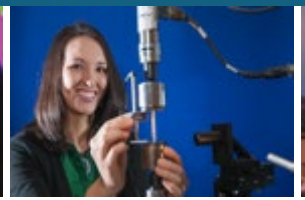
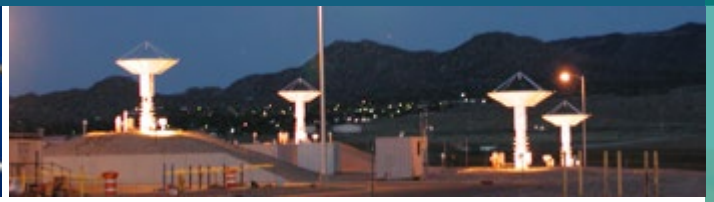
Question 1: What Systems Engineering provides to an organization that Project Management does not?





Presented By

Ann Hodges, Distinguished Member of Technical Staff, CSEP, SAFe SPC 4

September 14, 2022

Based on A. Hodges, "Integrating PM and SE – with No Tripping Hazards", June 2021, presented at PMI Rio Grande Chapter

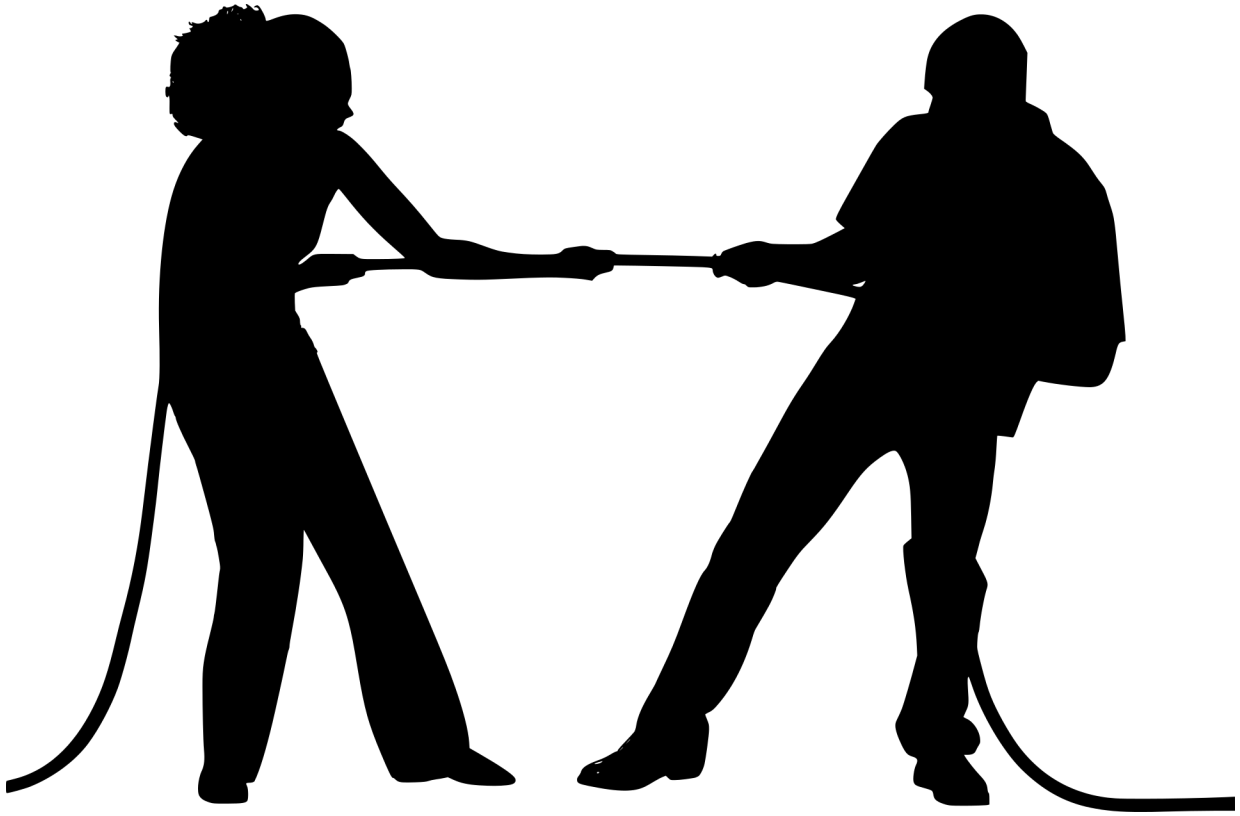
SAND2021-6968 PE

Some definitions

- System – a combination of interacting elements organized to achieve one or more stated purposes [ISO15288]
- Systems engineering – an interdisciplinary approach governing the total technical and managerial effort required to transform a set of stakeholder needs, expectations, and constraints into a solution and to support that solution throughout its life [ISO15288]
- Project – a temporary endeavor undertaken to create a unique product, service, or result [PMBOK]
- Project management – the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements [PMBOK]
- Program – related projects, subsidiary programs, and program activities that are managed in a coordinated manner to obtain benefits not available from managing them individually [PMBOK]
- Program management – the application of knowledge, skills, and principles to a program to achieve program objectives and obtain benefits and control not available by managing program components individually [PMBOK]

What's the problem?

- Education and ongoing professional development typically is siloed by discipline which leads to
  - isolated, narrow view
  - lack of cooperation
  - tension between disciplines
  - lack of understanding of roles, responsibilities
  - inefficiencies
  - tension

