



**29<sup>th</sup>** Annual **INCOSSE**  
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# WHY

**Why the SEMP is not Shelfware:**

**How to write a SEMP to ensure it delivers value to all**

*Summary Version for INCOSSE Enchantment Chapter December 2019*



# Mini-Tutorial Learning Outcomes

- Understand how to...
  - Identify SEMP stakeholders and their needs;
  - Summarize why a well-constructed SEMP delivers value;
  - Identify how a SEMP fits within a typical document hierarchy;
  - Describe the “lifecycle” of a SEMP: when it is initiated, how it is used, when it should be updated;
  - Summarize key questions that need to be asked when writing a SEMP in order to maximize value delivery.
- **SEMP = Systems Engineering Management Plan!**



# Introductions

becky  
**REED**



ian  
**PRESLAND**



# WHAT

## Is a SEMP?



# What does SEMP stand for?

The **S**ystems **E**ngineering **M**anagement **P**lan (SEMP)  
- which is best seen as the...

**P**LAN for  
**M**anaging the  
**E**ngineering of the  
**S**ystems



# Systems Engineering Management Plan



- Top-level plan for managing the SE effort and how this relates to other engineering effort
- How the project will be organized, structured, and conducted
- How the total engineering process will be controlled to provide a product that satisfies stakeholder requirements
- Provides guidance to a project
- Helps avoid unnecessary discussions about how to perform systems engineering

INCOSE Handbook v4.0, Chapter 5.1.2.2: Systems Engineering Management Plan



# SEMP preparation needs to start early



*Always plan ahead.  
It wasn't raining when Noah  
built the ark.  
Cardinal Richard Cushing 1917-1970*

- The SEMP provides a framework for thinking about the engineering of the system...
  - Identification of Issues and Risks
  - Organizing and planning
  - Allocation of responsibilities and ownership
  - Sequencing of tasks
  - Estimation
  - Management and control
- Use for technical management in Concept and Development Stages (or equivalent).
- **Build on the framework!**



# Why do we have a SEMP?

- To answer this, we first need to know...
  - Its **purpose**?
  - Who might **need or read** it?
  - The **value** it should deliver to them?







# WHO

Who is the “Audience”?

## Understanding the Need...



# Identifying the audience...

## Who are the key SEMP audiences?

*Examples...*



The Customer needs ...  
...to believe in us



The Team needs ...  
...to understand what to do

Each “Audience” is a **Stakeholder**  
who expects value



# Stakeholder: Any entity (individual or organization) with a legitimate interest in the system

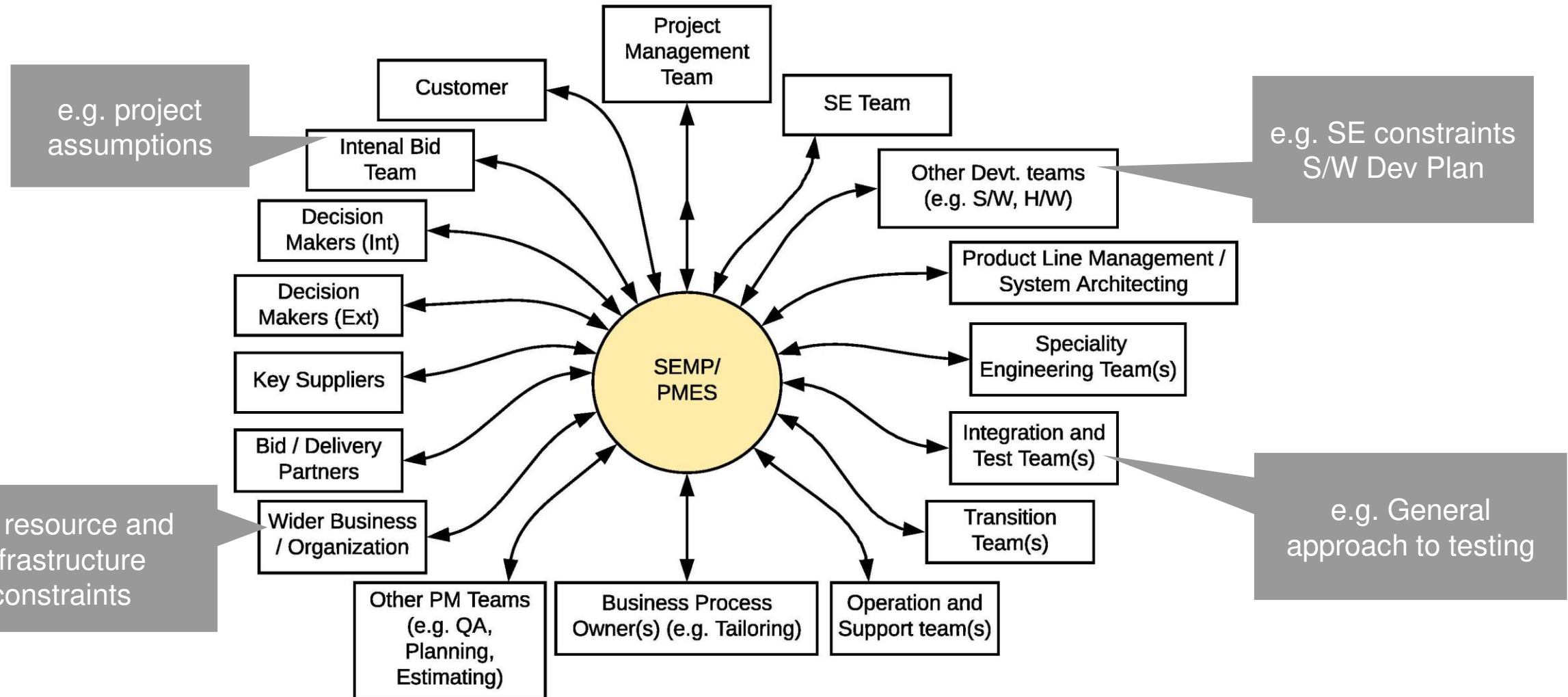
- Typical stakeholders include: Stakeholder Needs and Requirements Definition Process
  - Users
  - Operators
  - Organization decision-makers
  - Parties to the agreement
  - Regulatory bodies
  - Developing agencies
  - Support organizations
  - Society-at-large



