2023 Annual INCOSE international workshop
HYBRID EVENT
Torrance, CA, USA
January 28 - 31, 2023

Collaboration in Needs and Requirements Development

Good Collaboration and Effective Communications are Critical to Project Success

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Problem: No Tool can Do It All

- Projects made up of human beings
- Misinterpretations arise
  - Would take years to do enough SysML
  - Well-intentioned, but costly
- Lack of collaboration, poor communication
  - Rework, slower performance
- Digital Ecosystem / MBSE tools help
  - Not enough to overcome cultural barriers

Solution: Work The Three C's

- ## Collaboration, Communication, Culture
  - Reduces rework, redundant efforts, saves time
    - The right information to the right team(s)
    - Early fixes to errors in the model
    - Configuration Management
    - Team members informing each other voluntarily
    - Accurate information given to leadership voluntarily

Three Areas

- *Collaboration*
  - *Importance of an Integrated, Collaborative Project Team, NRM Section 2.9*

- *Communications*
  - *Importance of Effective Communications, NRM Section 2.10*

- *Collaborative Systems Thinking Culture*
  - *IS 2022 paper/poster, INCOSE TLI*

Needs and Requirements Manual, Section 2.9: Importance of an Integrated, Collaborative Project Team

Collaboration

Without Collaboration, Grinds to a Halt

- Teamwork between customer, supplier, third parties
  - Basic respect and code of conduct
- Applies within supplier / developer
  - Large programs, multiple facilities and sites
- Is the environment safe enough to share?
  - Collaboration includes vulnerability.

Internal safety, and the unwritten incentive structure, may be hindering needed teamwork
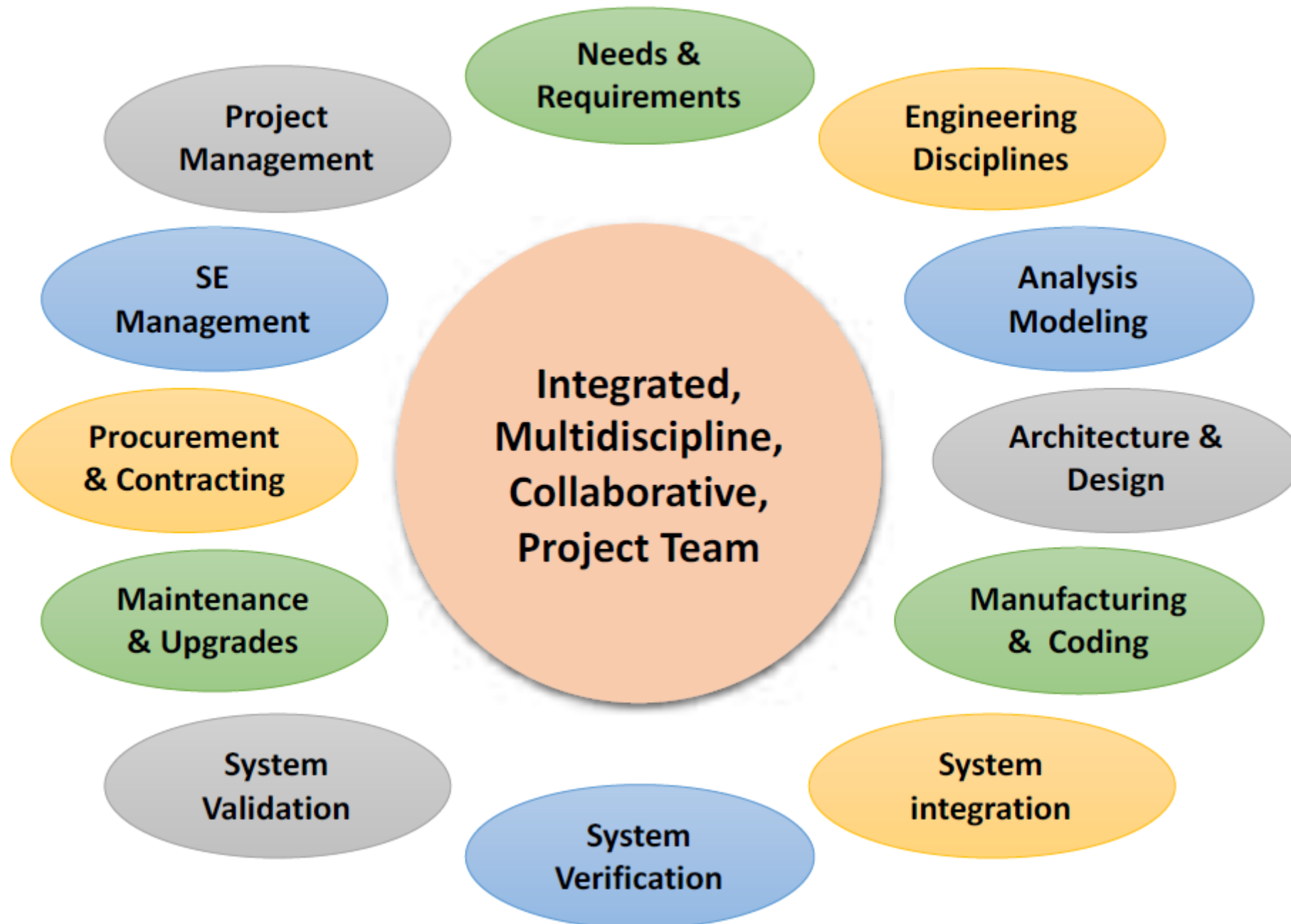
Collaboration and the Project Structure

