And not only can you look at the current situation with these questions, but the common responses can be considered in this light too. Does approach XYZ work best in a simple domain? Then don't try to use it when your situation is complex or chaotic. For example, process mapping with the intention of taking action against that process (for improvement) only make sense when the process is relatively stable and understandable.

Dettmer picks up a number of management tools and looks at them in a Cynefin light. He takes up the Logical Thinking Processes from TOC, Boyd's OODA (observe, orient, decide, act) Loop, Brainstorming, and then some of the tactical approaches as a group. He also tries to show how each of these approaches covers slightly different ground from the Cynefin perspective. Of course they do. It's important to remember this – and to see this as it applies to your own situation.

People have been thinking along these lines – using Cynefin to help think about their interventions – for some time. It came up in the Kanban training I attended last month, where we were encouraged to think about how the Kanban methodology fits into environments where it is being deployed. Kanban is a simple-seeming idea, but the concept helps organizations sense and respond in a way that fits more into complex environments. And I have seen people taking up the Cynefin call in a variety of perspectives. I even see on the main Cognitive Edge website that guest blogger Bob Williams has been thinking in a similar direction, such as in Sensemaker, Evaluation and the Logic of Interventions. Dave Snowden has been saying some of these things too, but it is always good to have other people interpret and re-interpret the ideas into slightly different contexts. It helps to strike more nerves – hopefully the right way.

Review by Jack Vinson.
Sourced from: Knowledge Jolt with Jack

Systems Engineering News

INCOSE Announces 2011 Election Results

The International Council on Systems Engineering (INCOSE) has announced the results of recent elections:

President Elect: David Wright
Treasurer: Marsha Weiskopf
Director for Commercial Outreach: Anne O'Neil
Director for IT: Ryan Mortimer

Member Board Representatives for the following Regions:
V (SE USA, Central and South America): David Takacs
VI (AU, Asia, and Middle East excluding Israel/Turkey): Paul Logan

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INCOSE INSIGHT Themes for 2012

The themes and theme editors for the quarterly newsletter INSIGHT, published by the International Council on Systems Engineering (INCOSE), are shown below:

Issue	Submission Date	Theme	**Editor**
1st Qtr 2012	15 Feb 2012	INCOSE Authors	Cecilia Haskins
2nd Qtr 2012	15 May 2012	Systems of the Third Kind: Distinctions, Principles, and Examples	Rick Dove
3rd Qtr 2012	22 July 2012 2012	International Symposium Coverage: Rome, Italy	Abraham Raher
4th Qtr 2012	15 Oct 2012	Health Care	Melissa Masters

Brasil Emerging Chapter of INCOSE Holds its Systems Engineering Week

The INCOSE Brasil Emerging Chapter held its "Systems Engineering Week" at the Laboratory of Integration and Testing (LIT), of the Brazilian Institute for Space Research (INPE), in São José dos Campos, SP, Brasil over 12-16 December, 2011. The program consisted of ten free half-day tutorials on aspects of systems engineering, together with two Emerging Chapter business meetings. The tutorials in order were:

Robert Halligan, PPI, *"An Introduction to Systems Engineering"*
George Sousa, Engeflux, BR, *"Systems Engineering Based Enterprise Transformation"*
Marcelo Lopes, INPE, BR, *"Requirements Engineering"*
Mauricio Aguiar, TI Metricas, BR, *"Practical Software and Systems Measurement – Metrics-based Project Management"*
André Mayoral, BR, *"System Requirements - Fundamentals and Specification"*
Carlos Lahoz, IAE, BR, *"Software Engineering Processes for Space Applications"*
Sergio B. Choze, BR, *"An Enhanced Approach to Systems Engineering: exploiting the synergies with Multidisciplinary Optimization"*
Ricardo Valerdi, University of Arizona, USA, *"Early Systems Costing"*
Gilberto Trivelato, BR, *"Aligning SE and Organizational Management"*
Dan Maticello, MIT (Massachusetts Institute of Technology, USA), *"System Complexity and Real Options"*

Some of these presentations will be available for download. Contact the Managing Editor of SyEN Robert Halligan if assistance is needed.

The event was a great success, with some tutorials unable to accommodate more people, and the objectives of the business meetings regarding chapter formation being well satisfied.

Systems Engineering to Drive Practice-Based Engineering Education in São José dos Campos, Brasil

Moves are said to be afoot to establish a huge, largely new, technology-based university complex at Technology Park in São José dos Campos, Brasil. The Universidade de Itajuba is said to be establishing a campus at the Park, with the intention of offering a systems-engineering based degree in control systems. SyEN understands that the degree would utilize Practice-Based Learning (PBL) as a major teaching strategy. Other universities involved are Faculdade de Tecnologia de São Paulo (FATEC), and Universidade Federal de São Paulo (UNIFESP), which is already at the Park.

