



# SLS Integrated Quality and Communication

**Leigh Key**

MSFC QD35 Systems Engineering and  
Integration (SE&I) Operations Quality  
Engineering Team Lead

National Aeronautics and  
Space Administration



**MARSHALL**  
SPACE FLIGHT CENTER

# Directors Agree Communication is **Key**



**“As engineers, our primary tasks involve dealing with imperfect engineering and imperfect hardware processing.... communication is a critical element of this process.” Steve Cash, former SMA Director**



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Communications are critical and, like engineering and manufacturing efforts, they can also be **imperfect**.

***Systemic imperfections:*** different meanings for words/acronyms, different Bodies of Knowledge and styles of thinking, and different Program cultures.

***Individual challenges:*** listening, articulation, information, personalities.

 Poor communication can be costly: ***A Brief Story . . . .***

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Poor communication can be costly: ***A Brief Story . . . .***



**Communication: Critical to Mission Success**

# QE Decisions: Flexible Surveillance Strategies

NPR 8735.2B - TOC      Verify current version before use at: <http://nsls1.gsfc.nasa.gov>      Page 1 of 35

 **NASA**  
**Procedural**  
**Requirements**      **NPR 8735.2B**  
Effective Date: August 12, 2013  
Expiration Date: August 12, 2018

**COMPLIANCE IS MANDATORY**

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**Management of Government Quality Assurance Functions for NASA Contracts**  
**Responsible Office: Office of Safety and Mission Assurance**

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## SMA GMIP AUTHORITY SOURCE

# NASA NPR 8735.2B

8735.2, 8.2.1: Program/project offices, with NASA SMA Lead and SMA office support, shall determine and assign GMIPs based on an analysis of risks related to contract noncompliance.

# QE Decisions: Flexible Surveillance Strategies

NASA  
Procedural  
Requirements  
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Chapter 3. Program Project Quality Assurance Surveillance Plan (PQASP)



  
National Aeronautics and  
Space Administration

**SLS-RQMT-014**  
REVISION E  
EFFECTIVE DATE: NOVEMBER 16, 2017

**SPACE LAUNCH SYSTEM (SLS) PROGRAM  
SAFETY AND MISSION ASSURANCE (S&M)  
REQUIREMENTS**

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The electronic version is the official approved document.  
Verify this is the correct version before use.

## SLS REQUIREMENT CAPTURE **SLS-RQMT-014**

SLS-RQMT-014, 6.8.4: The Government intends to use a combination of GMIPs and In-Line Assessment (ILA) to verify safety/mission critical attributes of the flight hardware and assembly/manufacturing and checkout processes.

# QE Decisions: Flexible Surveillance Strategies

1000-001-0000

NASA  
Procedural  
Requirements  
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Management of Government Quality Assurance Functions for  
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- 2.3 Commercial Items Acquired under FAR Part 127
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SLS-RQMT-014, 6.8.4: The Government may utilize ILA for those safety/mission critical attributes where a documented qualitative RBA [Risk-Based Assessment] is performed, which evaluates the safety and quality characteristics of the process and/or inspection point, and where it is shown that there is sufficiently low risk . . . of an undetected defect inherent in that process or specific inspection point.

# QE Decisions: Flexible Surveillance Strategies

NASA Procedural Requirements  
CONFORMANCE IS MANDATORY

Management of Government Quality Assurance Functions for NASA Contracts  
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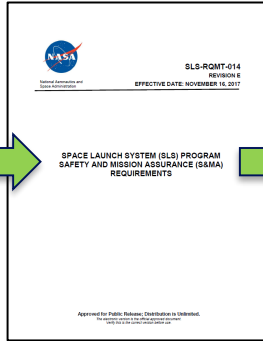
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**Chapter 2. Government Contract Quality Assurance Requirement**

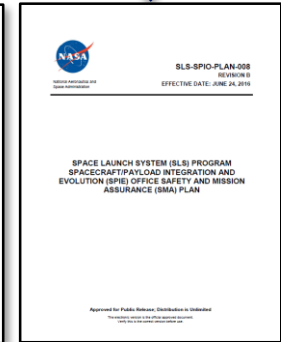
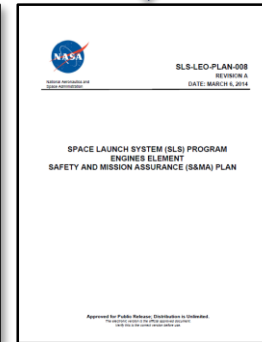
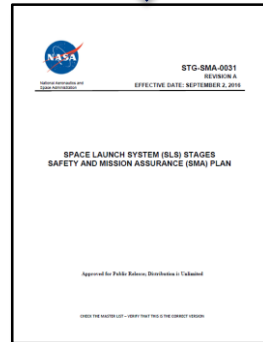
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- 2.4 Government Acquisition of the Small Business Items
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**Chapter 3. Program Project Quality Assurance Surveillance Plan (PQASP)**