- Agile development is popular
- Even without Agile, today's projects – very complex
- Still needs to be steered from the top
- The right project team structure can facilitate
- Cannot have everyone do deep collaboration all the time
  - The SME engineers need to execute their tasks
- Tiered structure can be very effective

Example Team Structure
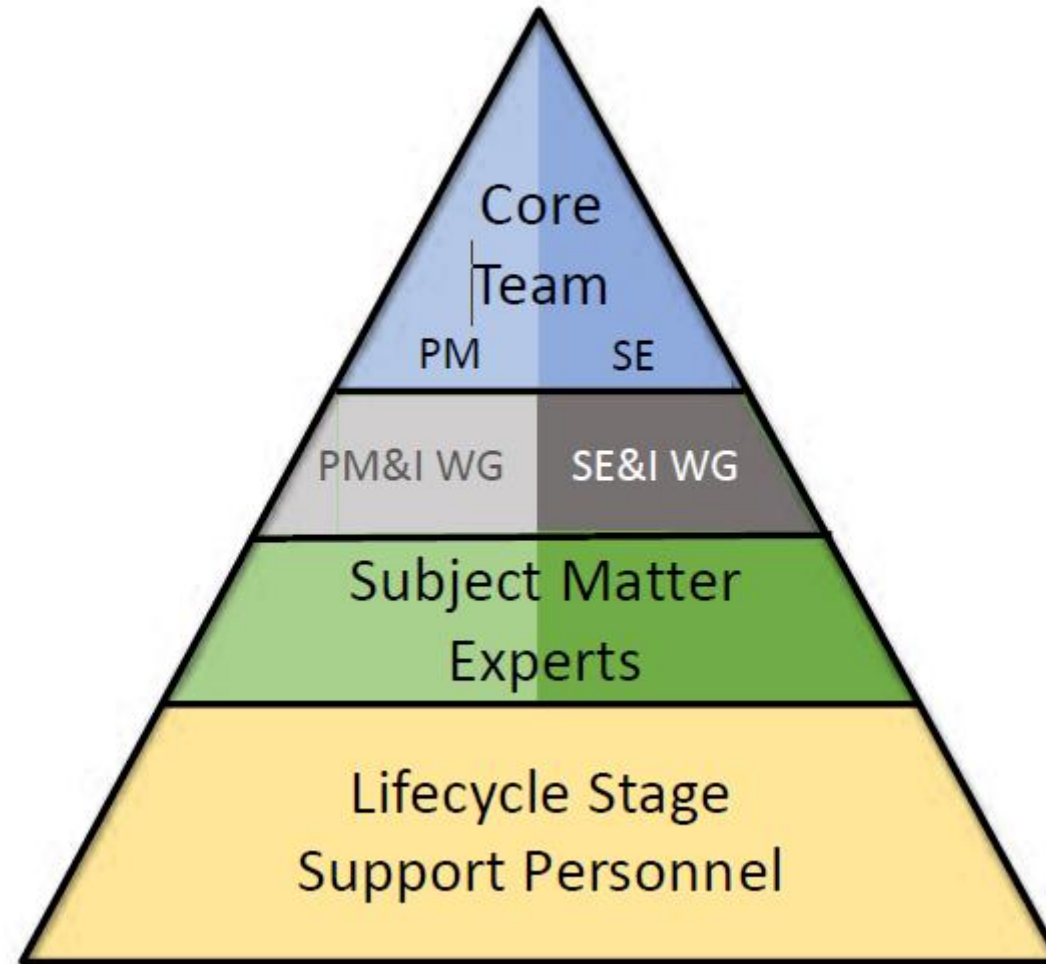
Collaboration Not Enough