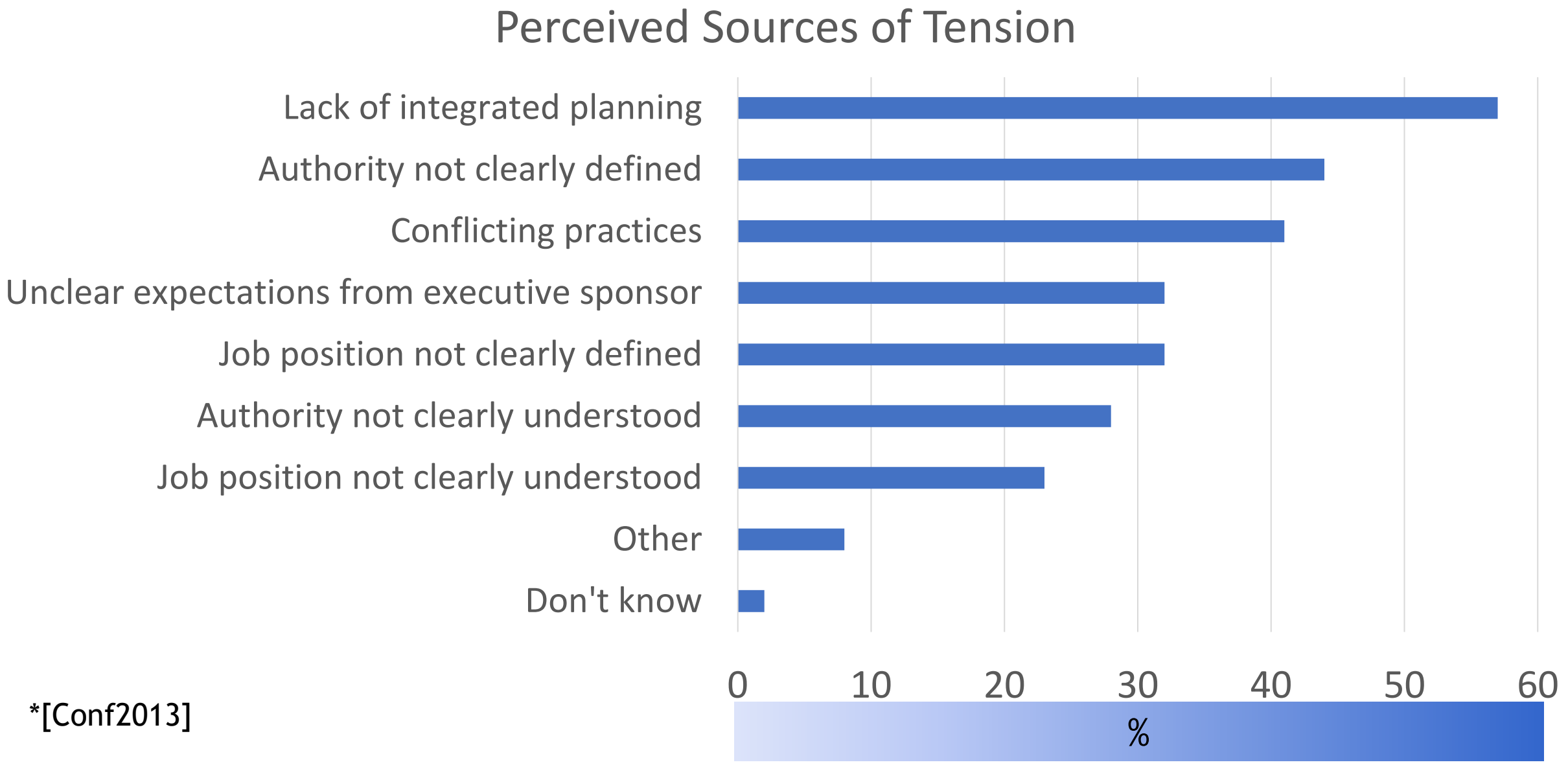


What's the problem – Joint INCOSE-PMI 2013 survey*

- Goal: reduce unproductive tension between systems engineers and program management
- 680 systems engineering and program managers responded

*[Conf2013]

What's the problem – Survey results*



*[Conf2013]

Perspectives of Program Management, Project Management, Systems Engineering, and Quality Management* Roles

ROLE	FOCUS	EXAMPLE: MAJOR SYSTEM CAPABILITY
Program Manager	Benefit to Stakeholder and Organization	Program delivers capability to the Sponsor, while the development provides improvements to the Organization's capabilities and product lines
Project Manager	Deliverable on time and within budget	Deliver system for $X on DD/MM/YYYY.
Systems Engineer	Deliverable meets requirements for intended use in the operational environment	Optimization of the entire system such that optimization of the individual components does not lead to sub-optimization of the whole. The process produces the requirement: System must have speed at Y mach, sustain Zg maneuverability, must obtain accuracy of N circular error probable, must fit to specified platform with cost no more than $X to produce, and meet test date of DD/MM/YYYY.
Quality Engineer	Minimize COPQ (Cost of Poor Quality) – affects cost, schedule, and performance	Minimize number of reworked and/or scrapped component and sub-assemblies. Maintain High First Pass Yield.