More information: Contact SyEN Managing Editor Robert Halligan

Mexico Now on the Systems Engineering Map

On December 1 and 2, 2011 the Autonomous University of the State of Puebla (UPAEP), Mexico, hosted a very successful event to promote systems engineering. The main objective was to gather interest towards the formation of an INCOSE chapter in Mexico. The main organizer was Dr. Jorge Aguilar Cisneros, a Professor in the Information Technology Department and a member of INCOSE. About 60 participants attended the event, which included tutorials and other presentations on both days.

For our readers in Mexico, please contact the Managing Editor, Robert Halligan, if you would like to connect into this initiative.

Europe Invests Over Euro 3M for Research and Development on Model-Based Tools for Embedded Systems in Aerospace and Defense

The Open Group announced on 28 November 2011 that it has partnered with a consortium of leading European real-time technology developers, industrial manufacturers and research organizations to develop a new model-based software development framework for complex real-time systems in Aerospace and Defense.

Systems Experts Gathered in Vienna: Systems thinking – What's it for?

On 17 November 2012 the Bertalanffy Center was host of 20 international systems theorists and practitioners, among them

leading representatives of systems movement organizations like the President of the International Academy for Systems and Cybernetic Sciences (IASCYS), Matjaz Mulej; the representative of the European Union for Systemics (UES/EUS), Pierre Bricage; the Director-General of the World Association of Systems and Cybernetics (WOSC), Raul Espejo; the representative of the recently founded Giordano Bruno GlobalShift University, Alexander Laszlo, to name but a few. They met with the BCSSS board members and other members of the Center to start the discussion on what systems thinking is for in the age of global challenges, which belongs to the Center's core activities. This gathering was the first international meeting the Center could organize. One focus was on how academic contributions to the systems movement can be revisited.

More Information

Systems Engineering Research Center Conference Addresses US Department of Defense Research Challanges

The Systems Engineering Research Center (SERC) – a US Department of Defense research center led by Stevens Institute of Technology in partnership with 20 collaborator universities and not-for-profit organizations – held its third annual SERC Research Review (ASRR 2011) on October 3-5, 2011 at the University of Maryland in College Park. The ASRR 2011 objective was to exchange ideas among government and academic thought leaders regarding some of the most pressing and important research challenges faced by the Department of Defense (DoD), learn about the ongoing research projects the SERC is conducting to address those research challenges, and continue to mature the collaboration among SERC researchers and government.

More Information

2012 NASA Systems Engineering Award Competition
Held in Conjunction with the SAE Aero Design West and Aero Design East Events

The NASA competition provides an opportunity for SAE Aero Design teams to obtain first-hand experience applying NASA's best engineering practices; manage their efforts for best performance, cost, schedule, and risk; and interact with professional NASA engineers. In addition, the winning submission at the West and East competitions will each earn a $750 cash award. The rules for the competition are found at: http://www.aeronautics.nasa.gov/sae_guidelines.htm

The rules call for submission of two reports, both describing the application of systems engineering practices to the development of the teams' entries. The first report describes the team's approach to managing performance, risk, cost, and schedule to meet the SAE Aero Design requirements. The second report, submitted at the flying sites, is the As Built report, which describes the rationale for changes between the initial design and the final vehicle.

More Information

Second International Conference on Complex Systems Design and Management Held in Early December

The Second International Conference on Complex Systems Design and Management (CSDM 2011) was held December 7-9, 2011 at Cite Internationale Universitaire, Paris (France). The CSDM conference is the annual meeting point for the industrial & academic environments working on all dimensions of design and management of complex industrial systems. It addresses societal & industrial challenges and covers the main industrial areas dealing with complex systems and technical & scientific methods used to model & master these types of systems.

More Information

Jacobs Receives DoD Systems Engineering Top 5 Program Award

Sponsored by the U.S. Deputy Assistant Secretary of Defense for Systems Engineering and the Systems Engineering Division of the National Defense Industrial Association, the Top 5 award recognizes excellence in application of Systems Engineering discipline that results in highly successful Department of Defense programs. Winners are selected based on the demonstration of successful implementation of Systems Engineering best practices resulting in program success, as assessed by their performance.

More Information

Featured Society

International Centre for Complex Project Management

The International Center for Complex Project Management (ICCPM) is a not-for-profit organization working to advance knowledge and practice in the management and delivery of complex projects.

In 2005, Australian, UK and US Government bodies and defense industry commenced an initiative aimed at improving the international community's ability to successfully deliver very complex projects and manage complexity across all industry and government sectors. Central to this initiative was the establishment in September 2007 of an international not-for-profit company to provide global leadership to achieve this objective. That company is the International Centre for Complex Project Management (ICCPM), previously known as the College of Complex Project Managers.

Government support has since expanded to include Canada and Singapore and a growing number of global corporate partners including BAE Systems, Lockheed Martin, Booz Allen Hamilton and Thales.