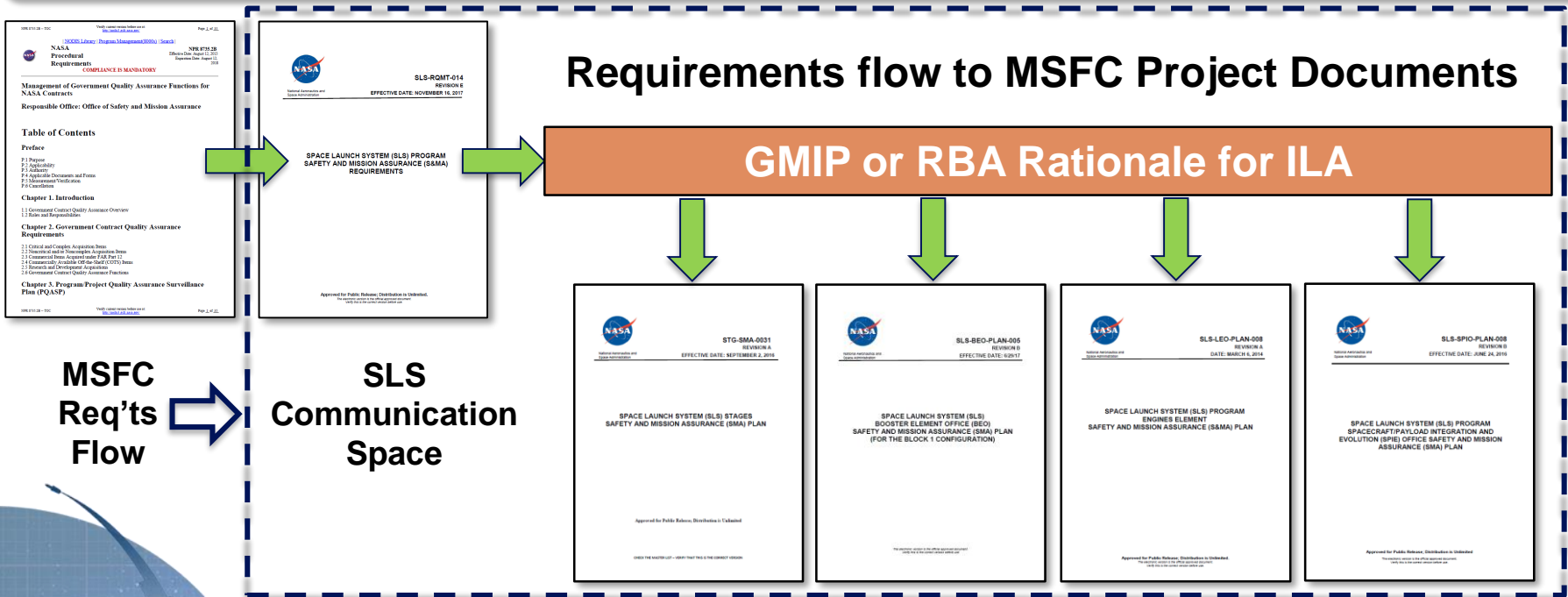
## Requirements flow to MSFC Project Documents

### GMIP or RBA Rationale for ILA

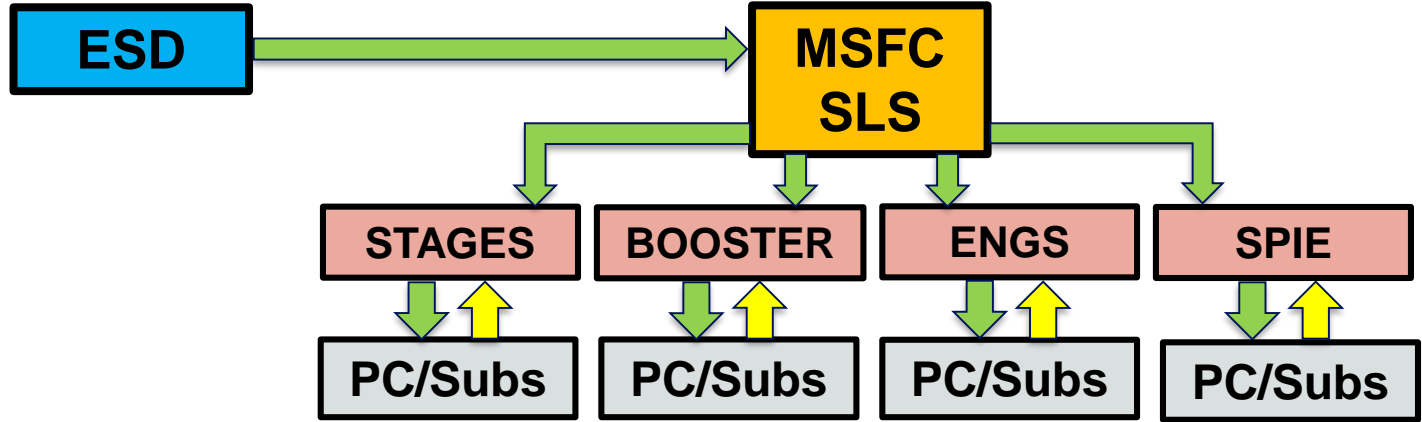




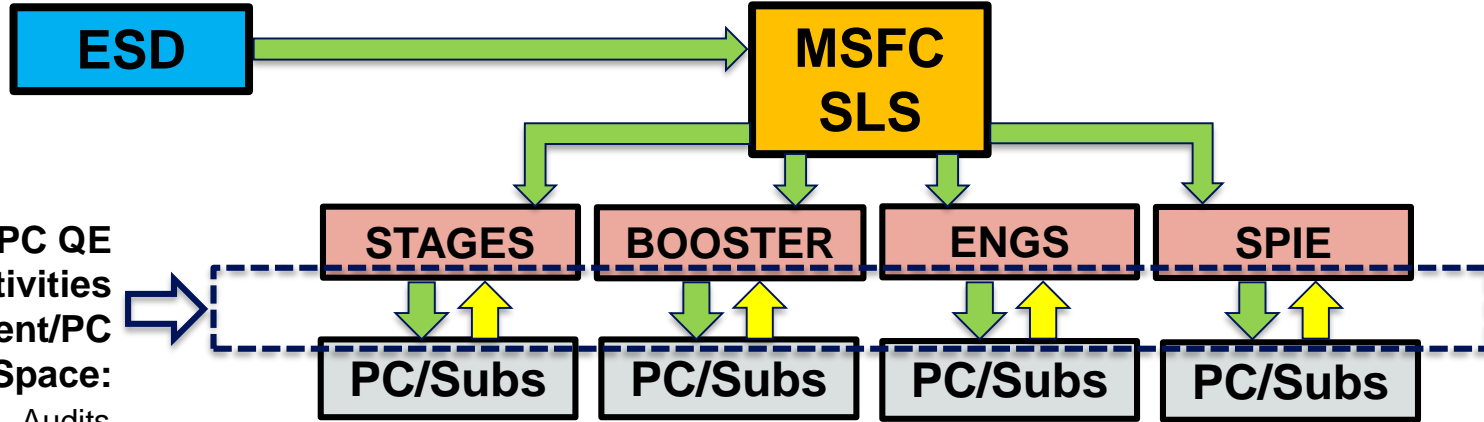
# QE Decisions: Flexible Surveillance Strategies