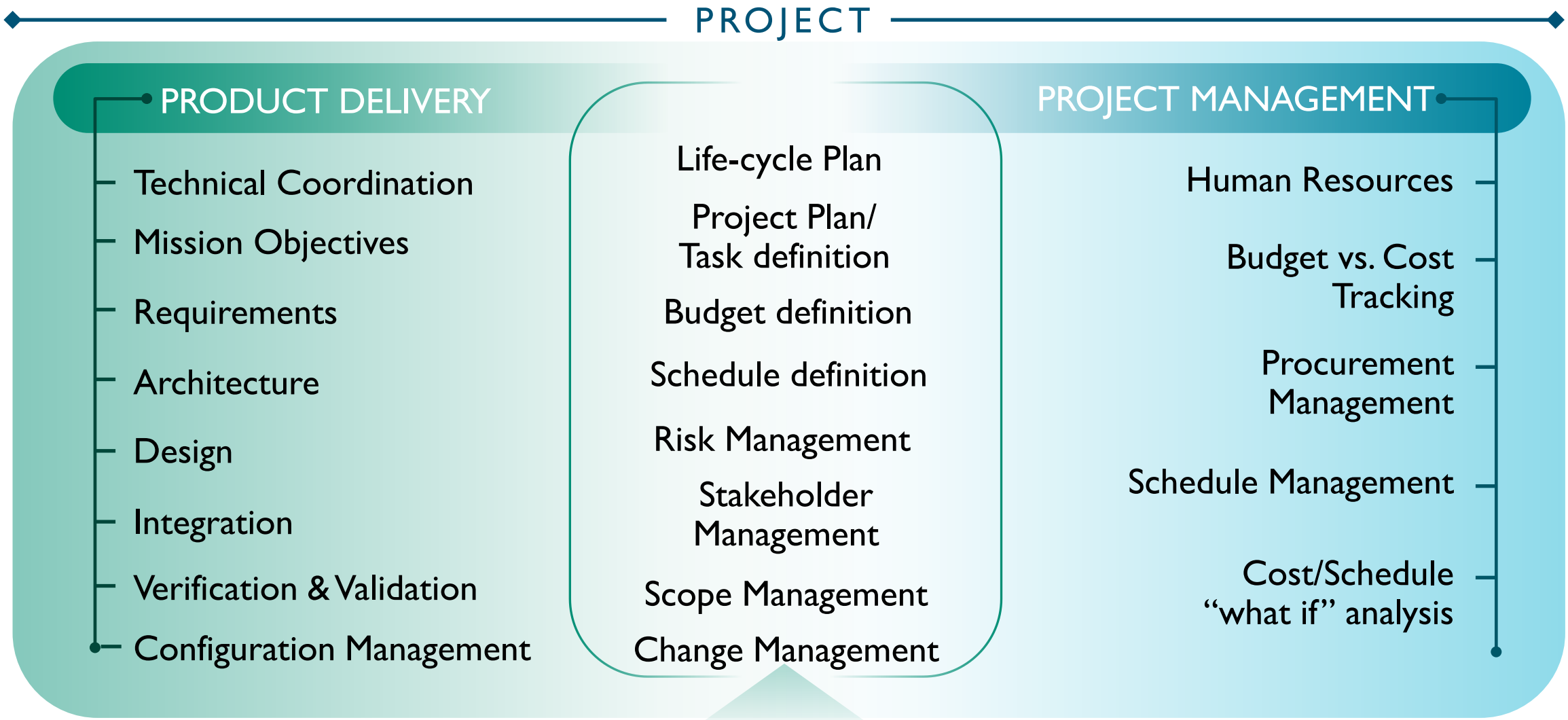
*Adapted from [PMSE] Table 4-1, page 55

My PM-SE integration journey

- Sandia National Laboratories' Science and Engineering Management and PMO organizations merged 2019
- Improving integration
  - Removing project management, systems engineering and quality management categories in the PPDS framework
  - Framework adapted from ISO 15288 process categories
  - Inputs/outputs listed with each process area
  - Project management and systems engineering professionals collaborating in development
- Need both business and systems engineering perspectives in product development
  - Balanced views for triple constraint
  - Particularly stressed with agile approach

PM-SE integration tripping hazard is lessening

Partnership Between Systems Engineers and Project Managers



There are domain-specific distinctions in the intersection:

- Technical planning vs. budget/schedule planning
- Product risks vs. project risks