- If the wrong information is passed around
  - Well-intentioned, but expensive rework

- Communications must also be in step
  - Single, integrated data and model
  - Robust configuration mgmt., chg. Control
  - Interpersonal communications

Needs and Requirements Manual, Section 2.10: Importance of Effective Communications

Communications

Needs / Requirements Work

- Requires thorough communications at many levels

  – Understanding customers needs

  – Educating customer on needs vs. requirements

  – Transmitting design input information to designers

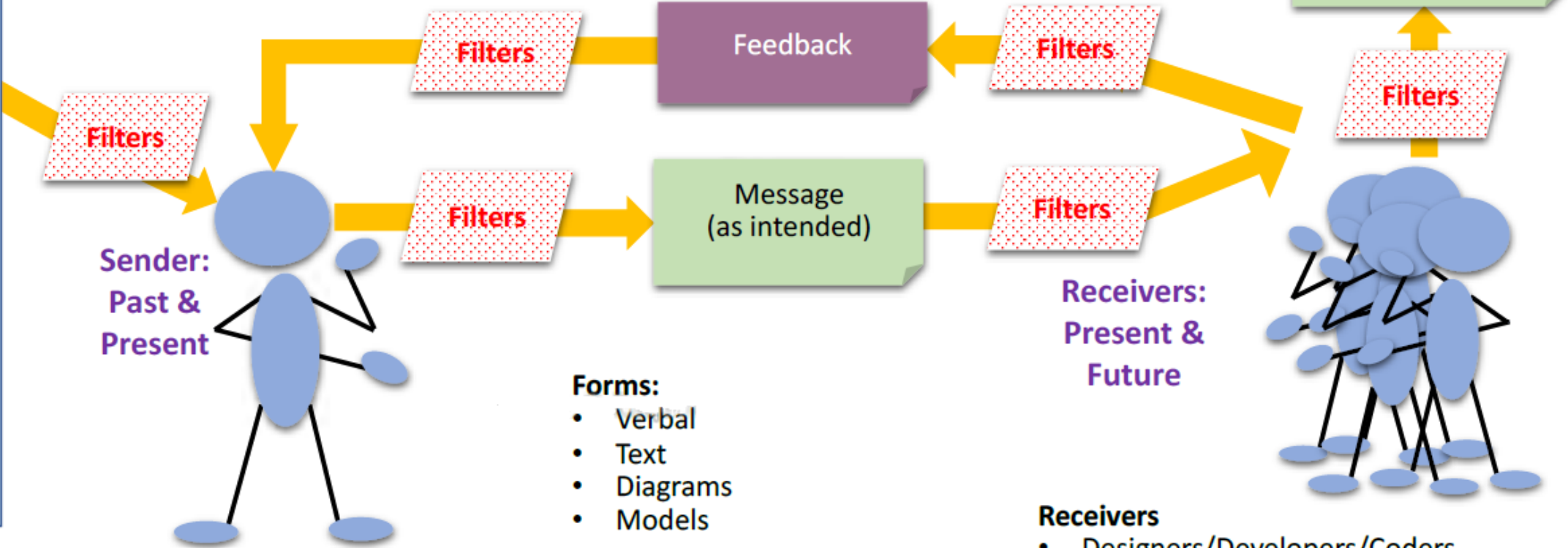 – Communicating to the customer the results for verification and validation

Success Requires Great Communication

- Without it, great process = OK results

- This is a solvable problem!