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RMO, MSFC and PC QE  
Pre-Delivery Activities  
Occurring in Element/PC  
Communication Space:

Audits

Print and Plan Reviews

GMIP or RBA/ILA Determination

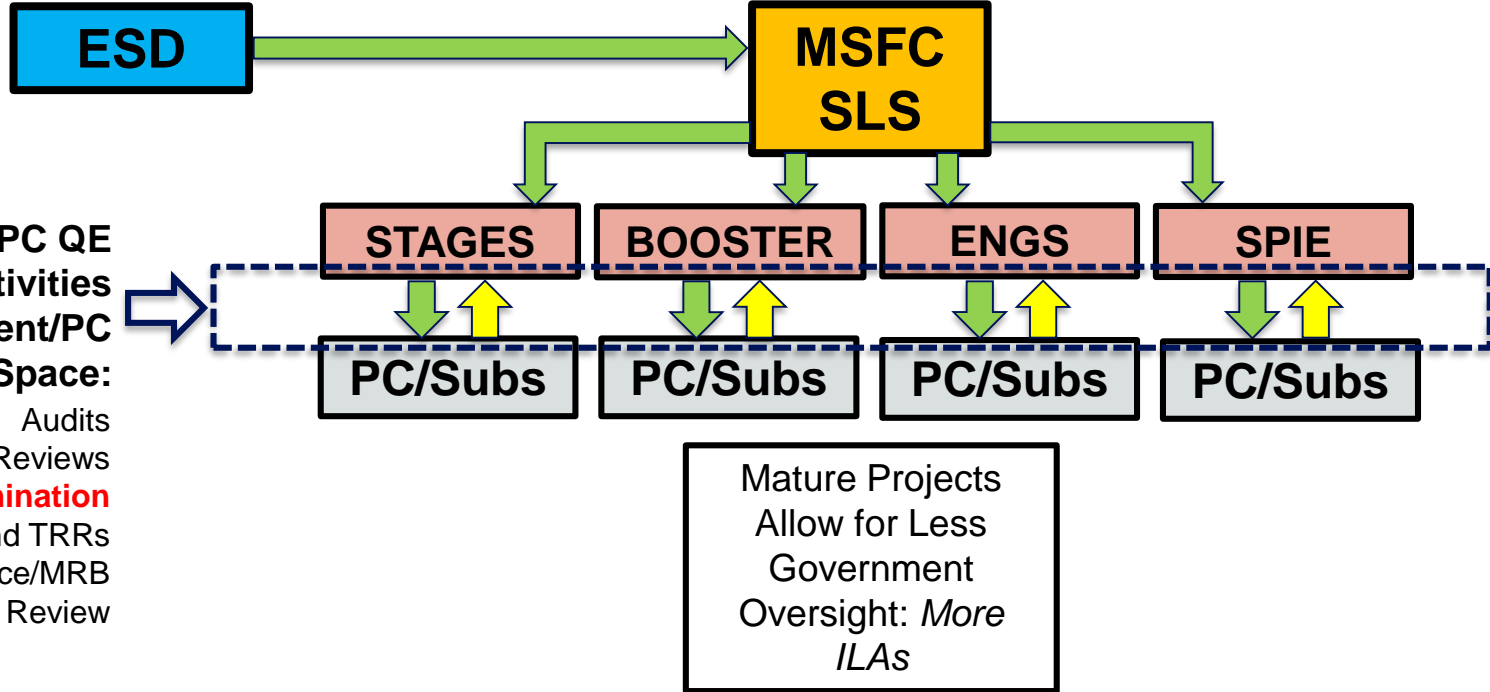
MRRs and TRRs

Nonconformance/MRB