Figure adapted from [HB3.1]Figure 5-1

My PM-SE integration journey

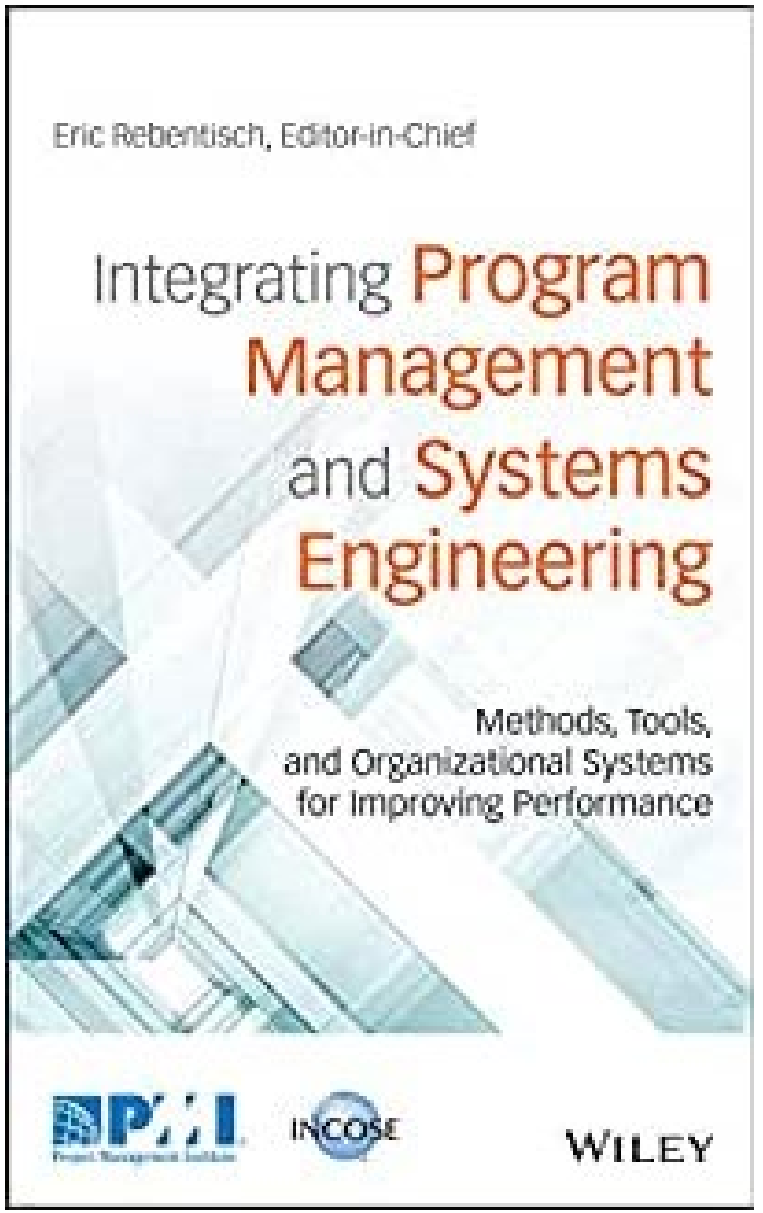
Approaches to integration

- 1 person has broad/deep background in both – may not scale well
- Include both PM and SE perspectives in project/program leadership
- Identify interfaces and timing in both PM and SE practices, communicate opportunities for integrating
- Weave SE and PM practices in agile approaches, reinforce with management expectations and Agilists' coaching
- Join professional societies' efforts in integration endeavors

PM-SE integration tripping hazard is lessening

PMI and INCOSE actively working on integration

- 2011: International Council on Systems Engineering (INCOSE) and PMI started partnership to "enhance, foster, and enable collaboration between program managers and systems engineers." [PMBOK] page xxxix
  - Joint white paper – *Toward a New Mindset: Bridging the Gap between Program Management and Systems Engineering* [LANG]
- Jointly-supported studies
- 2017: Jointly-supported book – *Integrating Program Management and Systems Engineering – Methods Tools, and Organizational Systems for Improving Performance* [PMSE]
- INCOSE PM-SE Integration working group
- INCOSE SE Handbook to include chapter on PM-SE integration



Summary

- Progress is being made
- More progress needed
- “Call to action”
  - Academia – embrace interdisciplinary (not just multi-disciplinary) approach, raise awareness and facilitate adaptation/flexibility
  - Organization’s enterprise – culture, vision, leadership, talent, capabilities