The problem is ... **Stakeholders** expect different things

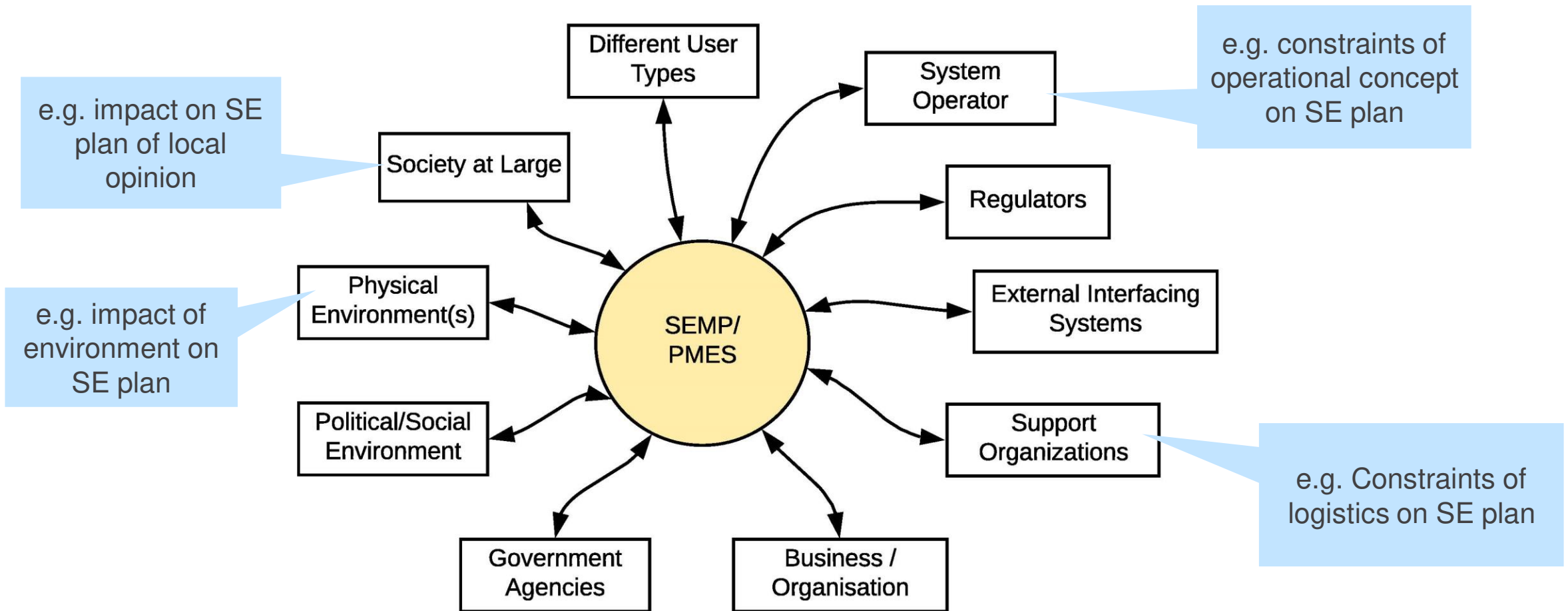


# SEMP – Typical Organizational Interfaces





# SEMP – Typical Solution-related Interfaces





# Stakeholders expect different emphasis

<b>SEMP Stakeholder / Audience</b>	<b>Needs (examples)</b>
<b>Customer</b>	Confidence in us May require evidence of certain activities
<b>Suppliers</b>	Our expectations on them, our commitments to them Where they “fit” into the “bigger picture”
<b>Partners</b>	The bigger picture and proposed collaboration methods
<b>The Systems Engineering team</b>	Processes and tools they are required to use to perform their job
<b>The SE Team leader</b>	Our stated commitments The process definition (e.g. for estimation)
<b>Other engineering teams</b>	How we will collaborate Our expectations on them and our commitments to them The bigger picture
<b>Reviewers</b>	Have we met our obligations within the contract or internally? e.g. against a mandated template, for completeness?
<b>Other functions</b>	e.g. for QA – Have we meet our obligations within the contract at appropriate quality level(s)?
<b>Internal sponsors</b>	Alignment with the bigger picture needs (e.g. organizational or business strategy)