Acceptance Review



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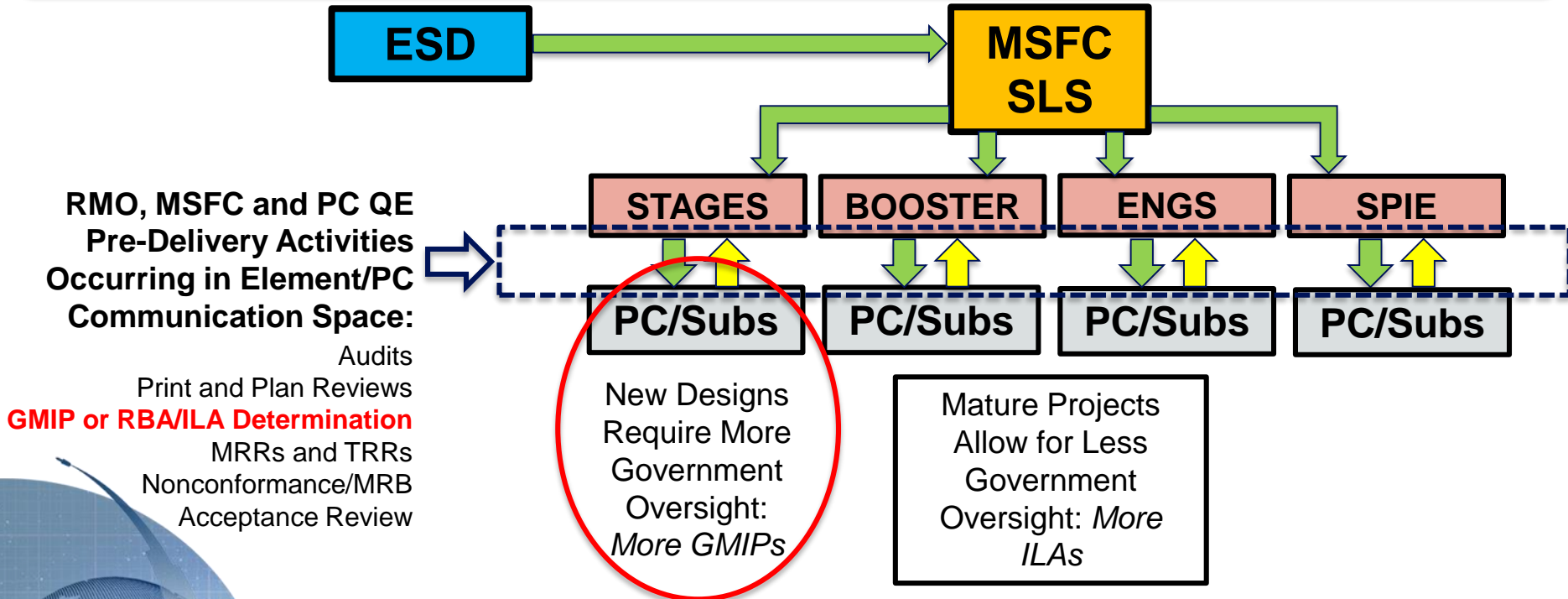
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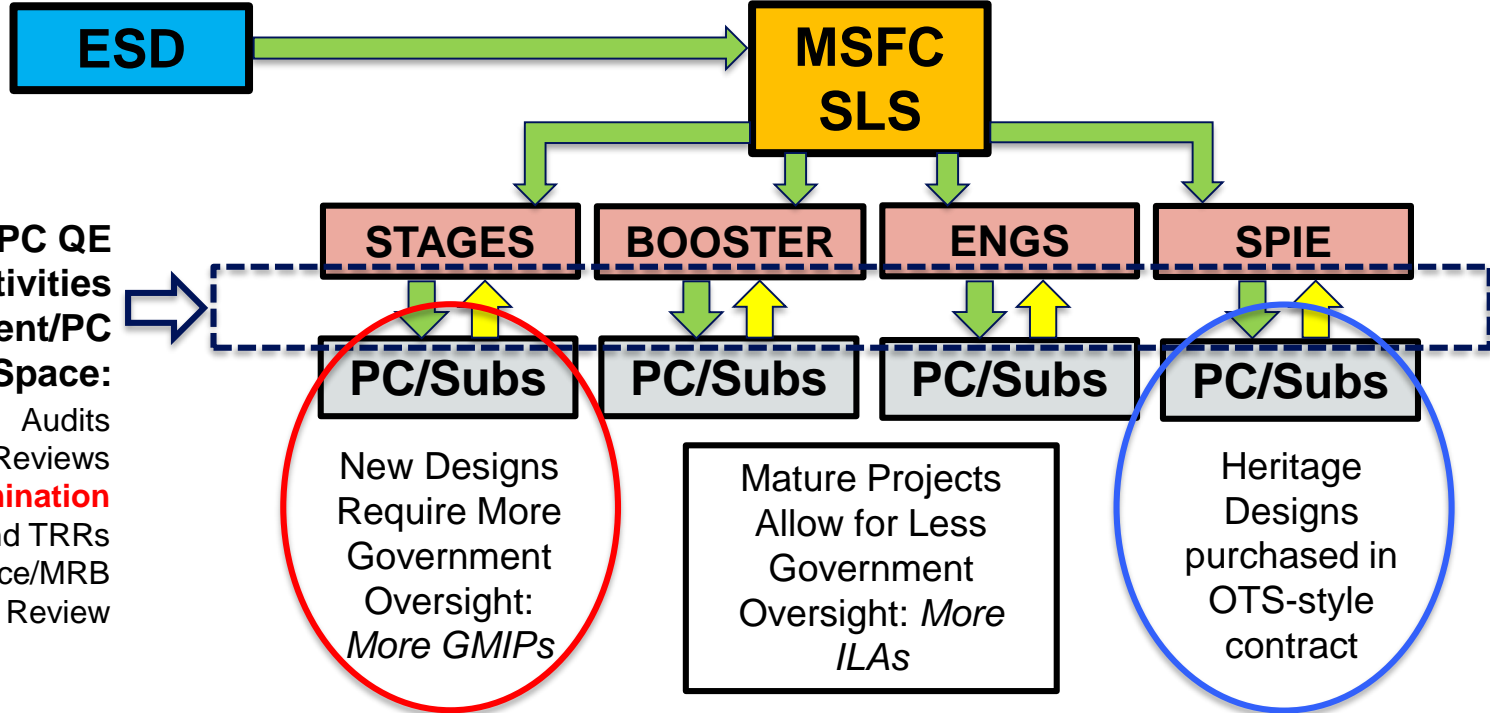
Mature Projects  
Allow for Less  
Government  
Oversight: *More  
ILAs*



