The Interplay between Project Management and Systems Engineering

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- PM & SE don't happen 'naturally'

- PM & SE – No 'one-man job'

- Simplicity works!

Project Management– Some History

- 1917: The Gantt chart Developed by Henry Gantt (1861-1919)
- 1956: The American Association of Cost Engineers (now AACE International) Formed
- 1957: The Critical Path Method (CPM) Invented by the Dupont Corporation
- 1958: The Program Evaluation Review Technique (PERT) Invented for the U.S. Navy's Polaris Project
- 1962: United States Department of Defense Mandate the Work Breakdown Structure (WBS) Approach
- 1965: The International Project Management Association (IPMA) Founded

- 1969: Project Management Institute (PMI) Launched to Promote the Project Management Profession
- 1986 Scrum Named as a Project Management Style
- 1987: A Guide to the Project Management Body of Knowledge (PMBOK Guide) Published by PMI
- 1989: PRINCE Method Developed From PROMPTII
- 1997: Critical Chain Project Management (CCPM) Invented
- 1998: PMBOK Becomes a Standard
- 2012: ISO 21500:2012 Standard for Project Management Released

Systems Engineering – Some History

- Early 1900s- the concepts of systems engineering are applied at Bell Labs
- The term systems engineering dates back to Bell Telephone Laboratories in the early 1940s
- Mid 1940s - major applications of systems engineering during World War II.
- 1946 - The RAND Corporation was founded in 1946 by the United States Air Force and created systems analysis , which is certainly an important part of systems engineering.
- Late1940s -The Department of Defense entered the world of systems engineering in the late 1940s with the initial development of missiles and missile-defense systems
- Late 1940s – early 1950s- Paul Fitts addressed the allocation of the systems functions to the physical elements of the system.
- 1950 - The first attempt to teach systems engineering as we know it today came in 1950 at MIT by Mr. Gilman, Director of Systems Engineering.

PM & SE

Project Management	Systems Engineering
Project: A project consists of a temporary endeavour undertaken to create a unique product, service, or result.	**System:** an integrated set of elements, subsystems, or assemblies that accomplish a defined objective.
Project Management: The application of knowledge, skills, tools, and techniques to project activities to meet the project requirements. From A Guide to the Project Management Body of Knowledge (PMBOK® Guide)	**Systems Engineering:** Systems engineering is an interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, and then proceeding with design synthesis and system validation while considering the complete problem: operations, cost and schedule, performance, training and support, test, manufacturing, and disposal. International Council of Systems Engineering. "Systems engineering handbook", INCOSE
Project Management: Involves project domain	**Systems Engineering**: Involves product domain
PM Standards: PMBoK - ISO 21500	**SE Standards**: (ANSI/EIA 632 - ISO/IEC 15288 - IEEE 1220 - INCOSE HANDBOOK - SEBoK
Life Cycle: (PM Process Groups) Initiating – Planning – Executing – Monitoring & Controlling – Closing	**Life Cycle:** Concept – Development – Production – Ultilization & Support - Retirement

Project Management

- Focus on management processes and their integration.
- Project management applies to any project, regardless of the specific field, scope or organisation involved.

System Engineering

- Focus on management and technical
- Systems engineering as a discipline is mostly developed and applied for taking on management of complex technical projects
- SE puts more emphasis on requirements

	INCOSE **Technical** processes	INCOSE **Project** processes	INCOSE **Agreement** processes	INCOSE Project **Enabling** processes
PMI **Integration** management processes	PMI 4.1 – 4.6	5.1; 5.3; 5.5		
PMI **Scope** Management processes	PMI 5.1 – 5.6 4.1, 4.2, 4.6; 4.7			
PMI **Time** management processes	PMI 6.1 6.7			
PMI **Cost** management processes	PMI 7.1 – 7.4			
PMI **Quality** management processes	PMI 8.1 – 8.3	5.2;		7.5
PMI **Human resource** management processes	PMI 9.1 – 9.4			
PMI **Communications** management processes	PMI 10.1 – 10.3	5.6		
PMI **Risk** management processes	PMI 11.1 – 11.6	5.4		
PMI **Procurement** management processes	PMI 12.1 – 12.4		6.1; 6.2	
PMI **Stakeholder** management processes	PMI 13.1 – 13.4 4.1			
Other "engineering" or design processes		4.3; 4.4; 4.5; 4.10; 4.11; 4.12; 5.7;		
Processes at entreprise or oraganization level				7.1; 7.2; 7.3