The ICCPM says that there is a strong emerging body of evidence and research indicating that traditional, linear project management tools and techniques, while still necessary, are insufficient to manage the most complex of today's projects through to successful delivery on time and within costs and performance targets. A primary focus of ICCPM is to work with its partners and the international community to fund, facilitate and conduct applied research that advances knowledge and practice in the management of complex projects. The aim is to share these outcomes with its partners across all industry and government sectors, and with the global community.

With support from its corporate partners, ICCPM has already made a significant contribution towards the development and delivery of the world's first Executive Masters in Complex Project Management through the Queensland University of Technology, Australia. ICCPM states it will continue to support the development and delivery of education and training programs, aimed at improving global capability to deliver complex projects and manage complexity. A current offering is a "Systems Thinking and CMP Foundations" course designed to introduce organizational leaders to complex project management and systems thinking. It aim to provide a conceptual bridge, complementing and extending traditional analytical tools of senior organizational members, project portfolio directors and project managers in the field of complex project management.

The ICCPM commenced publication in 2011 of a newsletter that is distributed electronically.

The ICCMP is governed by a board comprising (December, 2011): Chair Chris Jenkins, Managing Director, Thales Australia; Deputy Chair Simon Henley, President, EPI Europrop International GmbH; and Board Members Harry Bradford, Chief Operating Officer, BAE Systems Australia; Tom Burbage, Executive Vice President, Lockheed Martin Aeronautics US; Harry Dunstall, General Manager Commercial, Defense Materiel Organisation, Australian Department of Defense; Kim Gillis, Managing Director; Boeing Defense Australia; and Mary McKinlay, Adjunct Professor of Project Management, ESC Lille France CEO is Mr. Stephen Hayes.

More information

INCOSE Technical Operations

System Safety Integration Working Group
http://www.incose.org/practice/techactivities/wg/safety/

Charter

The System Safety Integration Working Group (SSIWG) Charter is to Integrate established system safety methodologies with System Engineering, thereby reducing residual safety risk of deliverable systems.

Leadership
- Chair: Mark Carlson

Accomplishments / Products
- Wrote and submitted the System Safety Chapter for the Systems Engineering Handbook

Contact Mark.Carlson@incose.org for additional information or to join this group.

Systems Engineering Tools News

UML/SysML Tool Vendor Model Interchange Test Case Results Now Available

OMG's® Model Interchange Working Group (MIWG) announced the public availability of the vendor test case results that demonstrate their UML® and OMG SysML™ model interchange capability. Six tool vendors, including Atego, IBM, NoMagic, Sodius (supporting IBM Rhapsody), SOFTEAM, and Sparx Systems, supporting six tools, are participating in the model

interchange testing using XMI® as the interchange standard. The test results encompass a test suite of sixteen test cases that provide test coverage of a majority of the commonly used UML and SysML functionality. Sandy Friedenthal, chair of the MIWG, noted that "the ability to interchange models offers the potential to significantly improve productivity, quality, and the long term retention of models. The MIWG test suite demonstrates a broad interchange capability that includes the interchange of executable activity models, and the interchange of domain specific models using profiles."

More information

Visure Solutions Launches U.S. Operations

After more than a decade of operations outside the United States, Visure Solutions, company specializing in Requirements Engineering throughout Europe and Asia, has launched its U.S. operations.

More Information

ATLAS ELEKTRONIK Selects Atego's Artisan Studio as their Modeling Tool for Worldwide Use

Atego, a software tools and professional services supplier for complex, mission- and safety-critical systems and software engineering, has announced that ATLAS ELEKTRONIK, Bremen, Germany (http://www.atlas-elektronik.com), a joint venture between Thyssen Krupp and EADS, has signed an Enterprise Agreement for Artisan Studio®. The agreement provides all ATLAS ELEKTRONIK business division's access to Artisan Studio including sites located in Germany, Austria, Switzerland, Australia and the UK.

More Information

Japan's Tokai University Adopts No Magic Suite of Software Products for Research and Development

No Magic, Inc., the leading global provider of integrated modeling, simulation & analysis solutions and services, has announced that the company's entire solution suite of products (Enterprise Editions) has been adopted by Tokai University in Japan for teaching and research purposes.

More Information

## Introducing the RUP plug-in for Model Driven Systems Development

The Model-Driven Systems Development plug-in for the IBM Rational Unified Process (RUP) is said to support basic principles of systems engineering and MDSD. The RUP for MDSD plug-in will be of particular interest to the managers of a systems development project, as well as those concerned with system analysis and specification, system architecture, implementation, and test.