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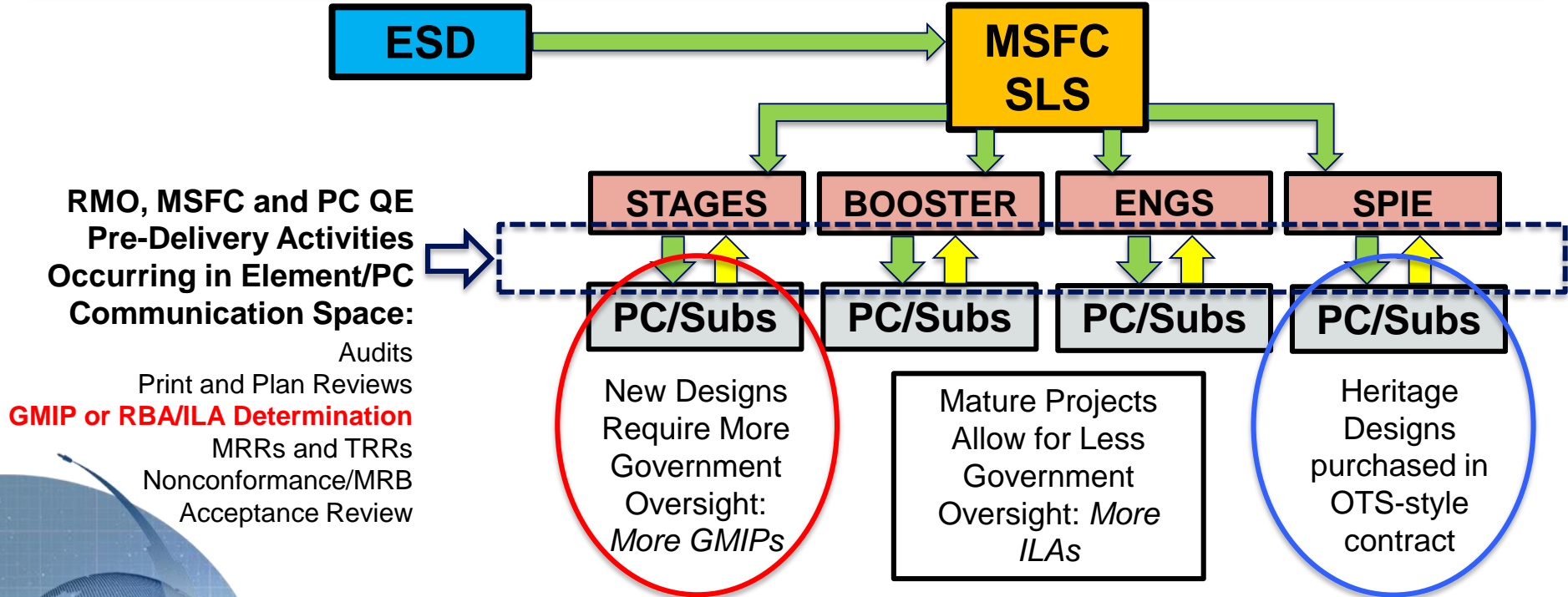
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# QE Decisions: Flexible Surveillance Strategies



**Flexible Requirements Enable QE Decisions**

# Good Communication: Flexible and Open Mind

Good Communication begins with  
*Active Listening*: ???





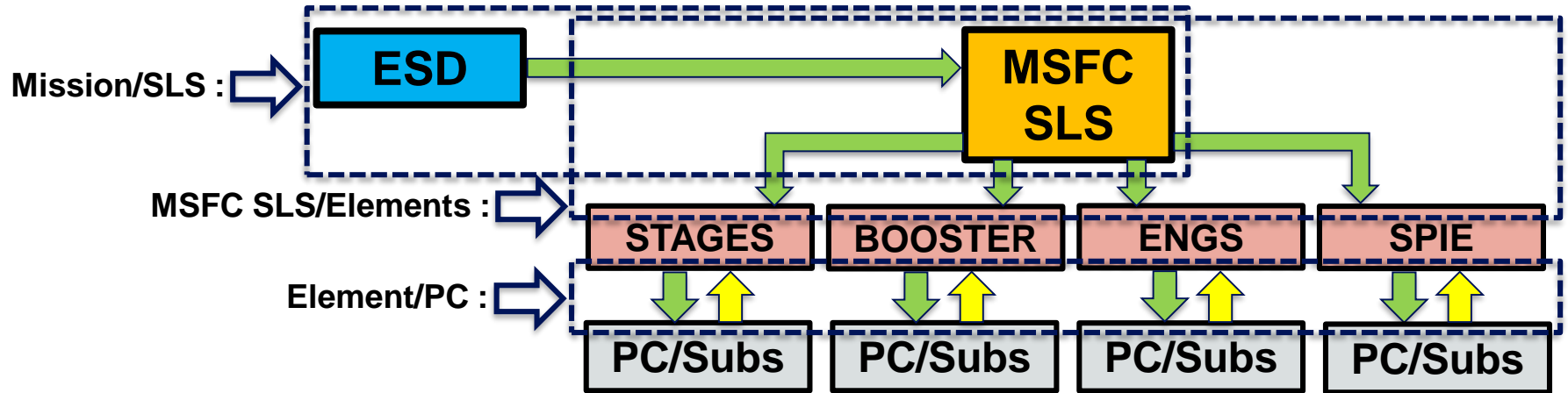
# Good Communication: Flexible and Open Mind

Good Communication begins with Active Listening: stays focused, refrains from interjecting remarks and suspends judgment until the speaker is finished.