Project Management Processes

http://apppm.man.dtu.dk/index.php/Systems_Engineering_versus_Project_Management,_a_comparative_study by Klaus Pallesen

PM & SE – Approach to Requirements

- Study on Program management versus Systems Engineering has identified "Unstable, unclear and incomplete requirements" as a top-10 challenge for managing engineering projects

- "Requirements management" is a core process in both domains.

Quantitative comparison of the standard practices:

	INCOSE Handbook	PMI BOK	ISO 21500
Processes specifically covering "Requirements"	4.1; 4.2	5.2	0
Pages on "Requirements", % of total	40/340 = 11%	7/410 = 1,7 %	0
Processes specifically covering "Scope"	4.1, 5.1	5.1; 5.3; 5.5; 5.6	4.3.11 – 4.3.14
Pages on "Scope", % of total	19/340 = 5 %	13/410 = 3%	1½/30 = 5%

- The PM and SE disciplines are not well aligned in objectives and incentives leading to lack of efficient, duplication of effort, cross purposes.

- The fact that they share artefacts, tools and framework creates tension between these disciplines.
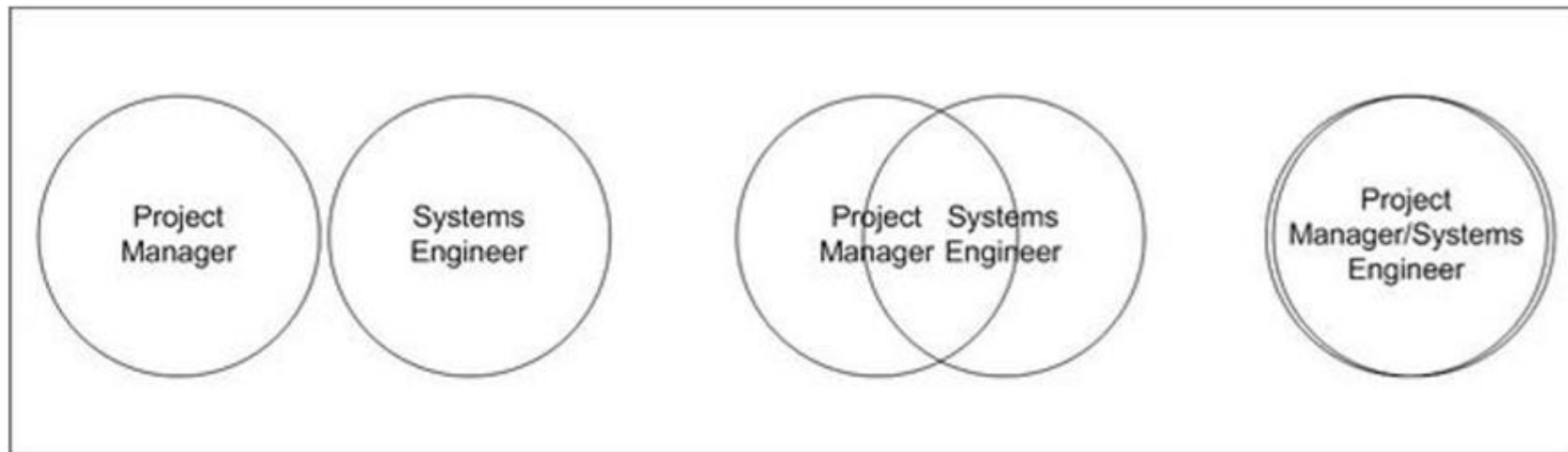