  - Industry, professional societies – foster interdisciplinary perspective

References

[Conf2013] Conforto, E. C., Rossi, M., Rebentisch, E., Oehmen, J., Pacenza, M. *Survey report: Improving integration of program management and systems engineering*. 23rd INCOSE Annual International Symposium, Philadelphia, USA. 2013.

[HB3.1] Haskins C. (Ed.) *Systems Engineering Handbook*, version 3.1. International Council on Systems Engineering, San Diego, CA. 2007.

[ISO15288] ISO/IEC/IEEE 15288, *Systems and software engineering – System life cycle processes.* First edition, 2015-05-15

[LANG] Langley, M., Robatille, S., Thomas J. *Toward a new mindset: Bridging the gap between program management and systems engineering*. PM Network, 25(9). 2011

[PMBOK] *A Guide to the Project Management Body of Knowledge (PMBOK® Guide) -- Sixth Edition*, © 2017 Project Management Institute.

[PMSE] Integrating Program Management and Systems Engineering – Methods, Tools, and Organizational Systems for Improving Performance, Eric Rebentisch, editor; jointly developed by PMI and INCOSE starting in 2011

Questions

Back Up

What's the problem - Issues

- Lack of integrated planning
  - By the time Systems Engineers (SEs) involved, requirements and timeline already "defined"
  - No negotiation on requirements and potential options (trade studies) → insufficient planning, off-target requirements
  - Lack of common objectives
  - Lack of valuing others' contributions
- Authority not clearly defined, understood
  - Business vs. technical management perspectives
  - Lack of specificity (more predominant in SE)