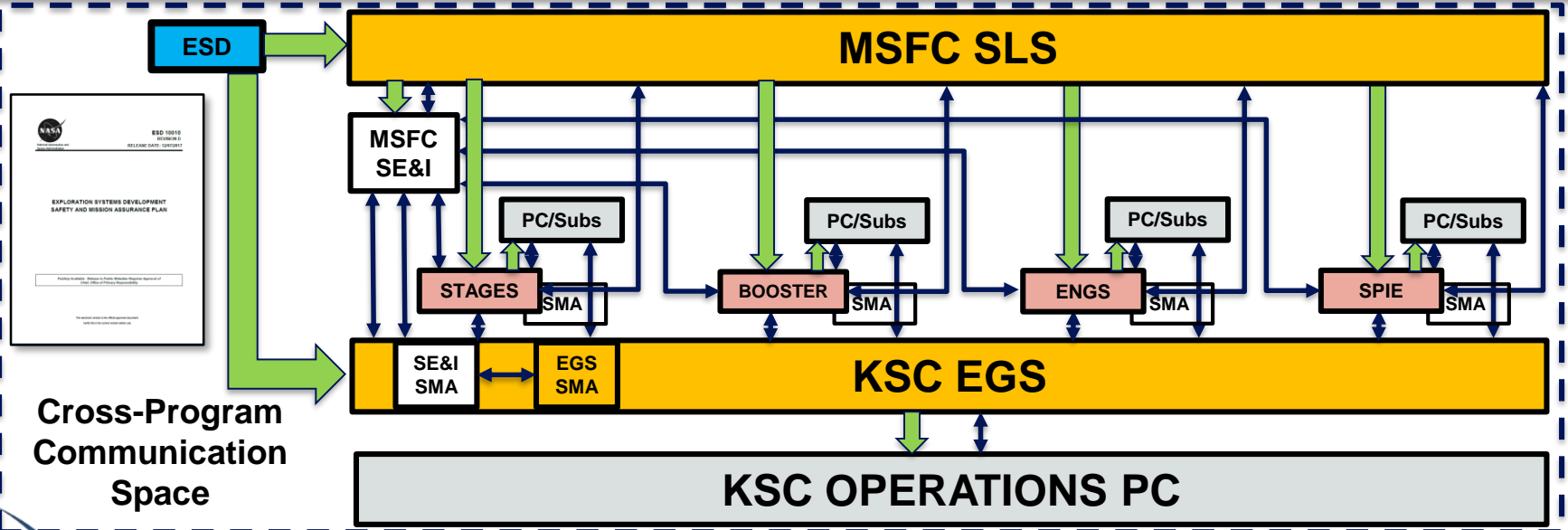


**Don't Speak Until You Have Listened Well**

# Cross-Program Hardware and Work Flow

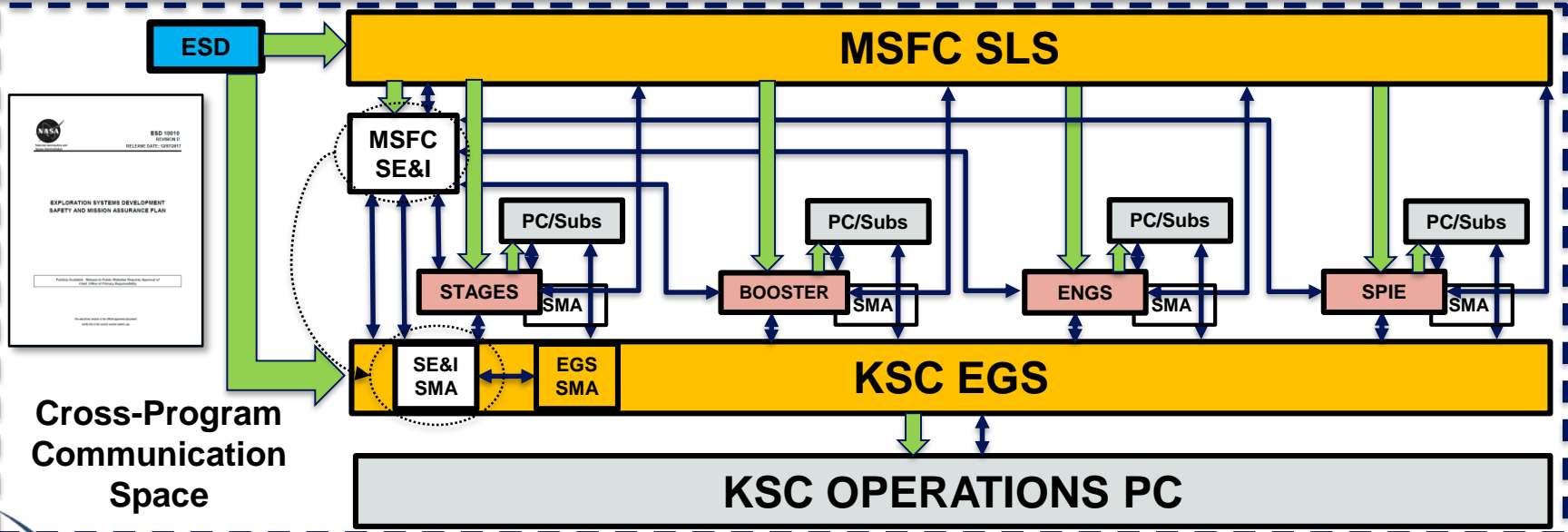


# Cross-Program Hardware and Work Flow



GSDO-PLN-1195 Cross-Program Process and Agreements for Launch Site Ground Operations describes activities/responsibilities to support flight hardware processing at KSC. Flows back to Elements via **SLS-PLAN-269 SLS Operations Implementation Plan**.

# Cross-Program Hardware and Work Flow



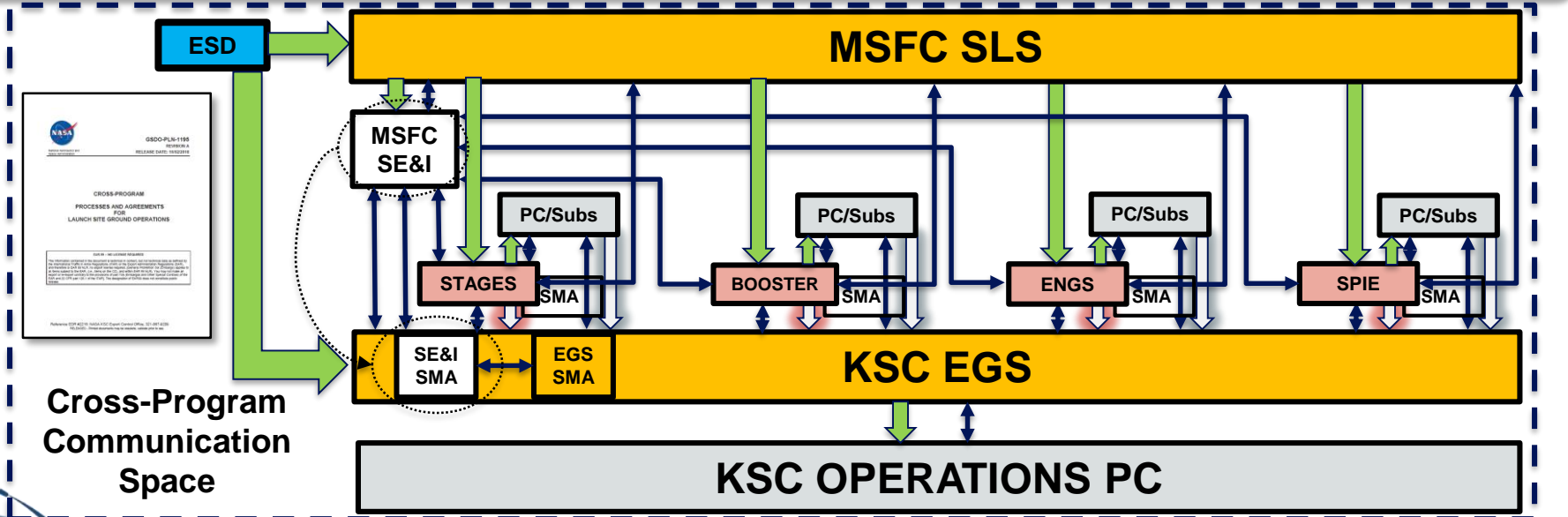
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# Cross-Program Hardware and Work Flow