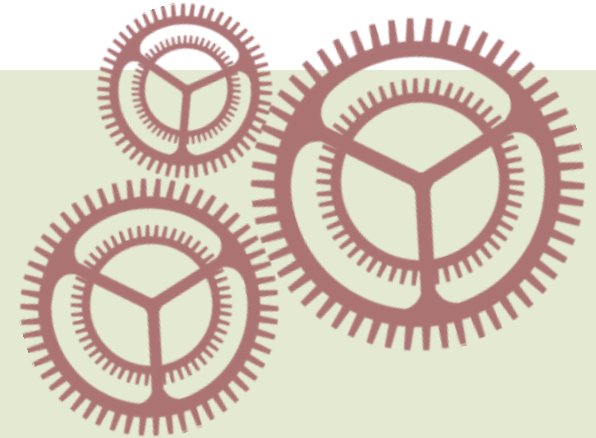


# How does the SEMP work with other documents?



# SEMP relationship with other Plans

- The SEMP...
  - Reflects the overall Project strategy
  - Should align with Project Master Schedule
    - a.k.a. SE Master Schedule (SEMS) and WBS
  - Is about engineering the system
    - Not just planning the work of the SE Team
  - Should be an **Integrated** Management Plan
    - Consistent with all other plans – horizontal and vertical
  - Exists - even on a software (or hardware) only project
    - Or as a minimum, its topics should be addressed



Plans are nothing;  
planning is everything  
*Dwight D Eisenhower*





# SEMP relationship with other plans

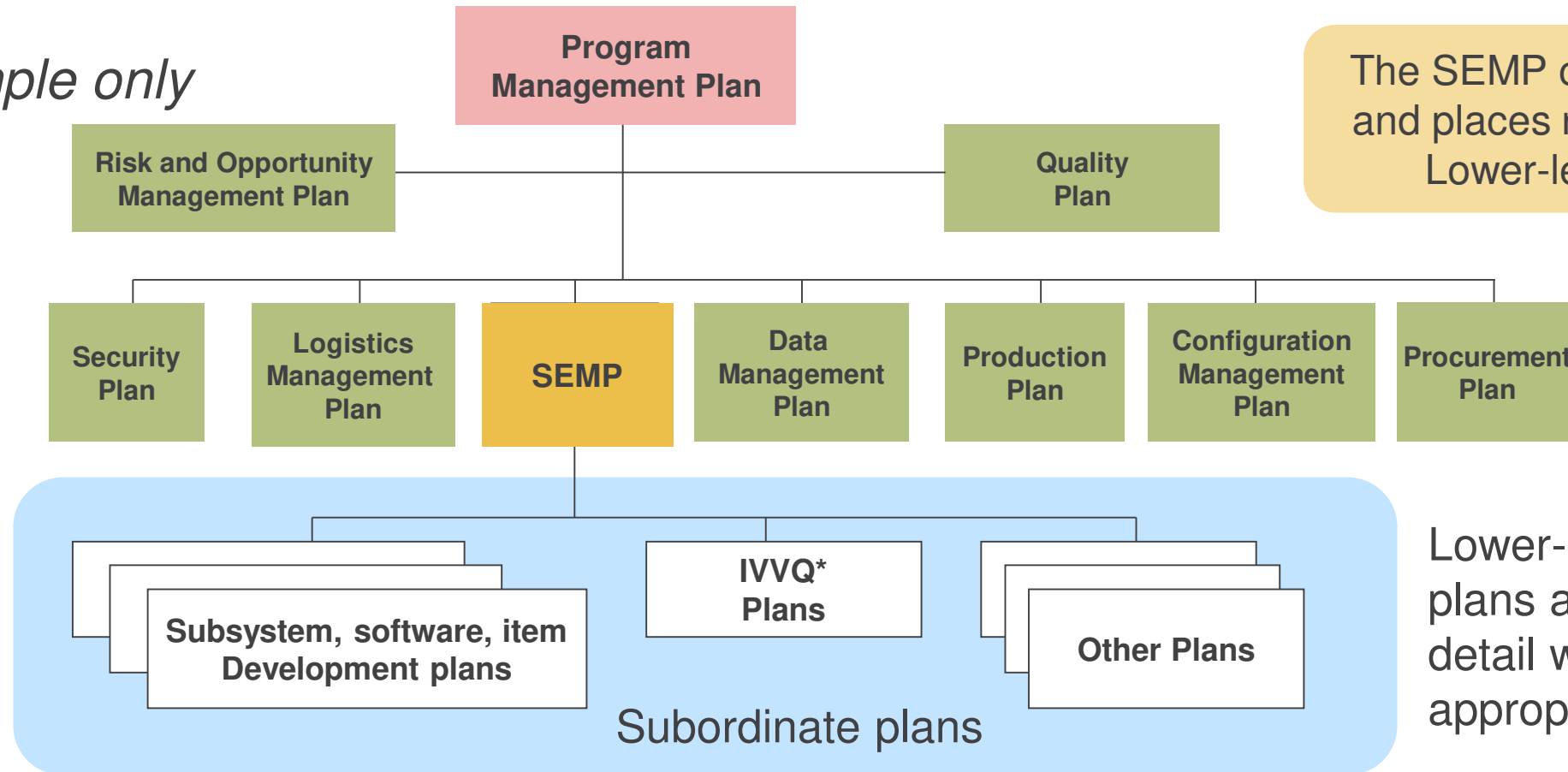
- Think about what needs to be done
  - Plan the activities in an integrated way
- You may combine the SEMP with other documents
  - Work with other plan owners
  - Cross-review plans
- Think about document tree and refer out
  - Avoid duplicating information in other plans or company processes / procedures
- Don't forget links to Speciality Engineering