More information

Systems Engineering Books, Reports, Articles and Papers

Project Retrospectives: A Handbook for Team Reviews

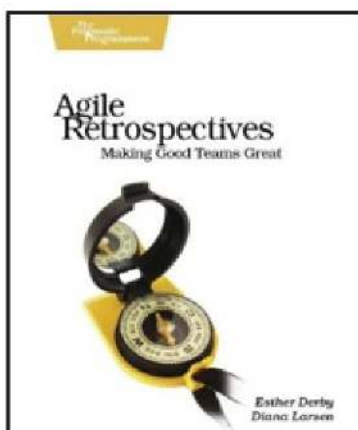Norman I. Kerth
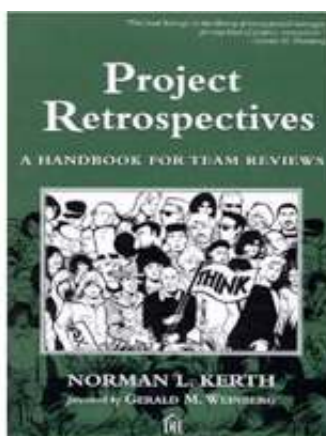
Abstract: *Project Retrospectives* is well written, well presented, and very useful. Norm Kerth presents a convincing argument for the value of taking the time to study past projects and learn from them. He then presents a rich tool kit of techniques for helping a project team explore what actually happened, what went well, what caused problems, and what happened that surprised them. Kerth's sensitivity to the complex interpersonal issues surrounding project retrospectives will help any facilitator, participant, or manager get the most out of these important learning activities. Despite the value of retrospectives, not every project team will find it possible to spend 2 or 3 full days reflecting on its experience. However, the methods described here can be scaled down so that any team can apply them. If a team doesn't take the time to learn how to improve, it shouldn't expect the next project to go any better than the last one. This unique book is a key enabler for any learning organization.

More Information

## Agile Retrospectives: Making Good Teams Great

Esther Derby and Diana Larsen

Abstract: Since Norm Kerth's seminal book on Retrospectives, development cycles have gotten shorter, and many teams have gone Agile. Where Norm focuses largely on big, end-of-project retrospectives, Diana and Esther close the gap, providing an excellent set of exercises that can be done in short periods time (say, at the end of an iteration), with or without a formal facilitator. A variety of exercises are described so that your retrospectives won't get boring and will continue to reveal process improvements that help your team optimize their process and stay sharp. This will become a well-thumbed trusty reference for agile teams.

More information

The Enterprise Business Analyst: Developing Creative Solutions to Complex Business Problems

Kathleen B. Hass
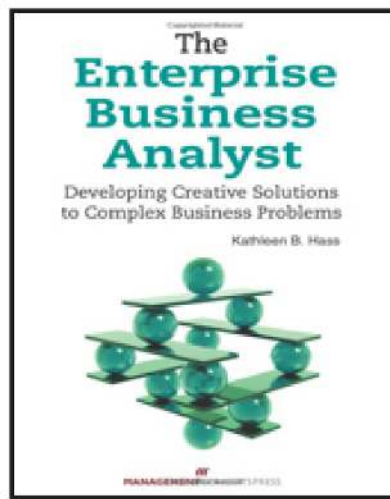
Publisher: Management Concepts Press
Publication Date: 2011
Binding(s): Paperback

Abstract: Engineering and business professionals are ultimately constrained by obsolete management expectations and politics and are not incentivized or encouraged to embrace and model evolving practices. This book aids the transition from a tactical, project-focused role to a creative, innovative role for requirements engineers and business analysts. A root cause of our inability to deliver successful business solutions is the gap in requirements analysis and complexity management capabilities and competencies. Currently, we don't diagnose, manage, and capitalize on complexity; however, complexity breeds creativity when we leverage it. The systems engineer is perfectly positioned to understand the needs of an organization, help it remain competitive, identify creative solutions to complex problems, bring about innovation, and constantly add value for the customer and revenue to the bottom line. We need enlightened workforce management practices in order to gain enterprise maturity. An enterprise-wide transformation initiative is required. The path to this transition—and the tools to accomplish it—are presented in this new book by Kathleen "Kitty" Hass. Winner of PMI's David I. Cleland Project Management Literature Award for her book *Managing Complex Projects: A New Model.*

More Information

New Book Release

Spacecraft Systems Engineering 4th Edition - Market Research Reports - Research and Markets

This fourth edition of the bestselling Spacecraft Systems Engineering title provides the reader with comprehensive coverage of the design of spacecraft and the implementation of space missions, across a wide spectrum of space applications and space science. The text has been thoroughly revised and updated, with each chapter authored by a recognized expert in the field. Three chapters – Ground Segment, Product Assurance and Spacecraft System Engineering – have been rewritten, and the topic of Assembly, Integration and Verification has been introduced as a new chapter, filling a gap in previous editions.

