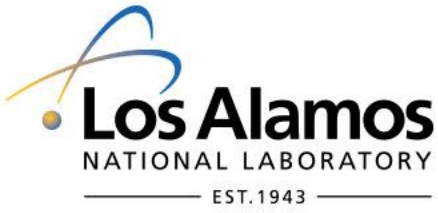
Integrating Program/Project Management and Systems Engineering in Practice



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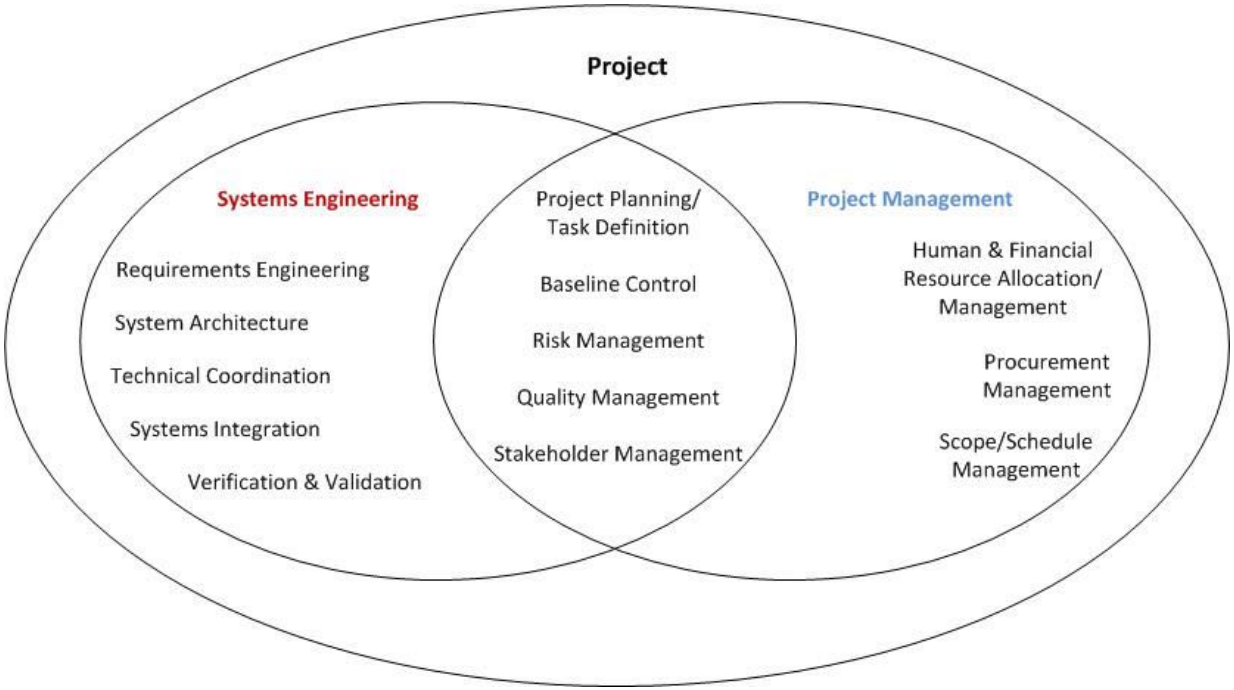
Background

- **Idea that bringing people from different disciplines together improves chances of project success not new**
- **Growing interest in applying systems engineering (SE) and program/project management (Pgm/PM) to complex projects in an integrated way**
  - –PMI/INCOSE/MIT Alliance Team
  - –Rebentisch's (Ed.) 2017 book *Integrating Program Management and Systems Engineering*
  - –PM-SE Integration Working Group
  - –Government/Industry Initiatives

Rationale for Need to Integrate SE and PM



- There are domain-specific distinctions relative to items in the bulls-eye:
  - Technical planning vs. budget/schedule planning
  - Product risks vs. project risks
- SE and PM leverage similar soft factors:
  - Process competence
  - Value proposition
  - Graded approach

Figure adapted from Haskins, C. (Ed.). (2007). *Systems Engineering Handbook*, version 3.1. International Council on Systems Engineering. San Diego, CA.

Integration Challenge

"While program management has overall program accountability and systems engineering has accountability for the technical and systems elements of the program, some systems engineers and program managers have developed the mindset that their work activities are separate from each other rather than part of the organic whole… As a result, the two groups have applied distinctly different approaches to the key work – managing the planning and implementation, managing the components and their interactions, building the components, and integrating the components (pp. 24-25)."

Langley, M., Robitaille, S., and Thomas, J., 2011, 'Toward a new mindset: Bridging the gap between program management and systems engineering', *PM Network*, 25(9), pp. 24-26.