# Typical positioning of the SEMP in hierarchy

*Example only*



The SEMP contextualizes and places restrictions on Lower-level plans

Lower-level plans add detail where appropriate

\*IVVQ = Integration, Verification, Validation, Qualification



We need to tailor the SEMP for its audience(s)

# Tailoring and the SEMP





# SEMP content is “audience” driven

- The SEM *always* captures how the system will be engineered across the full lifecycle applicable to the project...
- ...however there is no one correct standard “SEMP”...



SEMPs serve a variety of purposes so their “correct” content varies accordingly...



# SEMP content varies...

- A single SEMF may be written in support of a
  - Bid (addressing the topics the Customer has requested)
  - Single project (or part-project), supporting development activities
  - Product line (covering multiple product variants)
  - Business area (covering multiple projects, e.g. projects for the same organization or domain);  
...or some combination thereof
- A SEMF captures project-specific **tailoring**...



# SEMP Tailoring is essential

- INCOSE SE Handbook (ISO 15288) processes *are designed to be tailored*
  - SEMP content reflects specific usage context and as required by the contract
- We *may* have access to a standard SEMP organizational template
  - This is just the starting point
  - Organizations should provide guidelines for SEMP tailoring for common usage scenarios (e.g. CMMI\* Level 3)
- See INCOSE SE Handbook Chapter 9



Picture courtesy of Mr Andrew Chan, Tailoring Director Henry Bailey (Bespoke Tailoring) 9-10 Savile Row London W1S 3PF [www.henrybailey.co.uk](http://www.henrybailey.co.uk)

CMMI® = Capability Maturity Model Integration (Carnegie Mellon Software Engineering Institute (SEI))



**Delivering Value for Stakeholders**

**Addressing the “hard” issues...**





# What are the “hard” issues?

- Planning systems engineering requires consideration of some key questions...
- For the SEMP to deliver value it needs to provide the answers ...



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# The SEMP is shaped by context and risk



The SEMP is an expression of...

- **Project constraints**
  - e.g. context, key requirements and their impact;
- **Identified risks...**
  - selected mitigation strategies;
- **Wider benefits...**
  - realized from selected development strategies

- **Major concerns...**
  - driving lifecycle selection, process or other aspects of the plan;
- **Major decisions to be made, i.e.**
  - What decisions are required?
  - When they are required?
  - Formal decision mechanisms selected

All the above help  
*shape* the plan



# Some “hard” issues...

- **Defining the overall development strategy**
- **Key program drivers**, issues and risks driving chosen approach to development...
  - e.g. Context, key events, technology maturity, delivery deadlines, product line reuse...
- **Risks** (e.g. technology, timeframe, suppliers/supply chain, organization, politics, ... )
  - Manage risk within wider project risk management process
- **Benefits realization** from selected strategies



# Even more example “hard” issues...

- **Human-System interface** definition and approval
- **Processes and tools** and rationale for their selection
- **Lifecycle**
  - Justification for selection
  - Content for incremental / iterative deliveries
- **Key decisions** and decision points
- **Key Products or Suppliers** still to be selected or traded-off
  - Decision methods to be used

SEMP addresses these “hard” issues in the context of “planning”