What's the problem – Issues

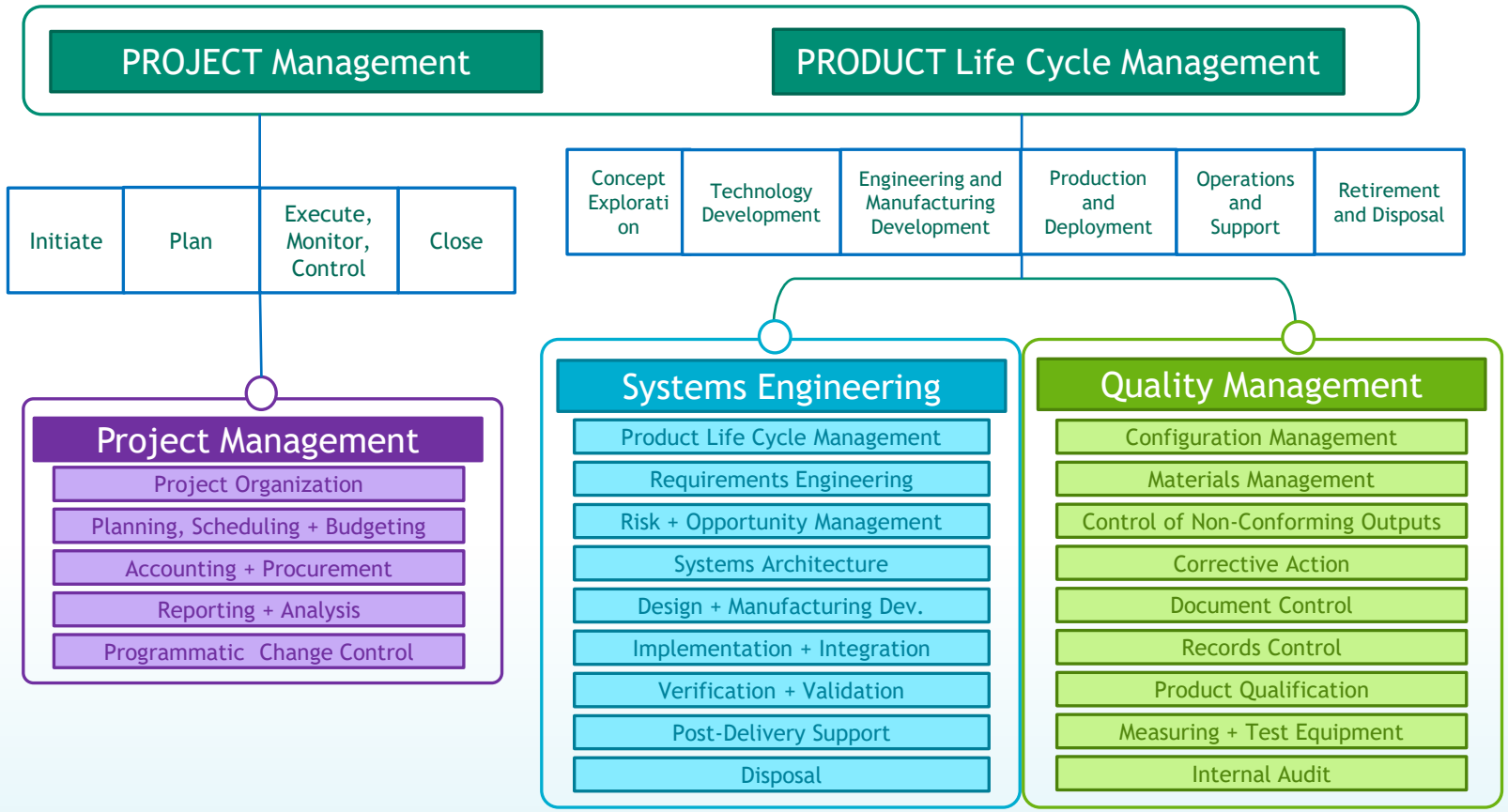
- Conflicting practices
  - Different standards base, "silo" mentality
    - "Center of the universe" mental model
  - Lack of common understanding of shared responsibilities

My PM-SE integration journey

- One of the primary developers of a Mission Assurance framework
  - Mission Assurance includes those elements necessary for meeting customer expectations with quality processes and scope-appropriate project/risk management
  - Rebranded as the Project and Product Delivery System (PPDS) Framework processes
    - Risk-informed graded approach to the application of project management, systems engineering and quality management
  - Discrete processes within these 3 categories
  - Based on industry standards (ISO 15288, PMBOK, ISO9001/AS9100)
  - Loosely integrated (in the same framework) – some tripping hazards

  - Developed by project managers, systems engineers and quality engineers
  - In use > 10 years

Backbone of the Project and Product Delivery System (PPDS) Framework



Project and Product Delivery System Framework

A framework based on industry standards that enables a consistent approach to successful project and product delivery to include policy, processes, tools, resources, and training. It is based on a graded approach and has the implementation flexibility needed for a wide variety of programs and customers.