More Information

Journal: Systems Engineering

"An advanced cost estimation methodology for engineering systems", C.G. Hart, Z. He, R. Sbragio and N. Vlahopoulos

"Overcoming barriers to transferring systems engineering practices into the rail sector",
Bruce Elliott, Anne O'Neil, Clive Roberts, Felix Schmid and Ian Shannon

"A systems framework for distance learning in engineering graduate programs", Adedeji B. Badiru and Rochelle R. Jones

"Incorporating the NATO Human View in the DoDAF 2.0 Meta Model", Holly A. H. Handley

"Requirements management within a full model-based engineering approach", Yves Bernard

"Sensitivity analysis for multi-attribute system selection problems in onshore Environmentally Friendly Drilling (EFD)", O.-Y. Yu, S. D. Guikema, J.-L. Briaud and D. Burnett

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NDIA 12th Annual Science & Engineering Technology Conference Poster Papers

The following poster papers from the U.S.A. National Defense Industry Association (NDIA) 12th Annual Science & Engineering Technology Conference:

- Capstone Exposure to the Systems Engineering Process
- Innovation Strategy IPT Process;

are downloadable at: http://www.ndia.org/Divisions/Divisions/ScienceAndEngineeringTechnology/Pages/default.aspx

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Conferences and Meetings

6th International Conference on Design Principles & Practices
January 20 - 22, 2012, Los Angeles, CA, USA
More information

INCOSE International Workshop (IW) 2012
January 21 - 24, 2012, Jacksonville, FL, USA
More information

Ontologies Influences in Systems Engineering   NEW
January 23 - 27, 2012, Carlos III, Madrid University Spain
More information

Eighth Asia-Pacific Conference on Conceptual Modelling (APCCM 2012)
January 30 - February 2, 2012, RMIT, Melbourne, Australia
More information

Systems Engineering for Defense Symposium
February 15 - 16, 2012, Defense Academy of the United Kingdom, Shrivenham, UK
More Information

ESSoS12 - International Symposium on Engineering Secure Software and Systems
February 16 - 17, 2012, Eindhoven, The Netherlands
More information

16th GfSE Workshop 2012
February 17, 2012, Hannover, Germany
More information

IEEE CogSIMA 2012 – 2nd International Conference on Cognitive Methods in Situation Awareness and Decision Support
March 6 – 8, 2012, New Orleans, LA, USA
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
The 27th ACM Symposium on Applied Computing
March 25 - 29, 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

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

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

Software for Theory of Modeling & Simulation at TMS/DEVS'12
March 26 - 29, 2012, The Florida Hotel, Orlando, FL, USA.

2012 SpringSim - Spring Simulation Multi-Conference
March 26 - 30, 2012, Orlando, FL, USA

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

The 31st International Conference on Modelling, Identification and Control
April 2 - 4, 2012, Phuket, Thailand

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

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

Workshop on Requirements Engineering (WER'12)
April 24 - 27, 2012, Buenos Aires This workshop will be held in parallel with CIbSE'12 and ESELAW¹12.

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

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

1st Annual Systems Engineering in the Washington Metropolitan Area Conference (SEDC 2012)
May 14 - 16, 2012, George Mason Inn and Conference Center, Washington, USA

IIE Annual Conference and Expo 2012
May 19 - 23, 2012, Hilton Bonnet Creek, Orlando, FL, USA

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

12th International Design Conference Design 2012

May 21 - 25, 2012, Dubrovnik, Croatia
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

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

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

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

INCOSE International Symposium (IS) 2012
July 9 – 12, 2012, Rome, Italy
More information

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

MODELS 2012, ACM/IEEE 15th International Conference on Model-Driven Engineering Language & Systems   NEW
Sept. 30th - Oct. 5th, 2012 - Innsbruck/AUSTRIA
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
October 24 - 26, 2012, San Francisco, USA
More information

Education and Academia

Universidade Federal de Minas Gerais (UFMG), Brasil Takes its Systems Engineering Degree to the Next Level

by Managing Editor Robert Halligan FIE Aust

Universidade Federal de Minas Gerais (UFMG) Brasil has introduced an undergraduate degree in systems engineering. The

Managing Editor of SyEN had the privilege of meeting in Brasil this month several professors from UFMG who are involved in the course.

Systems Engineering as an undergraduate degree in the School of Engineering at UFMG was proposed in 2008, approved by the University Council in 2009, and commenced in 2010. The course was championed by a group of professors involved in the Electrical Engineering Graduate Program and the research groups of Optimization and Computational Intelligence. It is an evening hours course (common in Brasil), with 12 semesters.

The course is essentially structured along two main tracks:
-a technical and scientific track; and
-a track of humanities.

With the first two years of the course now completed, the orientation of the course for the first group of students is turning to Practice-Based Learning (PBL), with project-based activity becoming the main vehicle for learning. The course has been popular with students, with applications exceeding places by a factor of 9:1, I am told.

Interestingly, the Brazilian Federal Council of Engineering and Architecture has a resolution dated August 22nd, 2005, in which the activities of a Systems Engineer are included in the 'big field' of Electrical Engineering: www.confea.org.br/serviços.

The primary contact at UFMG regarding the course is Associate Professor Oriane Magela Neto, Department of Electrical Engineering.