# But it's still just a plan...

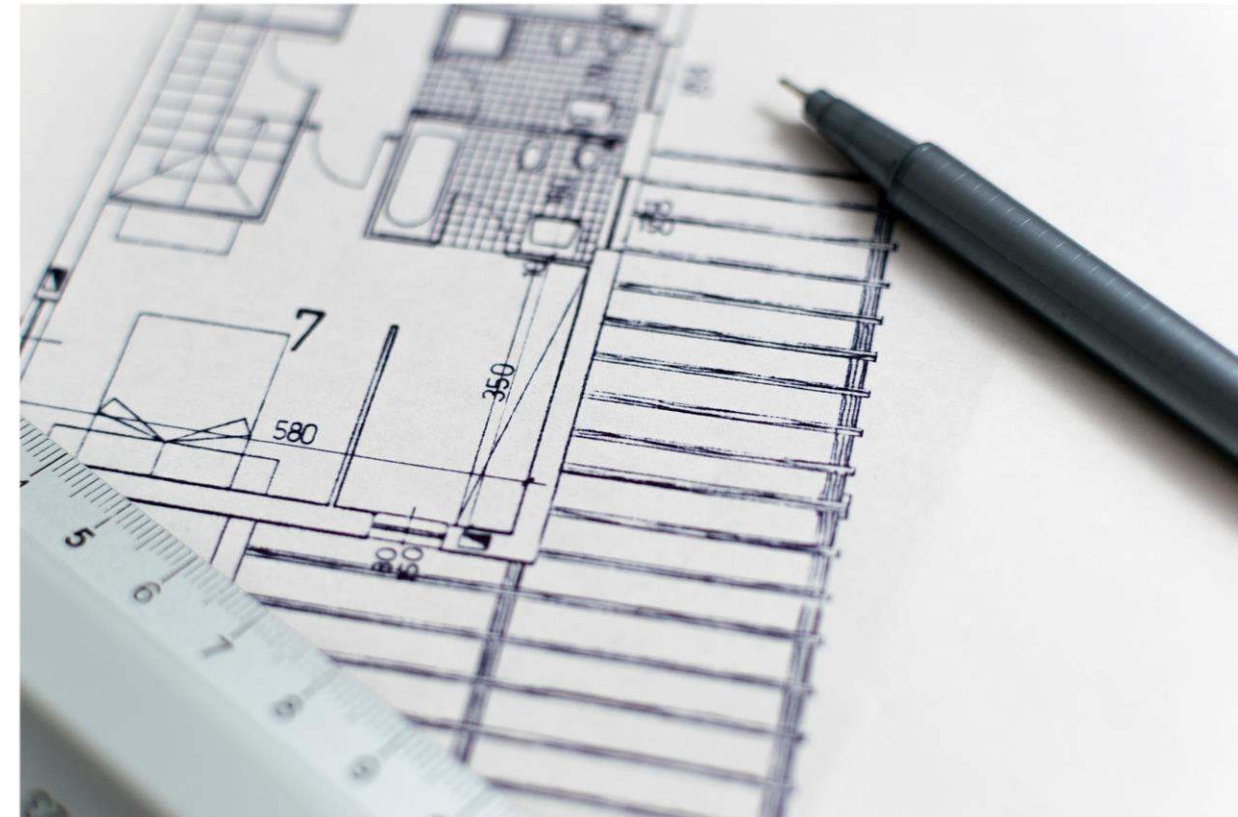
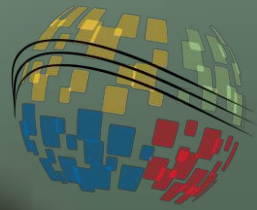


Image by Lorenzo Cafaro from Pixabay

- We don't need to detail every single item in full
- More on this in the next section ...





**More Value:**

# Linking the Estimate to the plan



# “The Virtuous Triangle”

What you  
**PLAN** to do

*Did you estimate the activities  
defined in the SEMP?*

*Are you doing what you  
planned to do?*

What you  
**ESTIMATE** doing

What you are  
actually **DOING**

Do the estimates reflect  
what you do?

Ref: Tutorial “Burden or benefit? 10 Ways to a better SEMP” Presland, I and Stoves, J, INCOSE International Symposium 2008

# Dividing “the cake”



The totality of all (technical) engineering work to be done needs to be...

- Identified
- Scoped
- Estimated
- Allocated to individuals within the (technical) organization
  - **Work Breakdown Structure (WBS)** defines the **work** through Work Packages (WP)
  - **Organization Breakdown Structure (OBS)** defines the **organization**
- This requires co-ordination with the wider project organization
  - In particular with the Project Manager





# Link the SEMP to the Estimate

- The SEMP can be used with the WBS to ensure a “complete” estimate
  - Use the SEMP to check engineering aspects of the WBS are addressed (and vice versa)
- A standardized WBS helps capture data as the basis for future estimates





# SEMP, OBS, WBS and Work Packages

SEMP should identify key...

- **Organizational roles**
  - engineering / technical
- **Teams (e.g. \*IPDTs)**
- **Relationships**
- **Responsibilities**

The SEMP does not normally define WBS or list all WPs

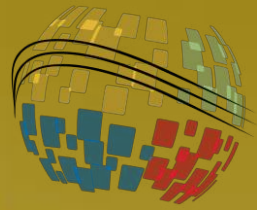
- WBS normally defined by PM

- However, a summary of key WPs can be included

But take care to maintain alignment!

