Mixed Discipline SE Training
Day 1 Intro Workshop

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Assistant: Anthony Salazar, NMT Student

Participants:

• **Griselda Acosta**	**UTEP Student**
• **Randy Anway**	**New Tapestry, LLC**
• **John Brtis**	**MITRE Corp**
• **Sergio De La Rosa**	**UTEP Student**
• **Heidi Hahn**	**Los Alamos National Lab**
• **Krishnan Iyer**	**UTEP Student**
• **Jim Larkin**	**MEI Technologies, AFRL Contractor**
• **Kerry Lunney**	**Thales Australia**
• **Tabatha Oria**	**UTEP Student**
• **Eric Smith**	**UTEP Professor**
• **Mark Timms**	**Sandia national Labs**
• **Sharissa Young**	**Sandia National Labs**

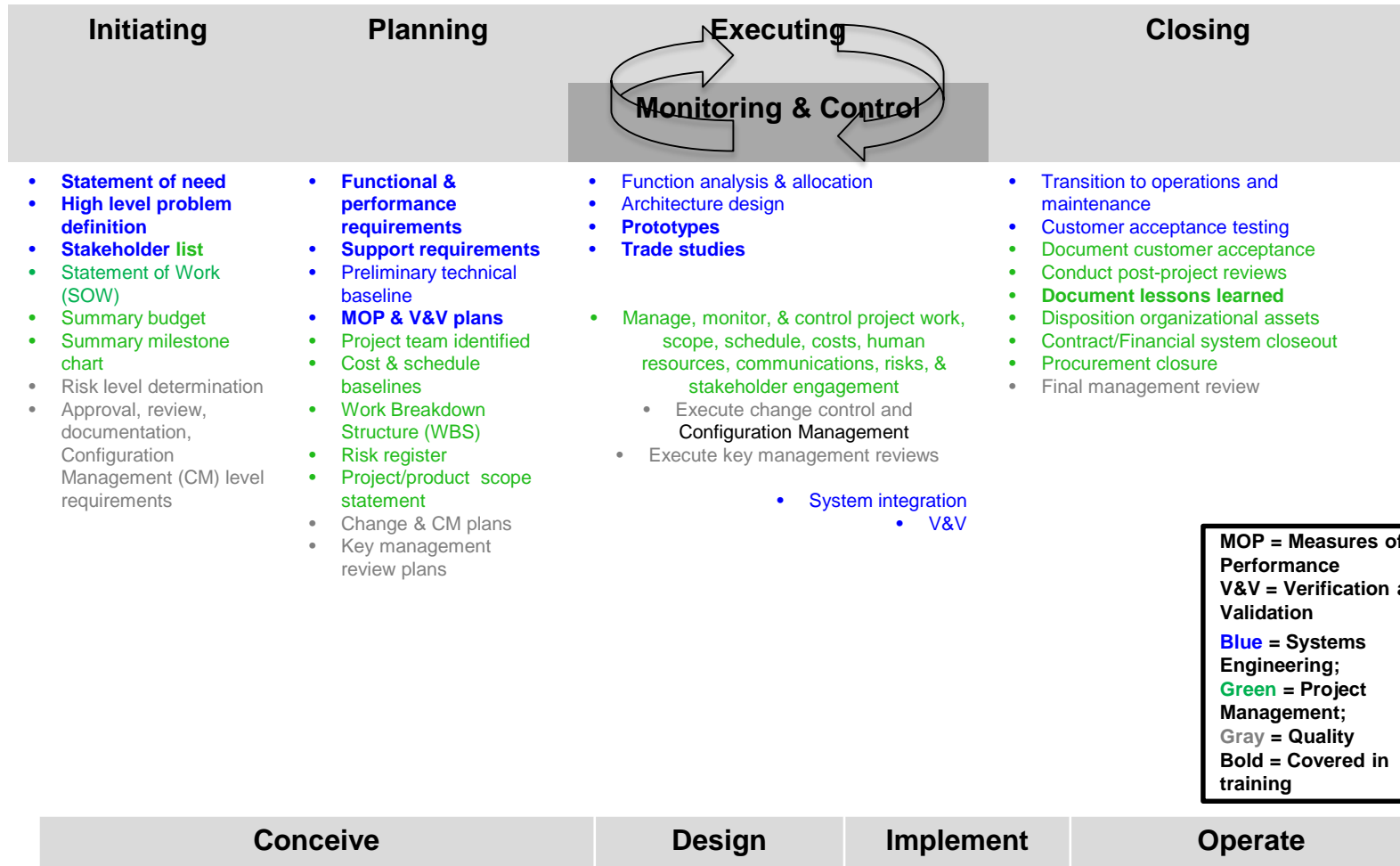# Mixed Discipline SE Training: Positioning the Problem Space

Does this mean training of SEs from a variety of engineering (and non-engineering) backgrounds? <u>or</u>

Does it mean including material from other disciplines in SE training?