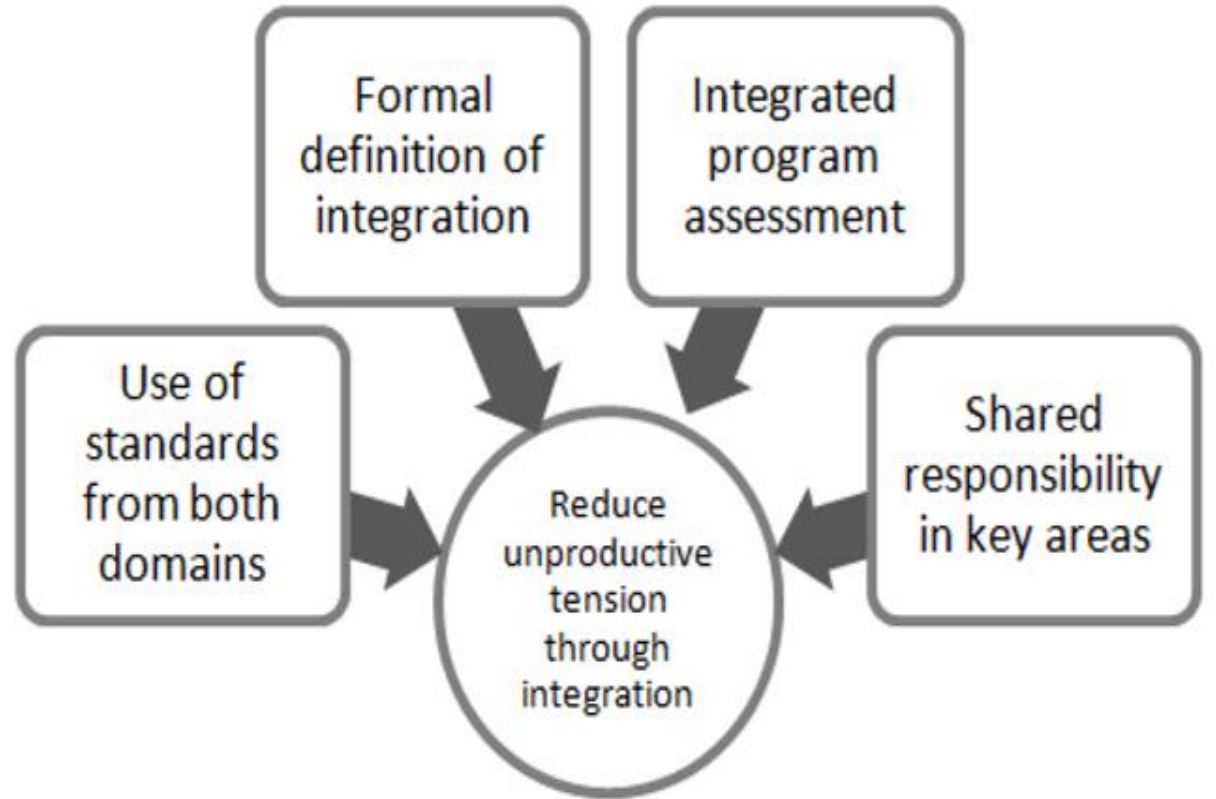**Figure 2. Overlap of Project Roles.** (SEBoK Original)

PM & SE Interplay- Challenges

- Lack of common vocabulary
- Lack of common life-cycle
- Asymmetry of understanding (PM not understanding SE)
- Compartmentalization within PM vs SE
- Lack of cross-education
- Conflicting priorities
- Lack of overlap definition

The Project Management Institute
PMI an the International Council
on Systems Engineering
(INCOSE) PM & SE Integration of
practices survey