...or reference PM docs

\*IPPD = Integrated Product Development Team



**Delivering value to Stakeholders...**

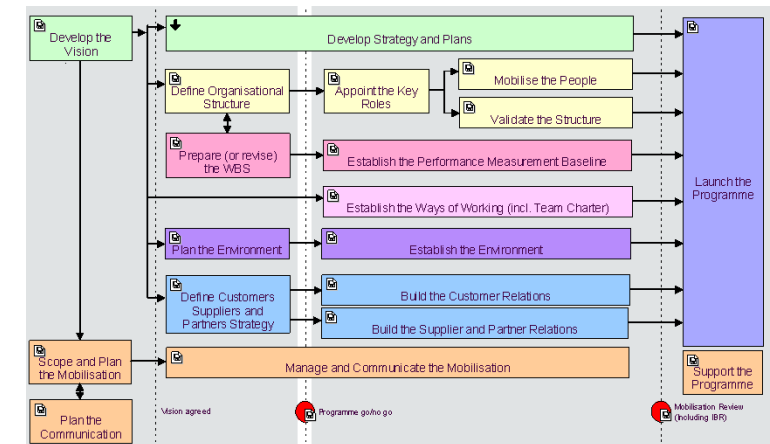
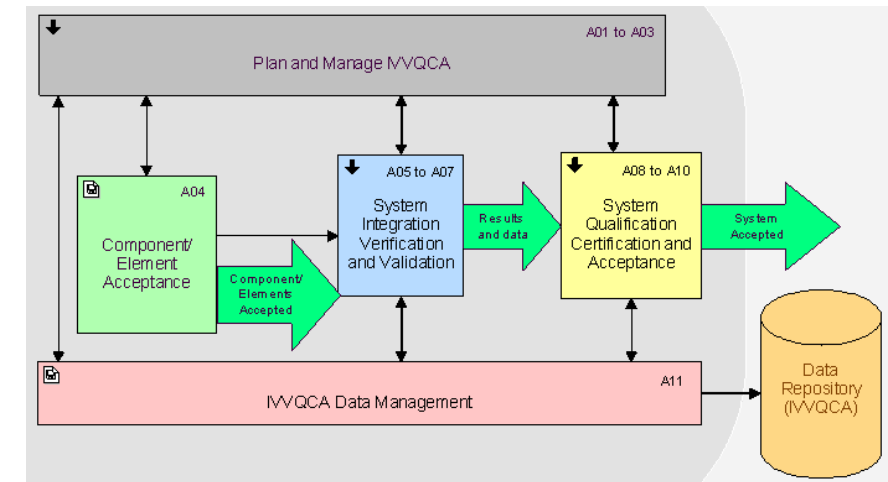
# Defining the Process



# The SEMP captures the *tailored* process

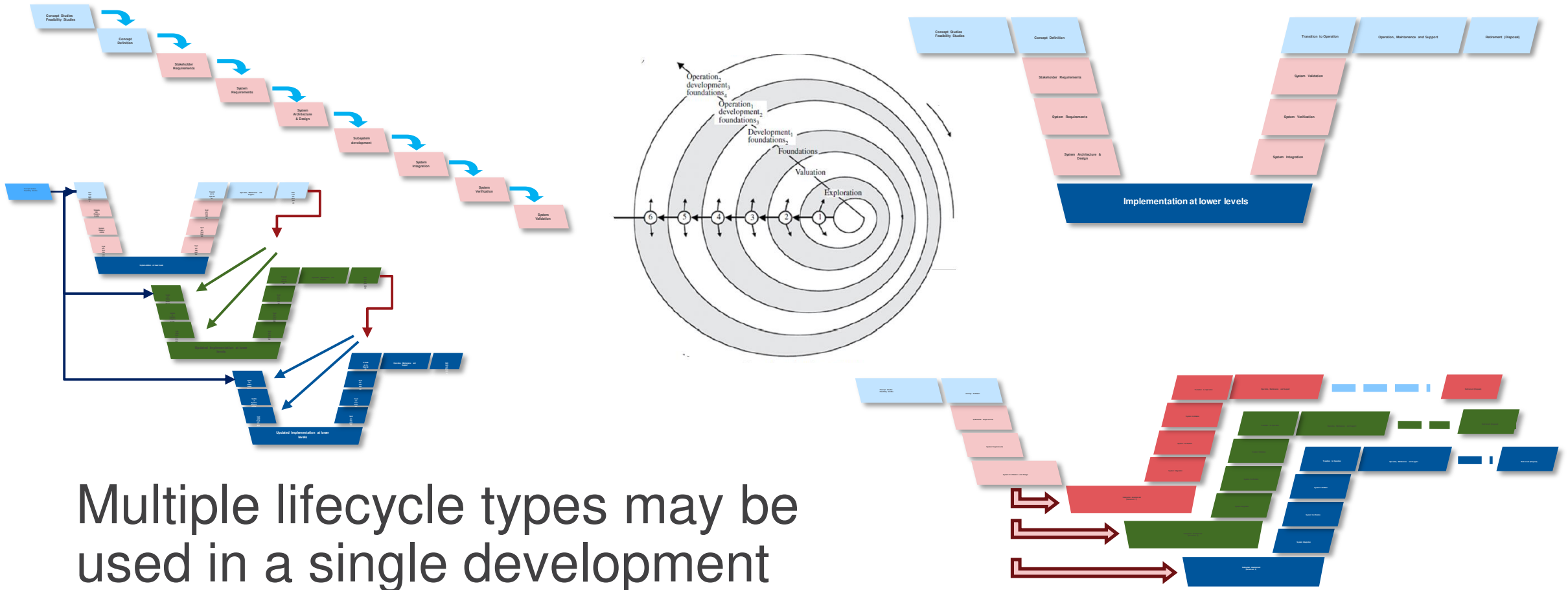
- SEMP captures the specific process to be used for the complete (contracted) lifecycle
  - to a level where key issues and risks can be characterized; and
  - which permits estimation of effort and resources

The SEMP should support the engineers performing development





# Reminder: Lifecycle types



# Defining “the Process”

- Put yourself in the place of a new starter...
  - What would they need to know to be effective?
- Define how standard company processes are being tailored
  - Follow company tailoring guidelines
  - Try not to duplicate processes in the SEMP
- Consider explaining along the lines of:
  - Timeframe - expressed through system lifecycle stages
  - Risk – in terms of mitigation actions
  - Organization - disciplines, specialities and their involvement