- Knowledge of how communications work, awareness is needed

Communication Model

Problem Statement, Mission, Goals, Objectives, MOSs, Needs, Expectations, Requirements Lifecycle Concepts, Drivers, Constraints, Risks, Needs, Requirements, Architecture, Deign, Design Output Specifications

Filters

Filters

Feedback

Filters

Message (as understood)

Filters

Sender: Past & Present

Filters

Message (as intended)

Filters

Receivers: Present & Future

Forms:
- Verbal
- Text
- Diagrams
- Models

Senders:
- Customer
- Managers
- Requirements Engineer
- Business Analyst
- Business Management
- Architects, Designers
- Regulators
- Standards Organizations
- Procurement
- Contracts; Lawyers

Media:
- Face-to-face
- Phone
- Email
- Printed Document
- Electronic Document
- Electronic Tool(s) database/models

Receivers
- Designers/Developers/Coders
- Testers (Verification/Validation)
- Customers
- Users/Operators
- Managers
- Quality Organization
- Regulators
- Standards Organization
- Procurement; Contracts; Lawyers
- Maintainers; Sustaining Engineers

Three Keys to Communicate Effectively

- What the receiver understood is what counts
  - Not what we meant, or even said…

- Appearances can deceive
  - The "Please leave me alone" head-nod

- Many modalities and forms
  - Neuro-linguistic programming (NLP)
  - Different types of media

Keeping These Changes Long-Term

- How to have a collaborative environment and good communications persist?
  - Training, helps.
  - Baked into the culture? Yes!
  - Add in systems-thinking for even better results
- Cultural change is possible
  - Yield the longest-term benefits
  - Collaborative Systems-Thinking Culture (CTSC)

Collaborative Systems Thinking Culture

Work done as part of INCOSE's Technical Leadership Institute Cohort 6; see IS 2022 paper for full author list.
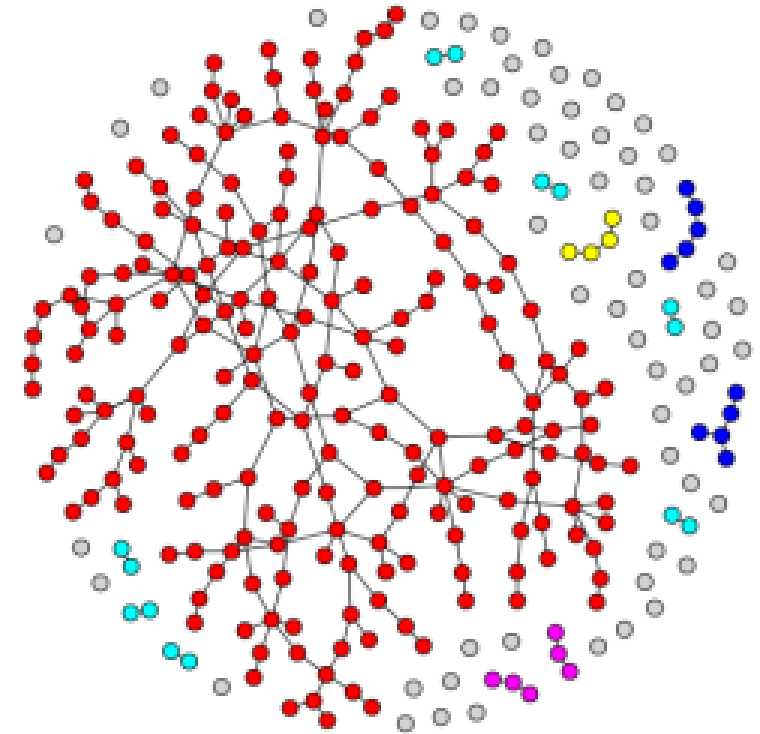
Collaborative Systems Thinking Culture

- Cultural aspects of our work environment

- Collaboration

- Systems-Thinking

Combining the two into the culture – can greatly improve our Needs and Requirements effort

Problem Statement and Solution

- The world is more complex, with rapid changes requiring more integrated collaboration to solve the tough technical problems organizations face.

- To solve these problems, a mindset shift centered on collaborative systems thinking culture (CSTC) will assist substantially.