Integrating SE, PM, and Quality Management Workshops

- **Goal: Explore factors involved in successful integration to improve chances for success**
- **General format:**
  - Icebreaker – participants introduced themselves and spoke about their desired outcomes
  - A review of Pgm/PM, SE and quality management (QM) terminology
  - Presentations by the Los Alamos National Laboratory (LANL) facilitator and Sandia National Laboratories (SNL) facilitator describing their integration implementations, including decision factors
  - Small group exercises on topics/issues to consider when making integration decisions

Participants

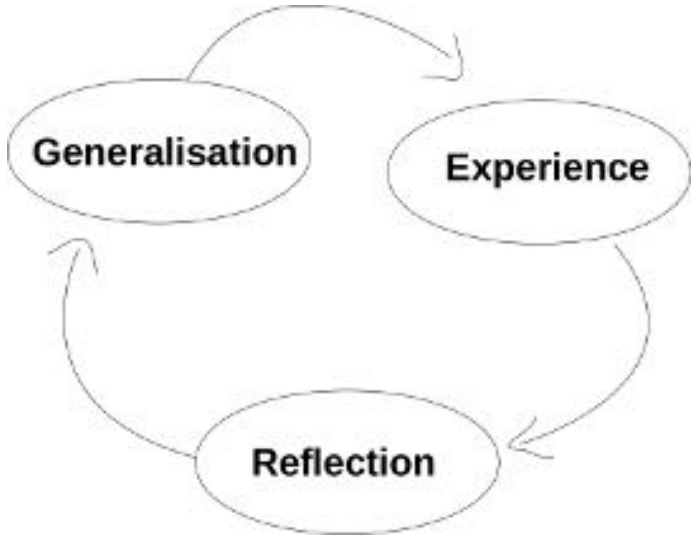
- Self-selected to participate
- First workshop → 15 people, mostly SNL and LANL employees, working in SE or PM fields (or both)
- Second workshop → 36 people, from 31 unique employers (industry, government, academia), multi-national, almost entirely SE practitioners

Small Group Exercise Methodology

- **Facilitated small group exercises, using topics adapted from Rebentisch (2017)**
- **General format:**
  - Context on topic given to whole group
  - Question(s) posed to provoke thought/discussion
  - Individuals brainstormed their own answers on Post-It™ notes and posted on flip-charts
  - Small groups clustered ideas, then gave each cluster a summary name/ theme
  - Debrief back to large group, using go-round method

Facilitation as a SE Competency

- Facilitation is about helping people gain skills and knowledge
- It is one of the professional competencies in the INCOSE SE Competency Framework
- Job is to set up activities that enable learning from others and building on one's own knowledge



Graphic from Seeds for Change '*Facilitating Workshops*'
https.seedsforchange.org.uk/facilitating workshops

Exercise Topics

- Motivations to Integrate
- Compare and Contrast
- Organizational Environments
- Influencers and Influence
- Integration Metrics
- Success and Failure Contributors

Introduction to the National Laboratories

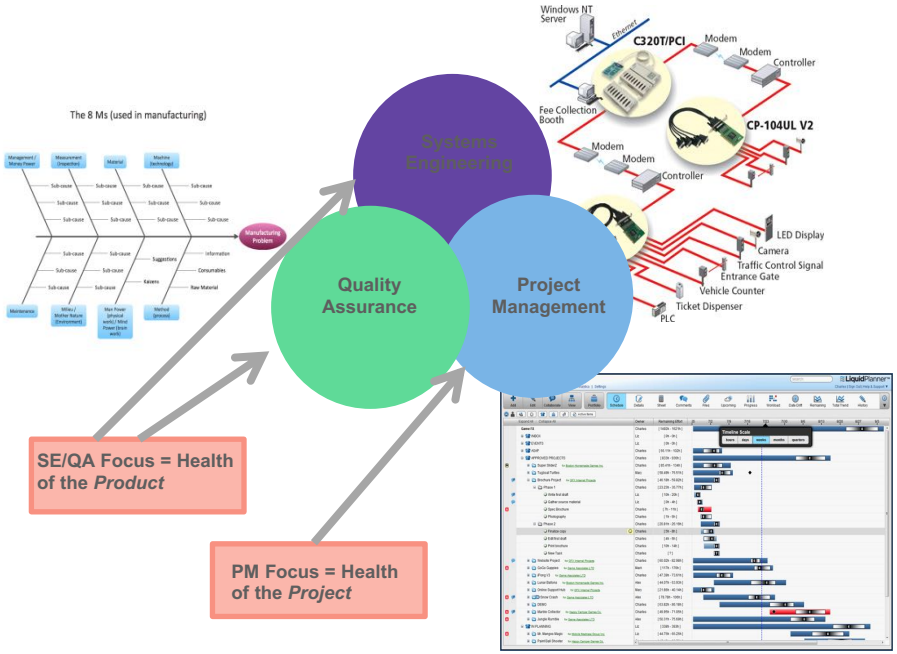
- **US National Laboratories deliver national nuclear and global security mission solutions**
- **Both Sandia and Los Alamos have an enduring nuclear weapons mission**
  - –Provide a safe, secure, effective nuclear deterrent
- **Both also have broader national and global security missions**
  - –Protect against the nuclear threat
  - –Counter emerging threats
  - –Provide solutions to strengthen energy security
- **Work spans from basic research to operational systems development and operations**