More information

Stevens Institute of Technology USA Systems Engineering Research Center Contributes to Systems EngineeringTechnical Leadership Student Pilot

The Stevens-led Systems Engineering Research Center (SERC), with sponsorship from the Defense Acquisition University (DAU), held the first SYS 350A Systems Engineering Technical Leadership Student Pilot at the Aberdeen Proving Grounds Mission Training Center from Nov. 14-18, 2011. Twenty-two systems engineers from various U.S. Army installations participated in this new technical leadership course, which immersed students into real-world systems engineering situations that required the expanse of superior domain knowledge to personal and organizational effectiveness considerations.

More Information

Some Systems Engineering-Relevant Websites

http://www.winstonbrill.com/bril001/html/article_index/articles/201-250/article242_body.html
This webpage contains a very good piece on managing for innovation. The website overall contains about 650 articles on R&D and innovation – some very useful content.

http://model-driven-blogging.blogspot.com/2011/12/sysml-comparison-and-contributions.html
This website is by Cédric Brun, CTO of Obeo, Eclipse Commiter, member of the Architecture and Planning councils of Eclipse, leader of the EMF Compare project, Modeling Amalgamation. The site has a lot of content on model-based systems engineering viewed through the SysML tunnel.

http://caminao.wordpress.com/about/umlcharp-manifesto/
This website, under the caption "Caminao's Way – Do Systems Know How Symbolic they Are?" contains a lot of critical evaluation of UML and a little on SysML. Included are some principles and a technical blueprint for re-engineering UML. The website overall contains much sound systems engineering content, written from a software engineering perspective. A good read and reference for those working in software-intensive projects, developing software, or managing software development.

http://herdingcats.typepad.com/my_weblog/earned_value/
This webpage by Glen B. Alleman contains some excellent content on Earned Value Methodology (EVM). The Herding Cats blog overall contains ideas, practices, and resources about increasing the probability of project success, with an orientation towards project management.

http://www.boydsays.com/2010/01/zods-axioms-principles-of-engineering.html
This webpage by Eric Boyd captioned Zod's Axioms: Ten Principles of Engineering Management makes interesting reading.

Challenging to implement though.

http://www.eng-tips.com
This substantial and well-used website provides a range of forums in which professional engineers can chat.

http://pmdoi.org/
This is the Declaration of Interdependence site, a community of project leaders who claim to be highly successful at delivering results. The title "Declaration of Interdependence" has multiple meanings. It means that project team members are part of an interdependent whole and not a group of unconnected individuals. It means that project teams, their customers, and their stakeholders are also interdependent. Project teams who do not recognize this interdependence will rarely be successful.

http://agileleadershipnetwork.org/
The Agile Leadership Network is dedicated to the evolution of leaders at all levels striving to transform teams, organizations and enterprises by applying agile leadership principles and values. They are an international network of local communities that provides opportunities for leaders in all industries to connect and engage to advance the practice of agile leadership.

http://www.johnstark.com/fwcce.html
This page provides a useful overview of concurrent engineering (also called simultaneous engineering, and integrated product and process development - IPPD).

Standards and Guides

ISO and IEEE Publish New Edition of Standard for Architecture Description of Systems

Note: This item adds to a preliminary item on the subject in last month's SyEN.

The recently published ISO/IEC/IEEE 42010:2011, Systems and software engineering — Architecture description, specifies what the publishers believe to be best practices for describing architectures, to maximize their utility throughout the life cycle.

The standard builds upon a conceptual model in which an architecture description is organized into multiple architecture views, where each view addresses specific concerns originating with the system's stakeholders. Diverse stakeholders entertain a variety of system concerns such as capability, cost of ownership, robustness, and usability which the architecture must face. To express these concerns, each view applies the conventions of its architecture viewpoint. A viewpoint determines the model kinds: notations, models, techniques and methods relevant to a view – thereby, according to the publishers, giving the creators and users of that view the basis for common understanding and analysis.

ISO/IEC/IEEE 42010 defines requirements on architecture descriptions as the work products used to express a system's architecture. Architecture descriptions take the form of a document, a set of models, or a repository. The standard is designed to be compatible with an organization's existing architecture methods and processes, tools and techniques.

ISO/IEC/IEEE 42010 was produced by WG42 (the working group on Architecture) within ISO/IEC JTC 1/SC 7 (Software and systems engineering). The new edition replaces IEEE 1471-2000 and ISO's international adoption of that standard (ISO/IEC 42010:2007).

Based on 10 years of usage of the first edition by industry, academia and government, the revision adds new features including: modeling architecture decisions, correspondences across views, and support for architecture description languages (ADLs) and architecture frameworks. Extending the concepts of the first edition, architecture frameworks and architecture description languages are introduced for codifying conventions and common practices. Requirements for conformance of architecture frameworks and architecture description languages are specified so that organizations may define and "standardize" their own reusable viewpoints, frameworks and ADLs.