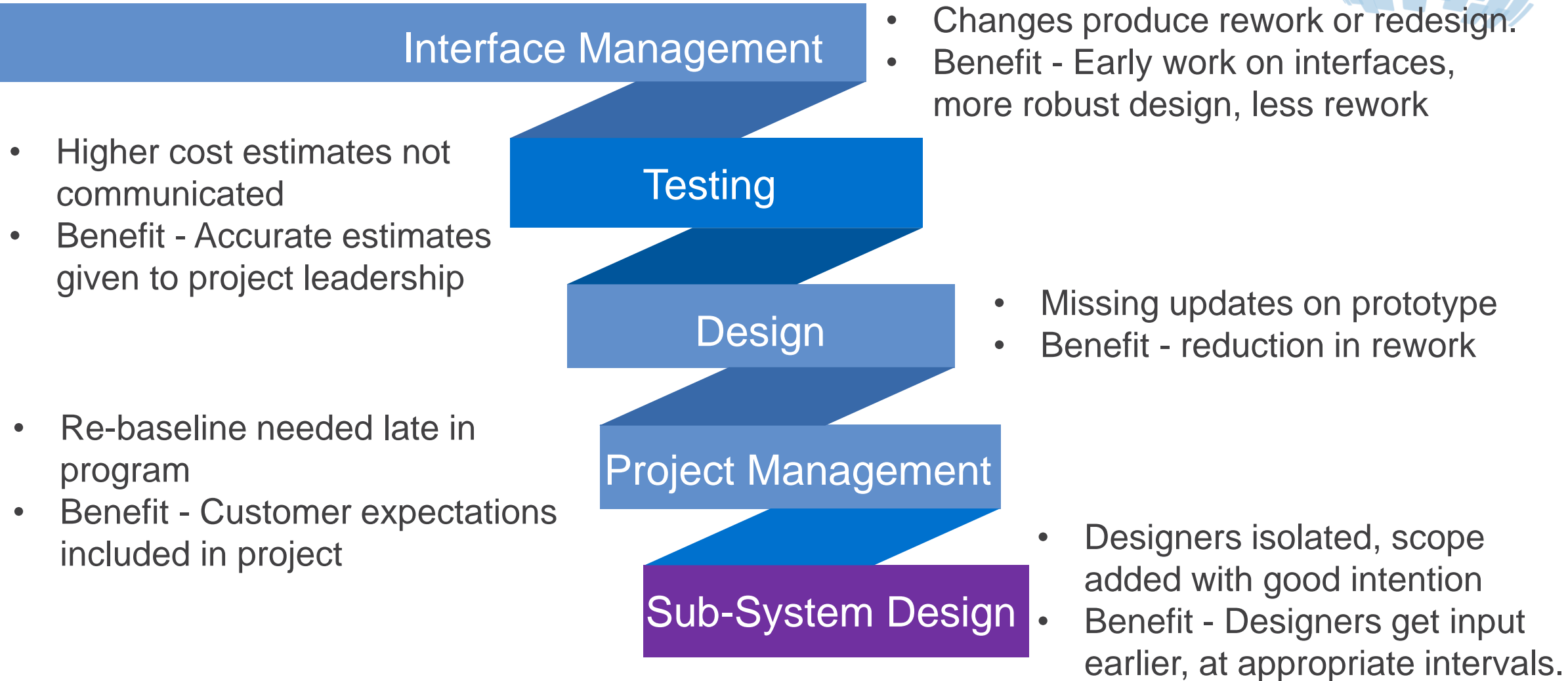- 7-step process to make this transition in the organization

CSTC Definition

- Collaborative Systems Thinking:

    "An emergent behavior of teams resulting from the interactions of the team members and utilizing a variety of thinking styles, design processes, tools, and communication media to consider the system, its components, interrelationships, context, and dynamics toward executing systems design (Lamb, Rhodes et al., 2008)."

- How to implement?