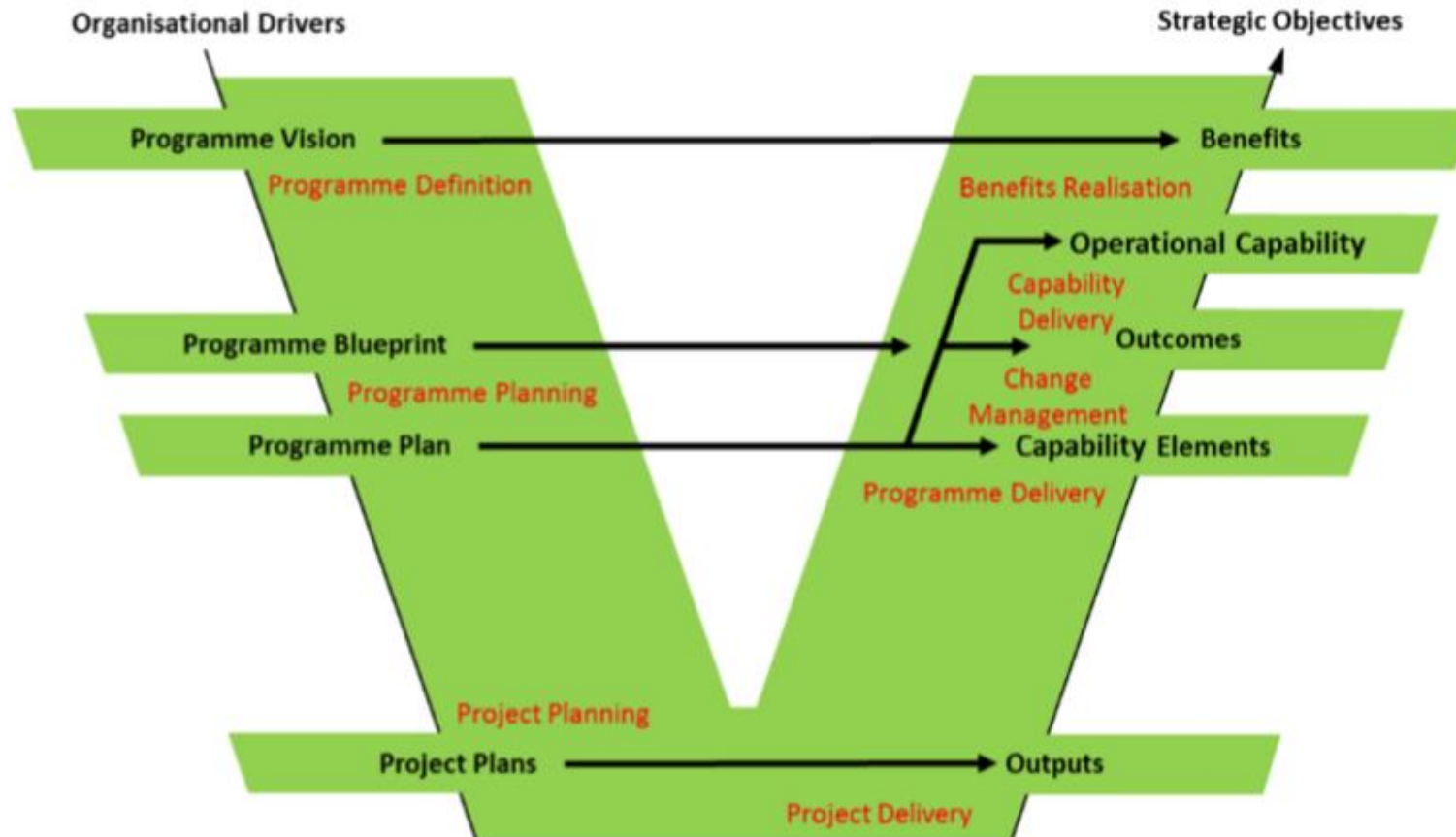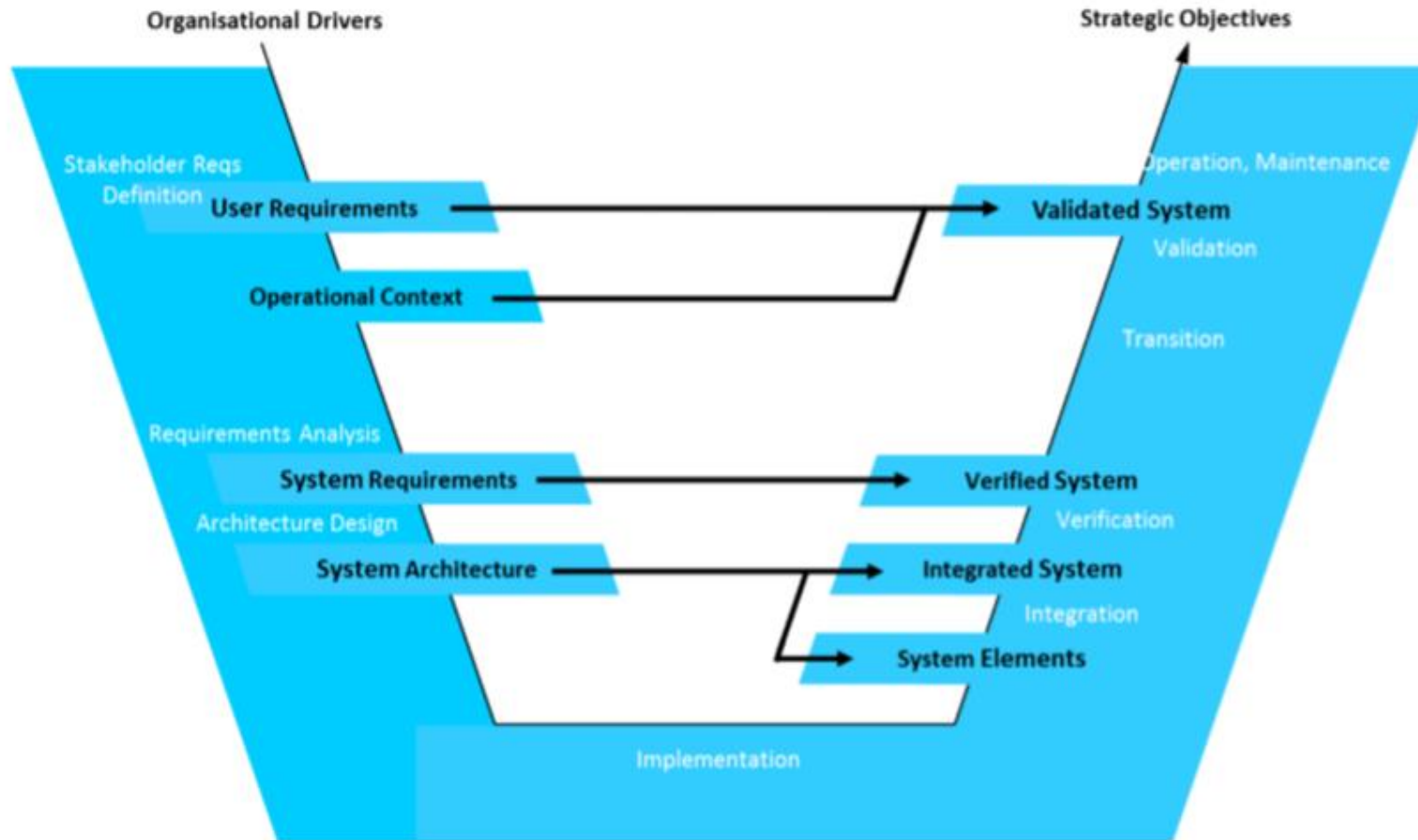Conforto, E., Rossi, M., Rebentisch, E., Oehmen, J., Pacenza, M.: Survey Report: Improving Integration of Program Management and Systems Engineering. MIT Consor-tium for Engineering Program Excellence