The standard's annexes provide users with a template for defining architecture viewpoints, and guidance for use of the standard with ISO/IEC 12207 (Software life cycle processes), ISO/IEC 15288 (System life cycle processes) and ISO/IEC 10746 (Reference Model for Open Distributed Processing).

ISO and IEEE advise that a Viewpoint Repository is now under development (see previous Standards item).

More information

ISO and IEEE Developing a Repository for Architecture Viewpoints

ISO and IEEE advise that a Viewpoint Repository is now under development, to contain a Viewpoint Library.

The goal of the Library is to provide a place for practitioners and researchers in software, system and enterprise architecture to publish, share and collaborate on architecture viewpoints documented in the style of ISO/IEC/IEEE 42010.

Viewpoints are one form of reusable architecture knowledge. A viewpoint codifies a way of addressing some architectural concerns in terms of notations, kinds of models or other forms. The idea of viewpoints dates back to the 1970s Doug Ross' Structured Analysis and Design Technique (SADT). Anthony Finkelstein and colleagues further refined the concept in the field of requirements engineering.

Early work in software architecture codified a number of architecture viewpoints (such as Kruchten's 4+1 view model). IEEE 1471:2000 formalized the notion of a viewpoint as a first-class entity. The international revision of that standard, ISO/IEC/IEEE 42010 is further refining it and introduces a "conformance point" for architecture viewpoints, so that users of the standard may document and "put on the shelf" viewpoints for general use.

An architecture viewpoint is characterized by:

• A set of concerns to be addressed
• A set of stakeholders interested in how they are addressed
• One or more model kinds
• The conventions: concepts, notations, rules, patterns, styles and semantics to be invoked in creating, interpreting and using models of each kind; and
• Correspondence rules linking the models together.

The Library will archive viewpoints, collect references and related resources and facilitate collaboration among those who wish to use and development viewpoints.

More information

Definitions to Close On

Concurrent Engineering, Enabling System

Concurrent Engineering

Concurrent Engineering: Integrated approach to product-design that takes into account all stages of a product's life cycle from design to disposal including costs, quality, testing, user needs, customer support, and logistics.
Source: www.businessdictionary.com

Concurrent Engineering: A systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support. Intended to cause developers, from the beginning, to consider all elements of the system life cycle from requirements development through disposal, including cost, schedule, and performance.
Source: Defense Acquisition University (USA) DAU Glossary: Defense Acquisition Acronyms and Terms, November 2009

Concurrent Engineering: Concurrent engineering is a systematic approach to creating a product design that considers all elements of the product life cycle from conception through disposal. In doing so, concurrent engineering simultaneously defines the product, its manufacturing processes, and all other required life cycle processes, such as logistics support.
Source: USA MIL-HDBK-59

Concurrent Engineering: Concurrent Engineering is a systematic approach to the integrated, concurrent design of products and their related processes, including, manufacturing and support. This approach is intended to cause the developers from the very outset to consider all elements of the product life cycle, from conception to disposal, including cost, schedule, quality and user requirements.
Source: Pennell and Winner, 1989

Concurrent Engineering: Concurrent engineering is a concurrent, collaborative and balanced approach to the development of a system of interest and one or more enabling systems.
Source: Robert Halligan FIE Aust, Project Performance International

Comment by Robert Halligan FIE Aust: The constant theme of the above definitions of concurrent engineering (also called simultaneous engineering) is the concurrent design of a system and related enabling processes such as development,

production, maintenance and disposal. A system which performs an enabling process is commonly referred to as an enabling system, e.g. the process of production is performed by a production system. Implied in most of the definitions is collaboration in the development of the system of interest and its enabling systems; this is indeed an important aspect of concurrent engineering for it to deliver the historically demonstrated substantial benefits in cost, time and product quality.

Under the above definitions, concurrent engineering *is not*:
- in itself, the performance of traditional life cycle phases concurrently;
- just the development concurrently of two interoperating systems, unless one of those systems is an enabling system; or
- the concurrent development of a system and one of its subsystems.

Enabling System

Enabling System: A system that supports a system-of-interest during its life-cycle stages but does not necessarily contribute directly to its function during operation.
Source: INCOSE Systems Engineering Handbook v. 3.2

Enabling System: A system that is not the system of interest, but which enables a phase of the life cycle of the system of interest.
Note: a production system and a support system are examples of enabling systems for a system to be produced/supported respectively.
Source: Robert Halligan FIE Aust, Project Performance International

Comment by Robert Halligan FIE Aust: A consequence of the widely used second definition is that the internal design of a system of interest and a corresponding enabling system cannot be independent. For example, the design of a production system cannot be independent of the design of the system to be produced. Concurrent engineering has substantially replaced the old sequential approach, in which, for example, the design of the system of interest acted as a set of constraints on the design of the enabling system, leading to poor product design decisions that had to be undone (if they could be), long timelines, and high costs.