- **The Systems Engineering and Integration (SE&I) SMA team** acts as the 'integration layer' for SMA at the program level
  - Interface with the Systems Engineering (SE) Discipline and Lead Systems Engineer (LSE) on SE&I topics that impact SLS Program SMA
  - Interface with the SLS Engineering Disciplines and associated Discipline Lead Engineers (DLEs) that makeup the SLS SE&I Team
  - Assesses SLS at the system level and integrates across SLS Element and SLS Flight Software (FSW) SMA teams
  - Acts as primary SMA resource to assess proposed changes to SLS specifications, requirements, plans, reports, models, and other data items that define SLS design and functionality



# Cross-Program Hardware and Work Flow



 = OMRs (Operational and Maintenance Requirements and Specifications) flow handling, processing and maintenance parameters to EGS.  
 WADs (Work Authorization Documents) use prints, specs, OMRs for input to KSC Ops docs.

# Cross-Program Hardware and Work Flow

## SYSTEMS



## TEAMS



**Systems:** facilitate information flow, but some of them are difficult to learn and some of them don't "talk" to each other yet.

**Teams:** NASA's Exploration System Development Program is ***built on teaming concept.***

 **Systems and Teams = Integration Success**

# Systems & Teaming Communication Opportunities

Learning another Center's System is an opportunity:

- Gain access to information you need
- Understand task-related thinking
- Learn the Languages of Cross-Program Teammates



 **Makes You a BETTER COMMUNICATOR!**



# Systems & Teaming Communication Opportunities

## Technical Cultures & Cross-Program Teaming

“But I don’t need **ANYBODY** to tell me how to do my job!” **TRUE, but . . .**

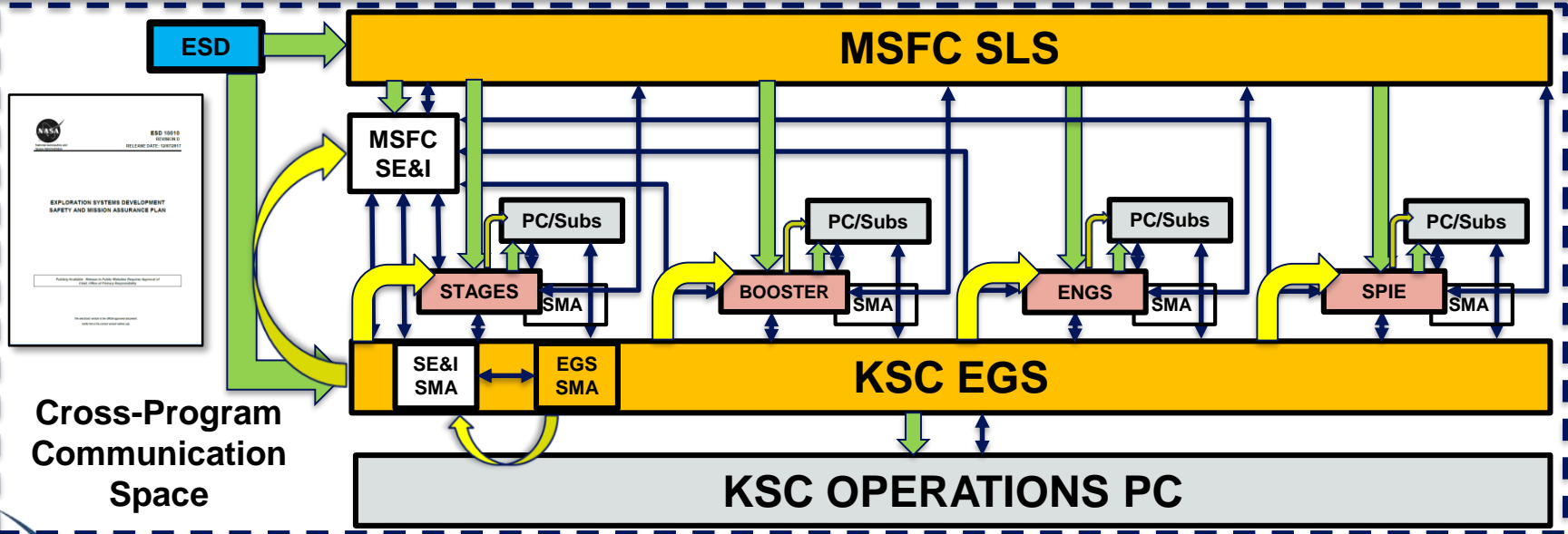
- Quality Engineers = system control, continuous improvement mind, but must understand the design, analytical products, manufacturing processes, assembly processes . . .
- Design Engineers = visualization mindset, but need input on manufacturability, inspectibility . . .
- Analysis/Model Engineers = mathematical/algorithmic mindset, but need design details . . .
- Manufacturing Engineers = shop-floor, “chip-making” mindset, but need Key Characteristics . . .
- Assembly Engineers = shop-floor, “task-oriented” mindset, but need OEM input to assemble . . .