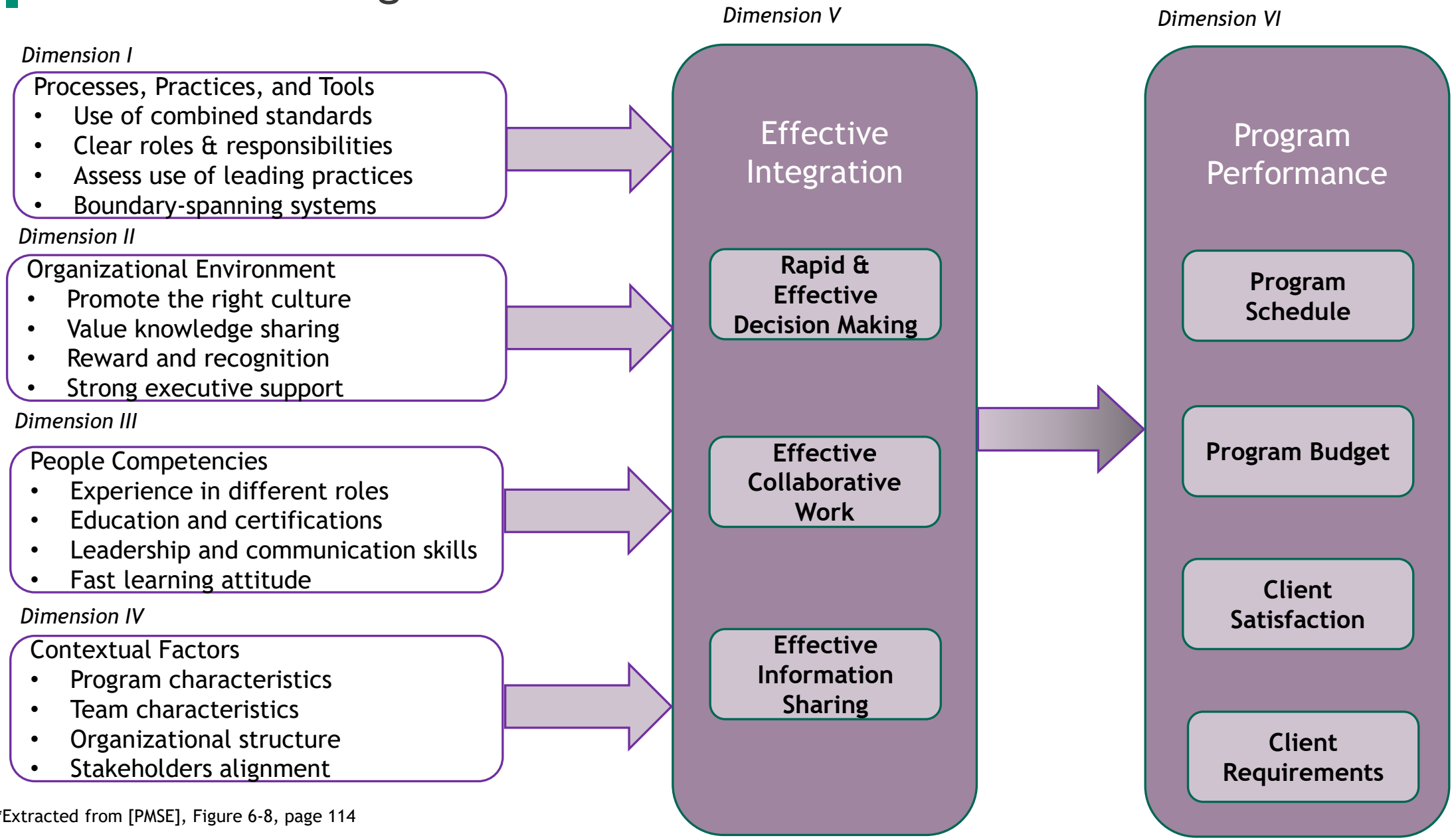
- DOE O 414.1D requires a graded approach
- Industry standards/best practices: PMBOK, ANSI 748, ISO15288, INCOSE, AS9100/ISO9001

Definition: Integration of Program Management and Systems Engineering*

"Integration is a reflection of the organization's ability to combine program management and systems engineering practices, tools and techniques, experience, and knowledge in a collaborative and systematic approach in the face of challenges, in order to be more effective in achieving common goals/objectives in complex program environments."