YES, to both!

NOTE: The group primarily used the first interpretation

LANL's View of the Problem Space

Initiating	Planning	Executing	Closing

Monitoring & Control

• **Statement of need**	• **Functional & performance requirements**	• Function analysis & allocation	• Transition to operations and maintenance
• **High level problem definition**	• **Support requirements**	• Architecture design	• Customer acceptance testing
• **Stakeholder list**	• Preliminary technical baseline	• **Prototypes**	• Document customer acceptance
• Statement of Work (SOW)	• **MOP & V&V plans**	• **Trade studies**	• Conduct post-project reviews
• Summary budget	• Project team identified		• **Document lessons learned**
• Summary milestone chart	• Cost & schedule baselines	• Manage, monitor, & control project work, scope, schedule, costs, human resources, communications, risks, & stakeholder engagement	• Disposition organizational assets
• Risk level determination	• Work Breakdown Structure (WBS)		• Contract/Financial system closeout
• Approval, review, documentation, Configuration Management (CM) level requirements	• Risk register	• Execute change control and Configuration Management	• Procurement closure
	• Project/product scope statement	• Execute key management reviews	• Final management review
	• Change & CM plans		
	• Key management review plans	• System integration	
		• V&V	

> **MOP = Measures of Performance**
> **V&V = Verification and Validation**
>
> **Blue = Systems Engineering;**
> **Green = Project Management;**
> **Gray = Quality**
> **Bold = Covered in training**

Conceive	Design	Implement	Operate	Retire

This is LANL's view of why the answers to the previous questions were "Both." This is essentially the syllabus for multi-disciplinary training (content covers not only SE, but also Project Management and Quality) that is given to R&D Engineers from all engineering disciplines.

Straw Man Poster
Topic: Mixed Discipline SE Training

Need: We are not able to take a systems approach to (early stage) R&D because of a lack of knowledge and appreciation of the SE domain that results from failure to engage R&D staff from all disciplines in multi-disciplinary training

Customers: Program and line managers, systems engineers

Issues to focus on:

This was a starting point. We first modified the need statement and customers through large group discussion, then brainstormed ideas for issues to focus on onto stickies, clustered them, and summarized them (see next slide for results).

My issues:

1. Lack of knowledge and appreciation of the SE domain
2. Lack of semantic consistency/use of common terminology across disciplines
3. Tunnel vision – reluctance to abandon disciplinary focus and/or the idea that the out-of-discipline functions are someone else's purview

Topic: Mixed Discipline SE Training
Reception Poster

Need: We are not able to take a systems approach because of a lack of knowledge and appreciation of the SE domain that results from failure to engage staff from all disciplines in mixed discipline SE training

Customers: Program and line managers, systems engineers, discipline engineers from various domains, trainers/educators, acquirers

Issues to Focus On:

1. **Silos based on domain/discipline, the need to include people from other disciplines in SE training**
2. **Lack of communication about SE value, lack of standards and processes**
3. **Lack of leadership in promoting SE**
4. **Differences in language and terminology, lack of semantic consistency**
5. **Balancing and integrating stakeholder needs**

Mixed Discipline SE Training
Day 2 Workshop Results

Day 2 Participants:

- **Heidi Hahn**   **Los Alamos National Lab**
- **Krishnan Iyer**   **UTEP Student**
- **Anthony Salazar**   **NMT Student**

Topic: Mixed Discipline SE Training

Need: We are not able to take a systems approach because of a lack of knowledge and appreciation of the SE domain that results from failure to engage staff from all disciplines in mixed discipline SE training

Customers: Program and line managers, systems engineers, discipline engineers from various domains, trainers/educators, acquirers

Issues to Focus On:

1. **Silos based on domain/discipline, the need to include people from other disciplines in SE training**