Every engineering “mindset” derives from a Body of Knowledge (BOK).  
**THEY ARE INTERDEPENDENT. ALL ARE REQUIRED FOR SLS!**



**Must Have Teams & Cross-Pollinated BOKs**

# NC Processing: Planned & “Under Construction”

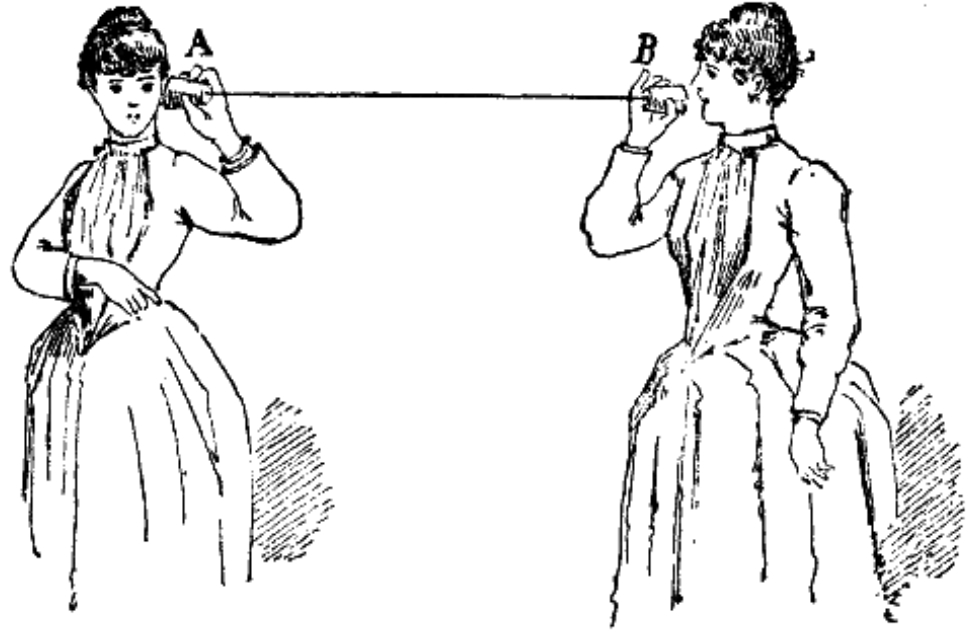


“Reachback” for NC Process Support =

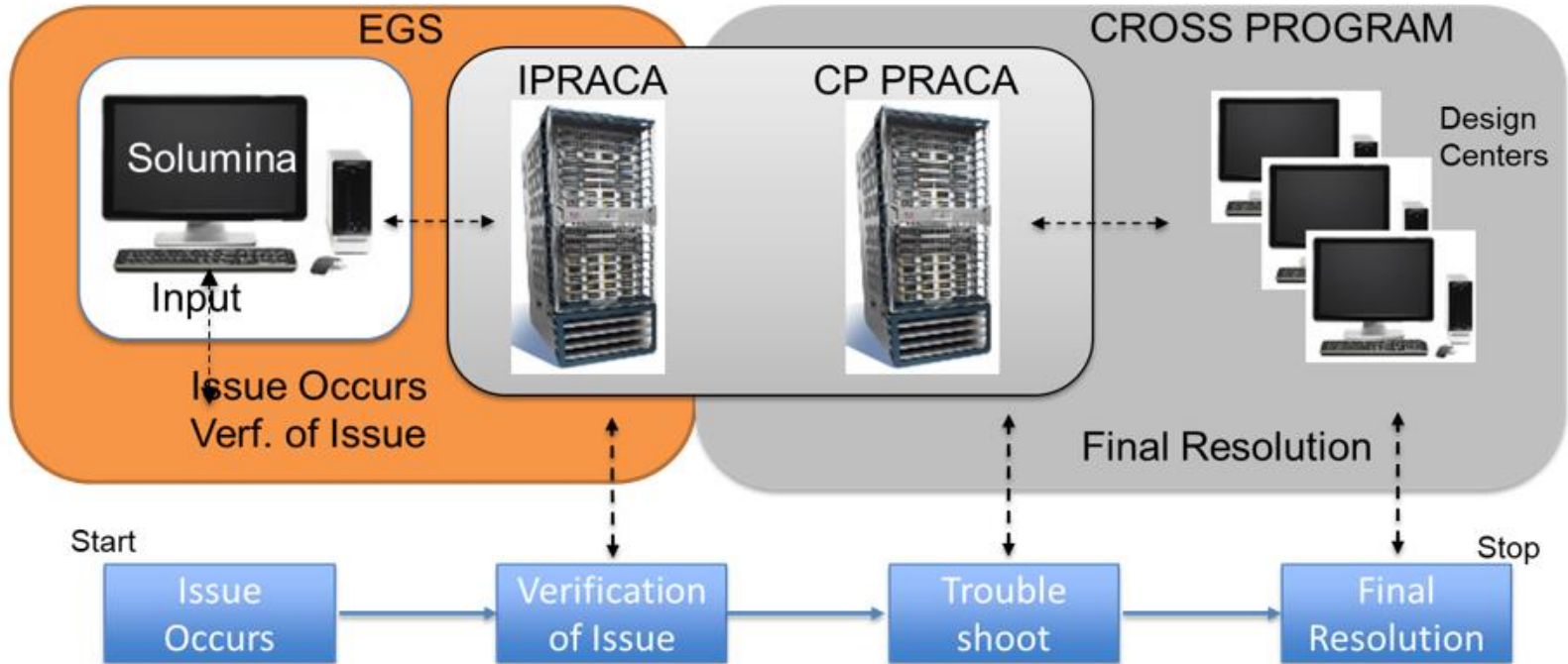


# NC Processing: Planned & “Under Construction”

**“Call Trees” are currently under construction in several Cross-Program Communities**



# NC Processing: Planned & “Under Construction”



# NC Processing: Planned & “Under Construction”

What about when **Cross-Program Systems** are not “talking”?

System difficulties and disconnects are Opportunities in Disguise: ???

System disconnects promote manual work-arounds and, thus, **Cross-Program teaming**.



**Fast NC Reachback/Communication Critical**

# Communication Challenges Multiply As T-0 Approaches



<https://www.youtube.com/watch?v=FG409y1WN4M&feature=youtu.be>



# Communication Challenges Multiply As T-0 Approaches

“Manufacturing, assembly, Qual tests, open design verifications, Acceptance Reviews, completing OMRs and LCCs, WADs reviews, CP-MRBs, FRRs, etc. **AND the work will only increase.**” Dan Mullane, SLS CSO



 **Our People, Our Mission, Our Time To Lead**

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