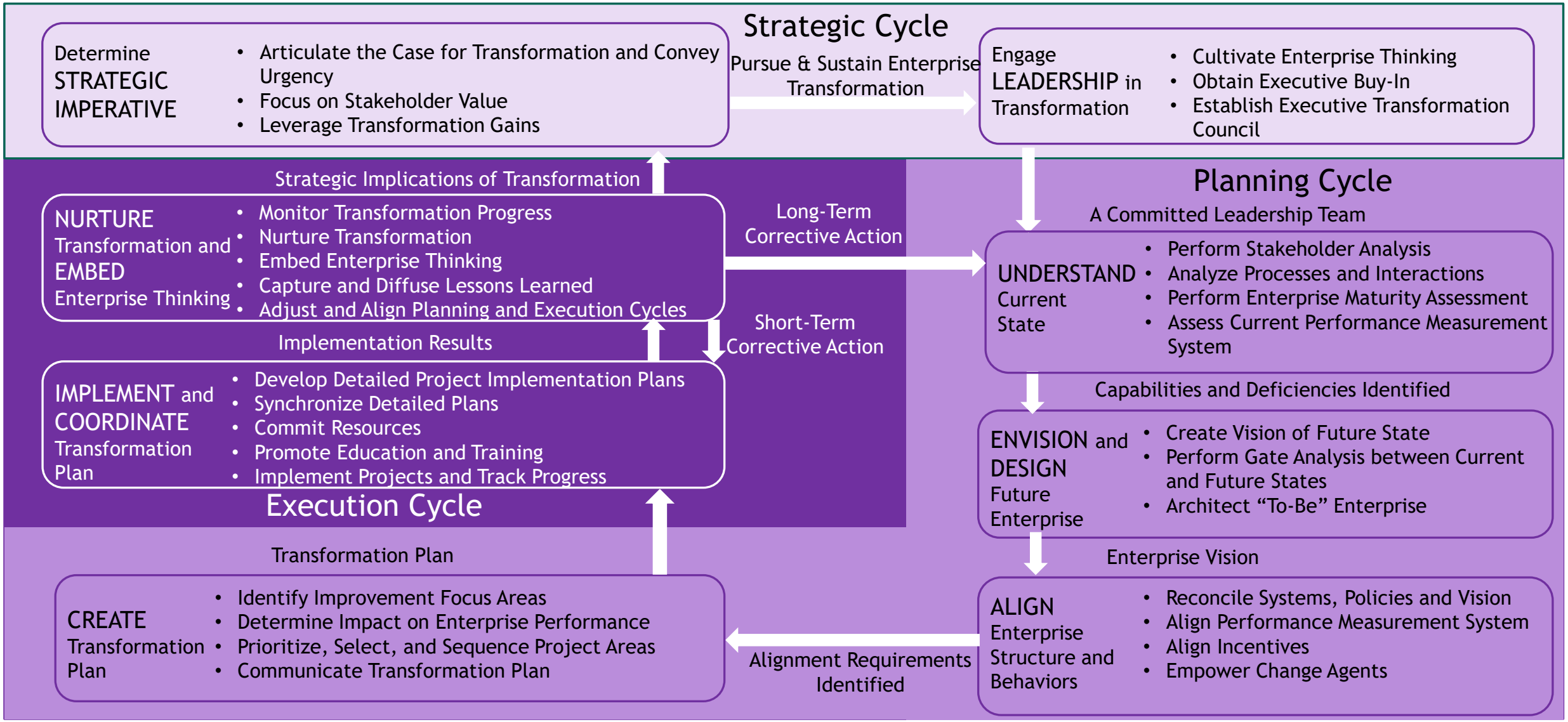
*Extracted from [PMSE], page 93

The PM-SE Integration Framework*



*Extracted from [PMSE], Figure 6-8, page 114

Transformation to an integrated PM-SE future – an enterprise transformation roadmap*



*Extracted from [PMSE], Figure 13-3, page 267

Change Process and Enabling Activities*

Change Process Steps[+]	Change-Enabling Activities
1. Create a sense of urgency across the organization	1. Creating a sense of urgency
2. Forming a powerful guiding coalition (leaders/managers/doers) 3. Creating a vision 4. Communicating the vision	2. Communicating the vision and alternatives (WIIFM)
5. Empowering others to act on the vision	3. Creating processes, picking people
6. Planning for and creating short-term wins 7. Consolidating improvements and creating still more change	4. Meaningful measures, metrics, and progress reports
8. Institutionalizing new approaches	5. Sustaining/monitoring adoption

[+]John Kotter's 8-step process, *Leading change,* Cambridge MA: Harvard Business Review Press.

*Extracted from [PMSE], Figure 15-3, page 320