Mission Assurance Definition

- **Mission Assurance (MA) is the disciplined integrated application of program/project management, quality management and systems engineering for the purposes of**
  - –delivering quality products and services to customers to achieve mission success and
  - –providing management clear insight into the health of projects and their products

Mission Assurance Implementations

- Early stage R&D is a crucial phase in the systems development process, but is inherently risky
- Requires disciplined approach to effectively manage scope, cost, and complexity
- Both Labs try to balance SE/PM rigor with innovation/ creativity by using a graded implementation approach



Integration of SE, PM, and QA Leads to Increased Assurance of Mission Success
(figure adapted from Hodges, 2013)

Hodges, A. 2013. "Bricks for a Lean Systems Engineering Yellow Brick Road." 23rd Annual INCOSE International Symposium (IS2013), Philadelphia, PA (US).

Compare and Contrast

Similarities

- Lack of SE understanding
- Tools to support implementation
- Core requirements can't be waived; risk-based tailoring possible
- Challenges with how to collect/ share MA data
- Organizational factors that contribute to implementation challenges
- Standards-based policies/ procedures
- Similar cultures

Differences

- SNL implemented in vertical slice; LANL was enterprise-wide
- SNL had VP-level champion with enforcement authority; LANL had a federated model with no clear champion
- Different quality standards; SNL uses industry-based standard, LANL uses research-based standard

Set-up – Motivations to Integrate

- **Context:**
  - Rebentisch (Ed., 2017): “The evidence supports the claim that organizations should embrace integration as a catalyst for improving program performance (p. 237)”
  - Sandia and Los Alamos presentations: improved efficiency and effectiveness, balanced with risk; desire to maintain reputation for technical excellence with no heroics; and avoidance of near misses (or worse) on critical projects

- **Prompt:**
  - *What would motivate you or your organization to pursue the integration of SE and program and/or project management?*

Results – Motivations to Integrate

- **Participants shared the SNL and LANL motivations**
- **Added**
  - Risk avoidance, especially when building high risk/high consequence systems
  - Promotes cross-discipline understanding and common terminology
  - Demonstrated evidence that integration increases likelihood of project success

Set-up – Organizational Environment

- **Context:** *Organizational environment* includes factors such as culture, mechanisms for "collective consciousness," leadership, and interdisciplinary teaming

- **Prompts:**
  - *What aspects of your organizational environment support integration? What can be done to reinforce positive environmental aspects?*
  - *Which aspects of your organizational environment are barriers to integration? What can be done to overcome the barriers?*
  - *Overall, would you consider your current organizational environment to be supportive of integration? Why or why not?*

Results – Organizational Environment

- **To succeed at integration, the organization must have**
  - –A culture of excellence (quality, safety) and continuous improvement
  - –A strong business case to start/sustain integration
    - Business case and implementation must balance short-term focus with long-term strategy
  - –SEs and Program/Project Managers and leaders who have the knowledge, skills, and abilities needed to succeed in an integrated environment
  - –Enterprise-wide standards that allow for flexible, scalable implementation

Set-up – Influencers and Influence

- **Context: A *stakeholder* is anyone who has an interest in or ability to *influence* (the power to produce effects on the actions, behavior, opinions, etc., of others) on a project or program outcome, either positively or negatively**

- **Prompts:**
  - *Who are the key stakeholders (by role, not name) in your organization who can provide support for integration? What motivates them?*
  - *Who are the key stakeholders in your organization who may raise impediments to integration? What motivates them? What challenges would you expect them to raise and how would you address those challenges?*
  - *What leadership qualities must key stakeholders have to oversee the integration of SE and PM throughout the life cycle?*
  - *If you have had experience identifying key stakeholders and gaining their commitment to change, please describe your experience. What lessons did you learn in the process*?