  - Requires deep understanding of **systems thinking**

  - Need a sense of an organization's **culture**

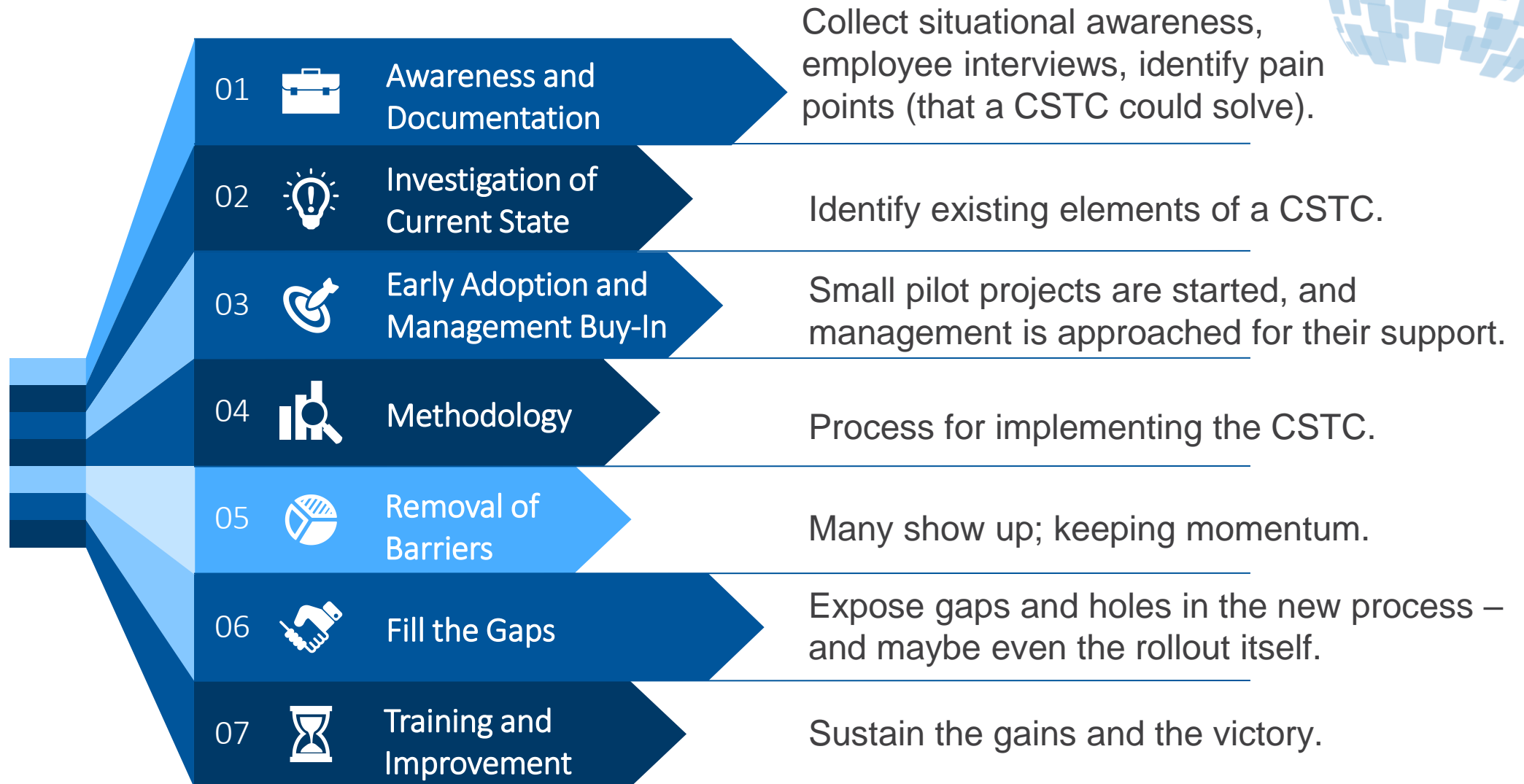**Movement towards a CSTC requires understanding both!**

Problems Addressed and Benefits Provided

Interface Management

- Changes produce rework or redesign.
- Benefit - Early work on interfaces, more robust design, less rework

- Higher cost estimates not communicated
- Benefit - Accurate estimates given to project leadership

Testing

Design

- Missing updates on prototype
- Benefit - reduction in rework

- Re-baseline needed late in program
- Benefit - Customer expectations included in project

Project Management

Sub-System Design

- Designers isolated, scope added with good intention
- Benefit - Designers get input earlier, at appropriate intervals.

Phases for Implementing in an Organization

01 Awareness and Documentation
Collect situational awareness, employee interviews, identify pain points (that a CSTC could solve).

02 Investigation of Current State
Identify existing elements of a CSTC.

03 Early Adoption and Management Buy-In
Small pilot projects are started, and management is approached for their support.