2. **Lack of communication about SE value, lack of standards and processes**

3. **Lack of leadership in promoting SE**

4. **Differences in language and terminology, lack of semantic consistency**

5. **Balancing and integrating stakeholder needs**

Notes on the Issues

We quickly realized that instead of having five more or less orthogonal issues, we had two groupings of related issues

- The first has to do with silos based on disciplines and the competition and within-discipline complacency that arises as a result
    - Interestingly, some participants didn't understand the term "silos" – "swim lanes" worked
- The second has to do with the lack of leadership and communication about SE that results from weakness in the SE value proposition or in how that value has been communicated, particularly to non-SEs
    - The value proposition for SE is a long-standing issue that INCOSE has been working
        - Hard to attribute success on a project to SE, can't prove that SE would have helped on a failed project
        - SE often perceived as an add-on that increases cost
    - What's the ROI for investments in giving employees SE knowledge?

It was also brought to our attention that another topic leader was using the term "mixed discipline" to mean software and hardware rather than different engineering disciplines/domains as we had been

➢ Even within SE, there are issues with semantic consistency!

Organizational and Cultural Impediments

These were provided as examples to get people aligned re: what we meant by organization and cultural impediments and what differentiates them:

Organizational	**Cultural**
-- Stove-piping based on discipline, including physical isolation of disciplines	**-- Lack of understanding of the value and limitations of one's own and others' disciplines**

A great resource for learning about impediments is *Barriers to Interdisciplinary Research and Training* available at: https://www.ncbi.nlm.nih.gov/books/NBK44876/

Organizational and Cultural Impediments Contributing to the Issues

- **Silos based on domain/discipline results in not including other disciplines in SE training**
  - **Incentives (funding and other resources [e.g., lab space], publication venues, promotion paths) reinforce silos, as do organizational structures**
    - **Too much encouragement to be a specialist compared to a generalist**
- **Differences in language and terminology, lack of semantic consistency**
  - **No motivation for cross discipline language – Why learn French if I'm never going to France?**
- **Balancing and integrating stakeholder needs**
  - **Competition between disciplines for who is the most important stakeholder to satisfy – I need to make my boss happy and I don't care about yours**

- **Lack of leadership in promoting SE due to inability to articulate a value proposition for SE**
  - **Results in career progression to SE leadership roles not being seen as desirable – No SE leaders = no promotion of SE**
- **Lack of communication about SE value, lack of standards and processes**
  - **Focused on their own piece of the puzzle (tunnel vision), leaders don't communicate the big picture**
  - **Why develop SE standards and processes if SE value not demonstrated?**
  - **Lack of know-how on how to tailor and implement SE processes**

Requirements for Solution

What would it take to overcome each organizational and cultural impediment?

Examples:

Organizational

Stove-piping based on ⟶ **Multi-disciplinary**
discipline, including physical **departments, co-location of**
isolation of disciplines **staff, shared facilities**

Cultural

Lack of understanding of the ⟶ **Integrated review groups that**
value and limitations of one's **cover the full range of expertise**
own and others' disciplines **necessary and whose members**
are engaged in multi-disciplinary
training

Organizational and Cultural Requirements

- Silos based on domain/discipline results in not including other disciplines in SE training
- Differences in language and terminology, lack of semantic consistency
- Balancing and integrating stakeholder needs
    - Multidisciplinary departments
    - Co-location of staff, shared facilities
    - Integrated review groups that cover the full range of expertise necessary and whose members are engaged in mixed discipline SE training
    - Include SE core and professional competencies in specialist competency frameworks*
    - Collaboratively develop a shared ontology*
- Lack of leadership in promoting SE due to inability to articulate a value proposition for SE
- Lack of communication about SE value, lack of standards and processes
    - Need compelling stories demonstrating the value of SE* – Analogy of the value of marketing or IT, neither of which was considered essential when first introduced
    - Demonstrate how SE services enable success of profit centers*
    - Articulate career paths and provide exposure to cross-departmental job opportunities; ensure that cross training (e.g., rotational assignments) is valued
    - Provide tailorable SE standards and processes and practical guidance on how to tailor*
    - Include the big picture in all project communications

The sub-bullets are the things that would need to be in place to (start) to address the impediments that lead to the issues.

Most of the above actions would be for academia and companies to implement. * = INCOSE should lead or could help. The group agreed to follow up with relevant INCOSE WGs (primarily Analytic Enablers and Application Domains WG) and the CAB.