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

PPI Expands in Europe

PPI has expanded its team by establishing a relationship with Kamal Hammoutene in Amsterdam via his KnowHow Advisory enterprise. Kamal will assist PPI clients in Europe, will deliver some of PPI's portfolio of courses, and will consult to PPI clients worldwide. Kamal Hammoutene is a French-born professional and senior consultant. He has over 20 years experience in systems engineering. He is also an experienced trainer, having trained hundreds of qualified analysts, systems and software engineers. He has successfully applied systems engineering concepts for different types of systems, of different systems sizes, and in different business domains.

Among the various analysis techniques he likes to use, Kamal values highly the use of modelling techniques and model-based development throughout the system life cycle. Kamal has helped high-tech companies to benefit from systems engineering and requirements engineering, having worked with large international companies such as Cubic, EADS, Electricité De France, France Télécom, Gaz De France, Lyonnaise des Eaux, Michelin, Peugeot, Renault, Thales, TomTom, and the Transportation Department of France. Kamal has worked in France, the USA, the UK, and the Netherlands. This worldwide professional experience has helped Kamal in understanding how diversity and culture are (or should be) important influences when defining and designing systems. Kamal obtained his PhD in France in the field of performance evaluation of computer systems, showing how computer simulation and probability theory can be combined to predict the performance of complex computer systems architectures. In addition to time with family, Kamal enjoys his free-time as a volleyball coach, golf player and amateur astronomer.

PPI's 5-Day Systems Engineering Management Course Launches in Amsterdam and Las Vegas

PPI's Systems Engineering Management 5-Day Course & Workshop was launched this month in Amsterdam, the Netherlands and in Las Vegas, NV USA. Both course deliveries were a great success, with median delegate ratings of 9 and 10 respectively! Whereas PPI's 5-day systems engineering course is 90% about doing systems engineering and 10% about managing, this new course is 90% about managing systems engineering, and 10% about doing.

This Systems Engineering Management 5-Day Course & Workshop is scheduled for delivery worldwide during 2012. Click here to find out more about this ground-breaking course.

CTI's ASEP/CSEP Training Gather Pace

PPI subsidiary Certification Training International is continuing to deliver exceptional ASEP and CSEP training worldwide. The most recently delivered course, held in Las Vegas, NV USA over 5 – 8 December, 2011, was a fantastic success, with median delegate rating for the course of 9. Following the course, 2 delegates went on in the following week to pass the CSEP examination. CTI's CSEP success rate continues to be 100%!

To find out more about CTI's ASEP and CSEP Preparation Courses, visit the CSEP website: http://www.certificationtraining-int.com/. Courses are scheduled throughout the USA, Europe and South Africa during 2012. On-site training is also available worldwide for larger groups; companies are in the process of arranging on-site CSEP training with CTI. The course is designed rigorously using adult learning techniques, resulting in the subject mastery needed to pass the CSEP exam, and having fun in the learning process (yes, learning to pass an exam can be fun!).

Robert Halligan to Speak for INCOSE Singapore

PPI Managing Director Robert Halligan FIE Aust will speak in Singapore on 22 December, 2011 on the topic "The Business Case for Systems Engineering". Robert will present a now strong, evidence-based case for systems engineering adding value. The event is being conducted by the INCOSE Singapore Chapter.

Farewell to Elise Matthews

PPI's Marketing Assistant Elise Matthews will be leaving PPI and Australia in January, to pursue Masters studies in the USA. Elise's role will be taken over by Steph Halligan, who will look after much of PPI's marketing and travel arrangements.

Festive Season Celebration - Course Discount

In the spirit of the festive season, PPI is offering our clients a 10% discount on all new 2012 course registrations received and paid for by 31 December, 2011. This discount is in addition to any other discounts available, and is applied to the amount that would otherwise be payable. This offer does not apply to our PRINCE2 or MSP® course offerings.

We wish all SyEN readers a very happy festive season and a healthy and prosperous new year. See you in January!

Robert Halligan
Managing Director, Project Performance International

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

Systems Engineering Public 5-Day Courses

Upcoming Locations Include:

• Singapore
• Amsterdam, The Netherlands
• Melbourne, Australia
• Las Vegas, USA
• London, United Kingdom

Requirements Analysis and Specification Writing Public Courses

Upcoming Locations Include:

• Amsterdam, The Netherlands

• Las Vegas, USA
• Singapore
• Perth, Australia

Software Development Principles & Processes Public 5-Day Courses

Upcoming Locations Include:

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

OCD/CONOPS Public Courses

Upcoming Locations Include:

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

Cognitive Systems Engineering Courses

Upcoming Locations Include:

• Las Vegas, USA
• Melbourne, Australia
• Adelaide, Australia

PPI Upcoming Participation in Professional Conferences:

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

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

Kind regards from the SyEN team:
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