04 Methodology
Process for implementing the CSTC.

05 Removal of Barriers
Many show up; keeping momentum.

06 Fill the Gaps
Expose gaps and holes in the new process – and maybe even the rollout itself.

07 Training and Improvement
Sustain the gains and the victory.

CSTC

Enablers and Barriers to Increased CSTC
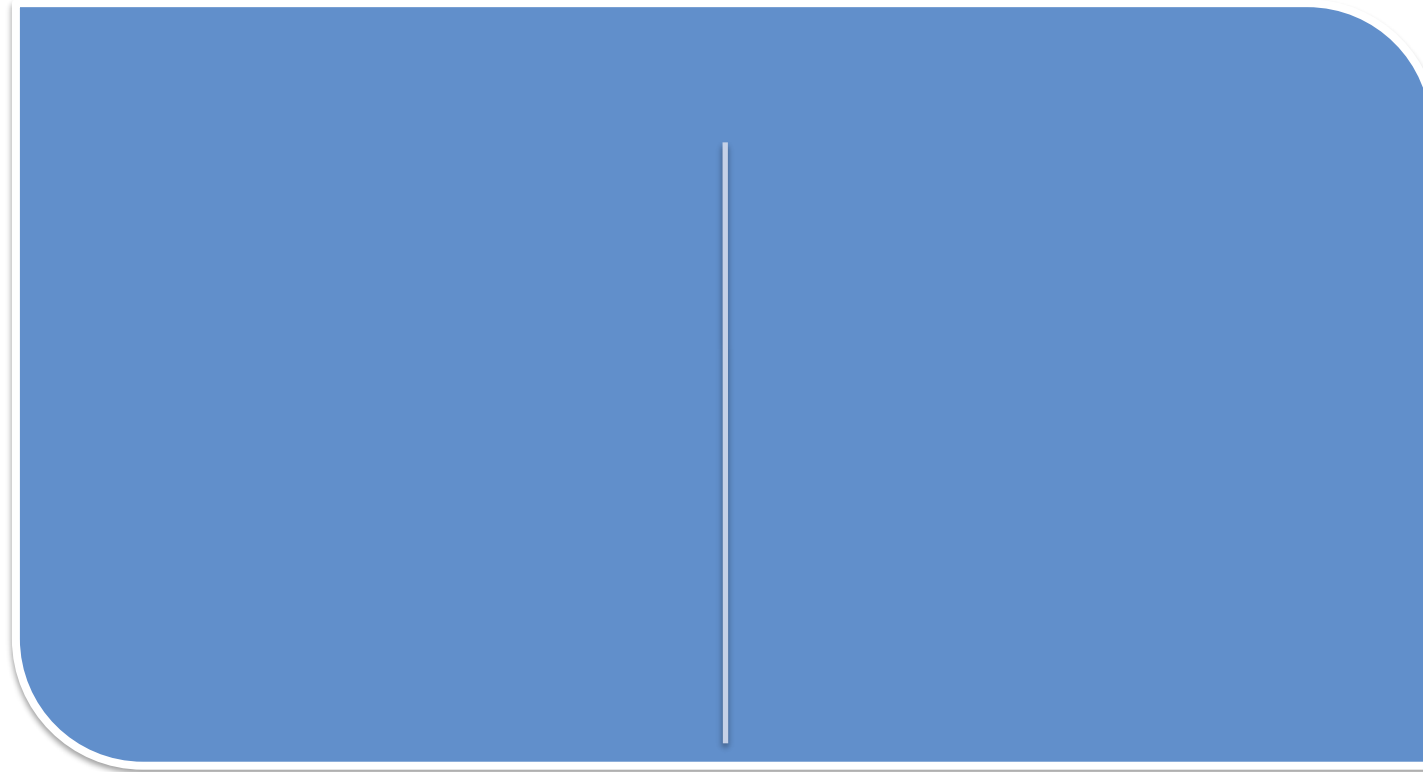
CTSC in the Organization - Workshop

- Workshop held Nov 8-9, 2022

- INCOSE Tech Leadership Inst. Community

- Brainstorming session

  - Ideas and experience on all 7 areas

  - General thoughts

- Shared workspace exercise (Miro)

Takeaways: Culture is Tricky

- Cannot just tell people, "Ok, now – collaborate!"
- Systems-Thinking also hard to command
- Small steps can have big impact
  - Collaborative tools, Miro/Others, like the workshop!
- Can prevent avoidable problems
  - Rework, in 20/20 hindsight, often painful
- Not the cure all
- Formal training, with budget, required to penetrate culture

CTSC is Hard Work, and Do-able!