# The SEMP is a living document

Delivering value





# Remember, the SEMP is a living document!



**A common QA failing is that the SEMP does not reflect current working practices**

SEI CMMI Assessor, 2008

The SEMP is not shelf-ware



# Keeping the SEMP alive...

- Manage the update process
  - Is a full document reissue necessary?
  - Is updating after the event useful?
- Perform Peer Reviews
  - Involve team (team buy-in)
  - Review in sections – not all at once
  - Use experts and specialists (e.g. CM, IVV etc....)
- Review SEMP at key reviews
  - Consider updating a SEMP at lifecycle stage reviews
    - e.g. 1-3 month detail, 3-6 month less detail, 6+ months high-level only
  - In an incremental/iterative delivery, consider a SEMP update per iteration







# The SEMP needs to be accessible

- If the SEMP is too big it will not be read...
  - Ask yourself - Is this information necessary and useful to the reader?
- If the SEMP is not navigable it will not be used...
  - Ask yourself – Would a “regular engineer” understand where to find the information they want in the document?

Say all you have to say in the fewest possible words,  
or your reader will be sure to skip them;  
and in the plainest possible words or he will certainly misunderstand them

*John Ruskin*



# Structuring the SEMP – Some ideas...

- Recognize the SEMP will be updated
- Modular - To aid update and reuse
- Use web-based mechanisms for common data or frequently changing items (e.g. organization role holders names)
- For large programs (e.g. Prime Contracts) consider high-level SEMP with lower-level subordinate plans

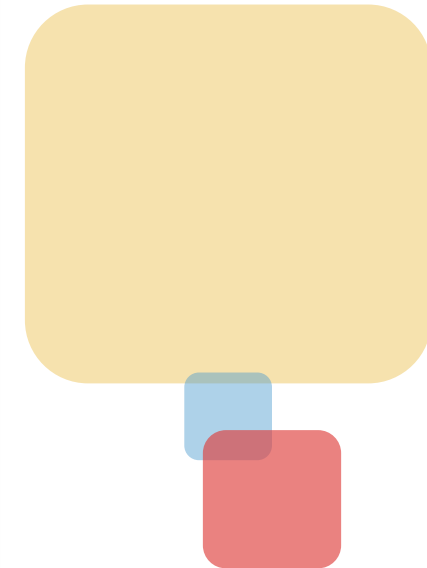
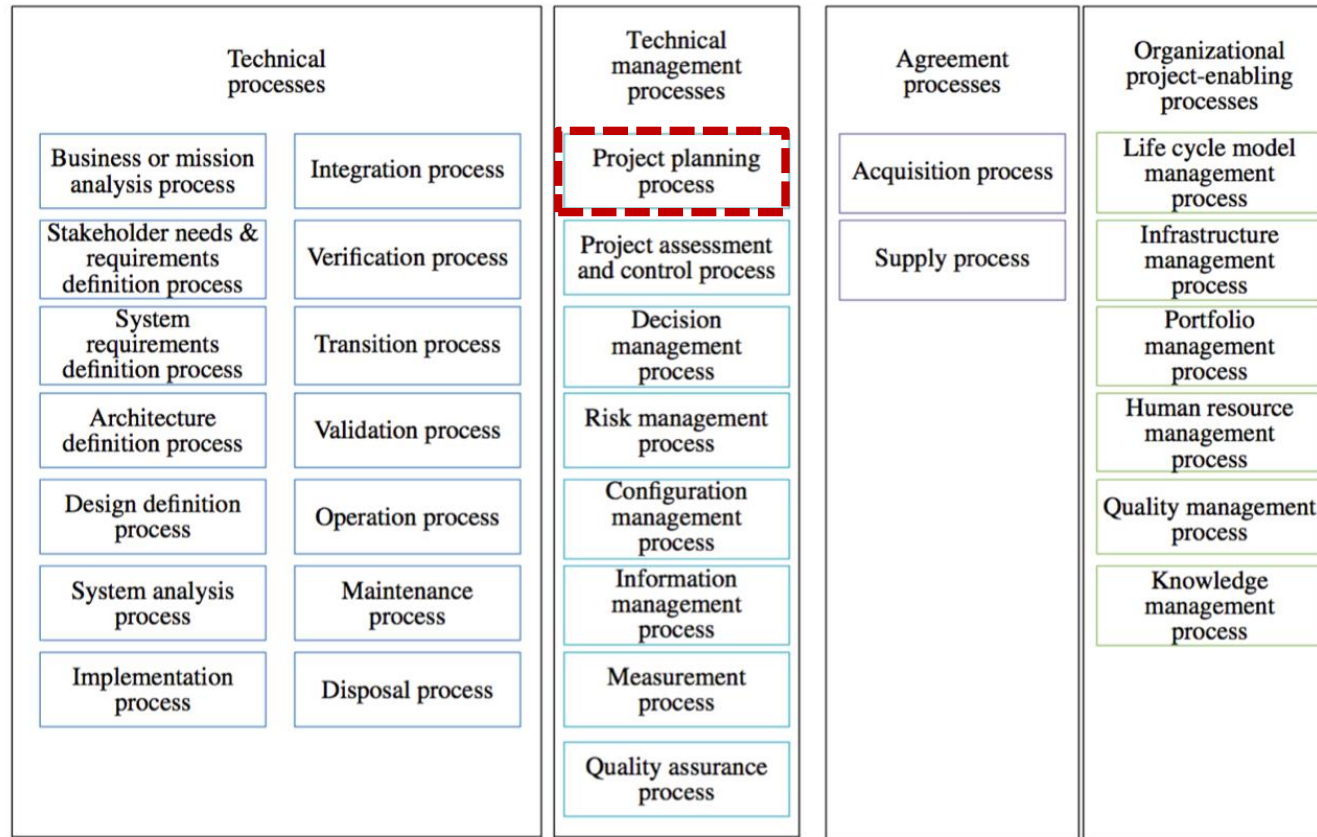




How does the SEMP fit in with other processes?