APM/INCOSE Joint Working Group

Programme and Project Management Perspective

Systems Engineering Perspective

Combined SEPM V-Model
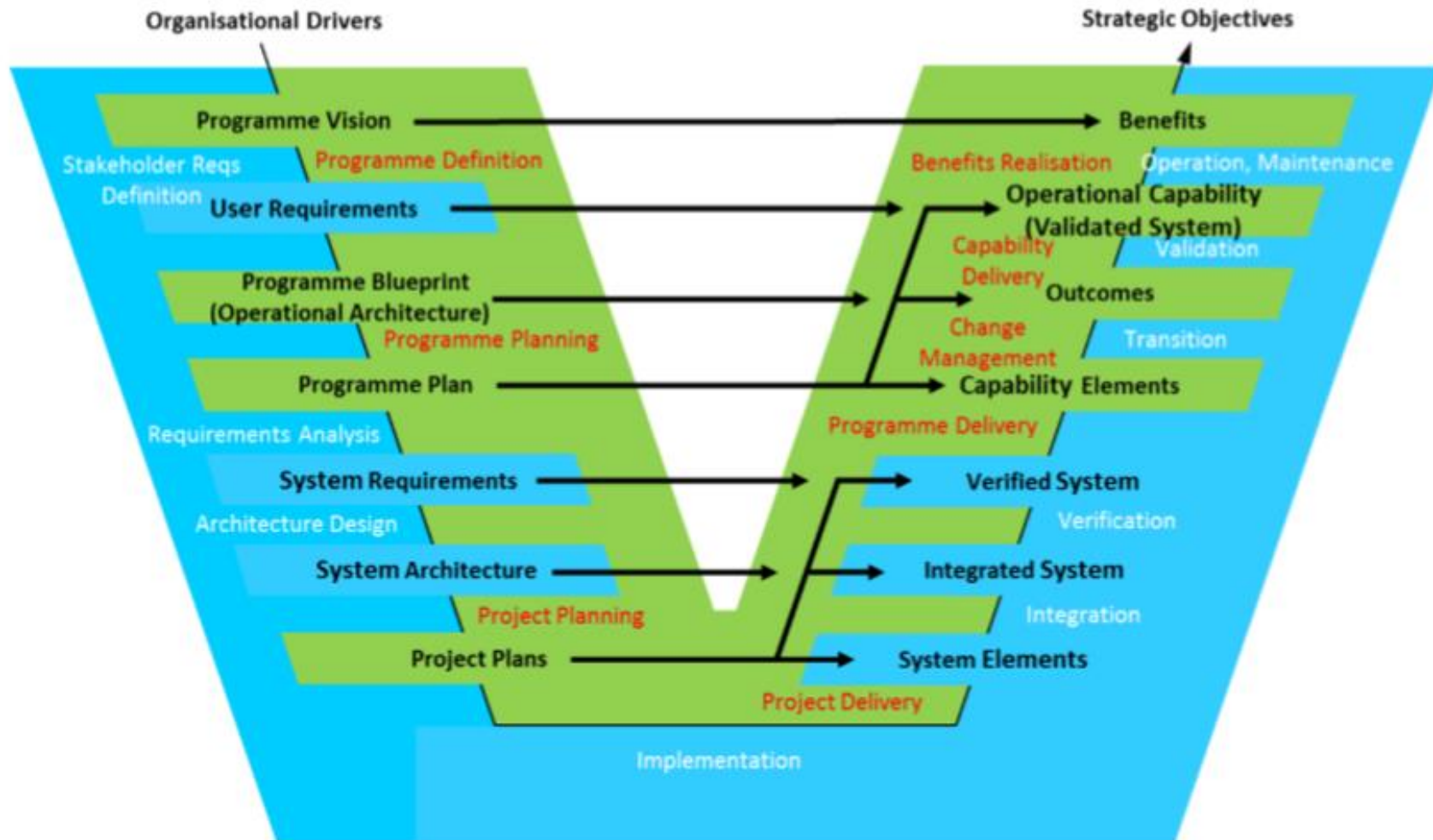
- Vocabulary consolidation
- Considering all the common concerns between both disciplines
- Harmonize life-cycle
- Develop cross-training system (make them work together)
- Recognize PM and SE value/priority differences and manage them
- Address goal alignment at enterprise level for SE and PM

PM & SE – The Win-Win

- The holistic and rigorous "requirements management" focus of systems engineering will contribute to improve project management practices.

- Programme and Project Management helps to establish the 'business context' within which the Systems Engineering activities are undertaken.

- The team is more likely to buy into the PM & SE practices if they 'talk to each other'.

Thanks!

Questions?