Results – Influencers and Influence

- **Wide range of stakeholders identified**
  - –Senior managers, customer(s), oversight organizations, engineering managers and line/functional managers, program/project managers, support services, systems engineers and technical leaders, project teams, independent reviewers, and end users
- **Stakeholder motivations that support integration**
  - –Desire for continuous improvement in efficiency and effectiveness
  - –Concern for individual or organizational reputation
  - –A drive for success
  - –Financial incentives that reward integration
  - –Risk aversion
- **Stakeholder motivations that impede integration**
  - –Resistance to change
  - –Silos and organizational boundaries that inhibit information sharing
  - –Cost and schedule pressure

Set-up – Integration Metrics

- **Context:**
  - *Metrics* – quantifiable measures used to track and assess status of business processes
  - Need to have meaningful measures in place before attempting organizational change (Rebentisch Ed., 2017)

- **Prompts:**
  - *What metrics would you use to determine the level of integration between PgM/PM, SE and QM?*
  - *Rebentisch (Ed., 2017) describes three elements of effective integration: rapid and effective decision making, effective collaborative work, and effective information sharing. Does this suggest additional variables that might be worth adding to your list of integration metrics?*
  - *What processes, practices, and tools would encourage greater integration between PM, SE, and QM? How would you measure their implementation/penetration in your organization?*

Results – Integration Metrics

- **Metrics about information sharing and other elements of effective integration are needed**
- **Suggested metrics from Larson (2017)**
  - Number of people who participated in the decision
  - Number of alternatives considered
  - Degree of alignment of decisions with business goals
  - How well decisions were communicated
  - How well people buy into the decision
  - How well the decision turned out

Set-up – Success and Failure Contributors

- **Context: The premise of the tutorial was that integration of SE, PM, and QM leads to increased assurance of mission *success* and that lack of applying SE, PM, and QM leads to increased likelihood of mission *failure***

- **Prompts:**
  - *Think of an example of a project failure and a project success. Consider the contributions of SE, PM and QM or the lack thereof to the outcome. What aspects do you associate with success or failure?*
  - *Where have you seen successful integration of PM, SE and QM? Did integration help achieve a positive outcome? Describe the situation and note examples*

Results – Success and Failure Contributors

- **Success and failure factors are two sides of the same coin:**
  - –Good communication → success
    - Especially critical between design and manufacturing and between system and sub-system organizations
  - –Poor communication → failure

  - –Inclusive stakeholder identification and engagement → success
  - –Poor definition of and engagement of stakeholders → failure

  - –Clear lines of responsibility, strong leadership, and leadership accountability → success
    - Use of Integrated Project Teams (IPTs) helps
  - –Poorly partitioned responsibility, lack of leadership or accountability → failure

Synthesized Results

- **Motivation to integrate: project progress cannot be accurately assessed without insight into the path to requirements compliance, the state of project risk items, confidence that the product is built correctly and is the right product**
  - –The integrated application of SE and PGM/PM provides that insight
- **Organizational environment can support or inhibit integration efforts**
  - –An organization in which multi-disciplinary teaming is the norm supports integration; a siloed organizational structure inhibits it
- **Need to know who the influencers for the integration endeavor are, what they want, and how they can help or hinder the effort**
  - –Stakeholder engagement is key
  - –Look broadly when identifying
- **In making the case for change, advocates must demonstrate the importance of the change and answer the What's In It for Me? (WIIFM) questions for the various stakeholder types**

Key Themes

- **Effective integration requires**
  - –A cohesive and dedicated group of subject matter experts actively working on the effort
  - –Involvement and accountability of senior management to enable the team's effort
  - –An environment in which the integration team is acknowledged to have a stake in the outcome and where open communication is a core value
  - –Good relationships with customers and other stakeholders
- **Focus is on relationship management**

Implications for Systems Engineers

- **Businesses and enterprises are systems in their own right**
- **The interdependencies between enterprise functions need to be designed using a systems approach at the enterprise level**
- **The integration of SE and PgM/PM is a System-of-Systems level endeavor**
  - –Provides lessons that add value to integration projects for other enterprise functions
- **Professional competencies enable successful integration**

Facilitation Advice Derived from the Workshops

- Icebreakers and small group exercises are good ways to help people get to know one another
- Facilitators need to be flexible to deal with logistical issues on the fly
- Small group assignments should be mindful of diversity of perspectives
- Individual brainstorming followed by group clustering and go-round debriefing proved effective
- Don’t throw raw data away until you’re sure you won’t need it again

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