- Many groups – already do one or both
  - Collaboration, and Systems Thinking – but with different names
- Do not need a technical background
  - Technicians, Proj. Mgmt. staff – can be great systems thinkers
- Relationships count – as does longevity
  - Design, Production halves of an industry
  - "Phone a Friend.."
  - Models can help, as can a Digital Environment
- We behave as per our incentives!
  - What is *really* rewarded, formally or informally?

Not All During Work Hours!

- New meeting series
  - 1-2 hrs/week max, inviting systems and component engineers
  - Hardware and software
  - Informal discussion, formal publication of decisions/actions
- Carefully worked collaboration tools
  - Needs/requirements VERY well defined up front
  - Can be digital, or "MS Office".
- After hours / outside-the-office team building
  - During work travel – going out to eat / Happy Hour
  - Getting to know each other, old-fashioned but effective!

Potential Upside is Large

- CSTC helps to **increase customer satisfaction**, and boost the organization's bottom line as well as their overall contribution to society.

- **Cut development time** with reduced rework.

- CSTC can provide Systems Engineers with a **mindset ready to solve complex problems** and grow leadership within engineering domains.

- Systems Engineers and SE leaders should consider steps towards a CSTC mindset **in themselves first**, and then the organization, to continue to provide solutions to modern complex problems.

Needs and Requirements is Important Work

- Key questions to ensure success:
  - Is there sufficient collaboration?
  - Are there communication problems
    - Including, communication done by models
  - Is there a mindset for systems-thinking?
    - Technical and organizational
  - Could all this baked into the organizational fabric?
    - Collaborative Systems-Thinking Culture

Questions?

Collaborative Systems Thinking Culture: A Path to Success for Complex Projects

Abstract: The world is filled with hard, complex problems seeking solutions. To make these often daunting problems more manageable to solve, both a mindset shift, and key candidate methodologies centered around a collaborative systems thinking culture are proposed. The idea is to introduce not just some collaborative practices, or systems-thinking approaches. Rather, the proposal for solving the tough problems – complex problems that basic approaches do not seem to solve – is to move an organization beyond basic techniques into a culture that has as its core a collaborative and systems-thinking theme. This paper will present an introduction to what a collaborative systems thinking culture (CSTC) is and looks like. The paper starts with exploring the state of the practice, presents the mindset change involved with systems thinking, propose that a collaborative approach is a part of this shift, and then conclude with the 7 phases that the reader can introduce into their organization to realize some of the benefits. What the attendee will learn, is a practical, 7-step approach to help facilitate moving their group to a more collaborative culture. Not all steps must be done at once, and the approach of course is tailorable to the attendee's situation. Cultural change can be hard, but this presentation will provide ideas and a process to get started. The intent is that with the right amount of CSTC in the organization, projects will produce results of higher quality, with better schedule and cost performance.

Speaker Bio

Raymond Wolfgang helps a variety of National Systems complete projects on-time and on-budget through crafting and managing requirements, verification, and validation activities. He currently serves as a Systems Engineer at Sandia National Laboratories in Albuquerque, NM. He has led requirements authorship and analysis for several programs, at both the systems-level and for multiple components. He has deployed several process improvement initiatives in requirements management, and currently leads an effort to complete a large program's use case portfolio. His INCOSE papers focus on requirements state-of-practice, and injecting MBSE into current programs that are already midway into the lifecycle. Raymond currently serves on the INCOSE Requirements Working Group, and as a member of the INCOSE Technical Leadership Institute (TLI). Before Sandia, while working for the US Navy (NAVWAR in San Diego), Raymond managed installation requirements for a critical ship-board technology refresh and served as a systems engineer and electrical engineer on several research and development programs. Raymond has a Master's degree in Electrical Engineering from Purdue University (USA), and remains involved in Toastmasters International as well as the Enchantment chapter of INCOSE in the southwest US. He is originally from the Philadelphia, PA, USA area.