# Relationship with INCOSE SE Handbook and ISO 15288

# System Life Cycle Processes Per ISO/IEC/IEEE 15288 (2015)



**FIGURE 1.1** System life cycle processes per ISO/IEC/IEEE 15288. This figure is excerpted from ISO/IEC/IEEE 15288:2015, Figure 4 on page 17, with permission from the ANSI on behalf of the ISO. © ISO 2015. All rights reserved.



# ISO 15288 Project Planning Process

## Purpose:

- Establish direction and infrastructure necessary to assess and control the progress of a project.
- Identify the details of the work and the right set of personnel / skills / facilities with a schedule of need for resources from within and outside the organization.





# Overview of *typical* SEMP Content

## The SEMP should include:

1. Organization of the project, and how SE interfaces with the other parts of the organization. How are communications at these interfaces handled?
2. Responsibilities and authority of the key positions
3. Clear system boundaries and scope of the project
4. Project assumptions and constraints



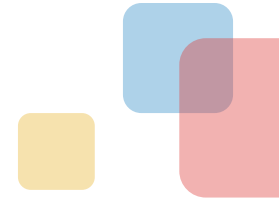
(INCOSE SE Handbook)



# Overview of *typical* SEMP Content

## The SEMP should include:

5. Key technical objectives
6. Infrastructure support and resources
7. Approach and methods used for planning and executing the technical processes
8. Approach and methods used for planning and executing the technical management processes
9. Approach and methods used for planning and executing the applicable specialty engineering processes



(INCOSE SE Handbook)



# Potential topics to be considered when writing a SEMP

- Program issues
- Issues / Constraints and Rationale for overall SE philosophy
- Key decisions and decision processes
- Document hierarchy and SEMP
- Customer needs
- System overview
- Lifecycle selection and definition
- Engineering roles and responsibilities
- Engineering planning
- Requirement analysis and management
- Interface management and control
- System design
- System Integration, Verification and Validation
- System Qualification, Certification and Acceptance
- IVV Preparation and Support
- SE Participation in transition processes
- Speciality Engineering
- Safety, Security Assurance
- Platform / Onsite integration
- Monitoring and control
- Technical reviews
- Issue Management
- Measurement / metrics
- WBS / SE WP Management
- Supplier / Partner relationships
- Tools and technologies
- Data / Configuration / Change Management
- Risk and Opportunity management
- Company standard process tailoring
- Traceability of non-technical requirements

NOTE: Some topics may not be relevant to the project or may be covered in other Plans

Ref: NCOSE SE Handbook V3.2.2





Delivering Value

# Conclusions

# Don't lose sight of what the SEMP is for



- Focus on **adding value**
  - Address issues that relevant and specific to the program - not generalised topics
- The SEMP should **not** be ...
  - A vehicle for reciting basic System Engineering principles and theory (“apple pie”)
  - A means of showing superficial compliance with company processes

# The SEMP is the top-level plan for managing the Systems Engineering effort



- How the project will be organized, structured, and conducted
- How the total engineering process will be controlled to provide a product that satisfies stakeholder requirements
- Provides guidance to a project and helps the organization avoid unnecessary discussions about how to perform SE



INCOSE Handbook v4.0, Chapter 5.1.2.2: Systems Engineering Management Plan



# SEMP should Add Value

- Understand the purpose of the SEMF within the context of the current program
  - and within the current program phase
- Make the content relevant
  - Identify what you are planning to do
  - Don't cover what you have already done
  - Don't cover things you are not going to need to do
- Use diagrams and pictures to clarify complex ideas and relationships
- Don't get tied up in the document structure
- Don't just start at Page 1 of the template...





# For Systems Engineering to work...

- Buy-in and active support are required at **all levels** of management as well as with technical contributors
- To Succeed??? – **PLAN!**

One of the nicest things about not planning is that failure comes as a complete surprise.

*Unknown*





# Useful References

- INCOSE Systems Engineering Handbook (Fourth Edition) INCOSE-TP-2003-002-004. *Compiled by Walden, Roedler et al, Published by Wiley 2015.*
- INCOSE Systems Engineering Competency Framework INCOSE-TP-2018-002-0. *Compiled and Edited by Published by INCOSE, 2018.*
- “Burden or benefit? 10 ways to a better SEMP” *Presland, I and Stoves, J, Proceedings of INCOSE International Symposium, Utrecht 2008*
- “Agile Systems Engineering” Bruce Powel Douglass. *Published by Morgan Kaufmann, 2015.*

Thank you for listening! Any questions?

