Developing Mission Success Capabilities for the Geostationary Operational Environment Satellite-R-Series (GOES-R) Ground Segment

Mission Assurance (MA) is the discipline to *independently* identify, analyze and effectively manage inherent risk and ensure mission success on a program through mission validation and monitoring adherence to core processes

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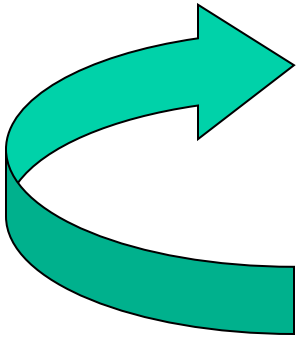
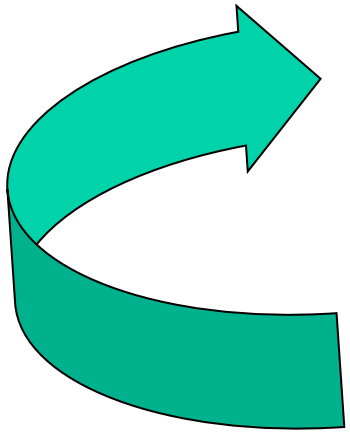
Steps Toward Mission Success



Mission Assurance

The discipline to manage inherent risk and allocate resources to ensure mission success through End- to- End independent verification that all mission core processes, performance, safety and quality requirements are met, including independent validation of the product to the mission



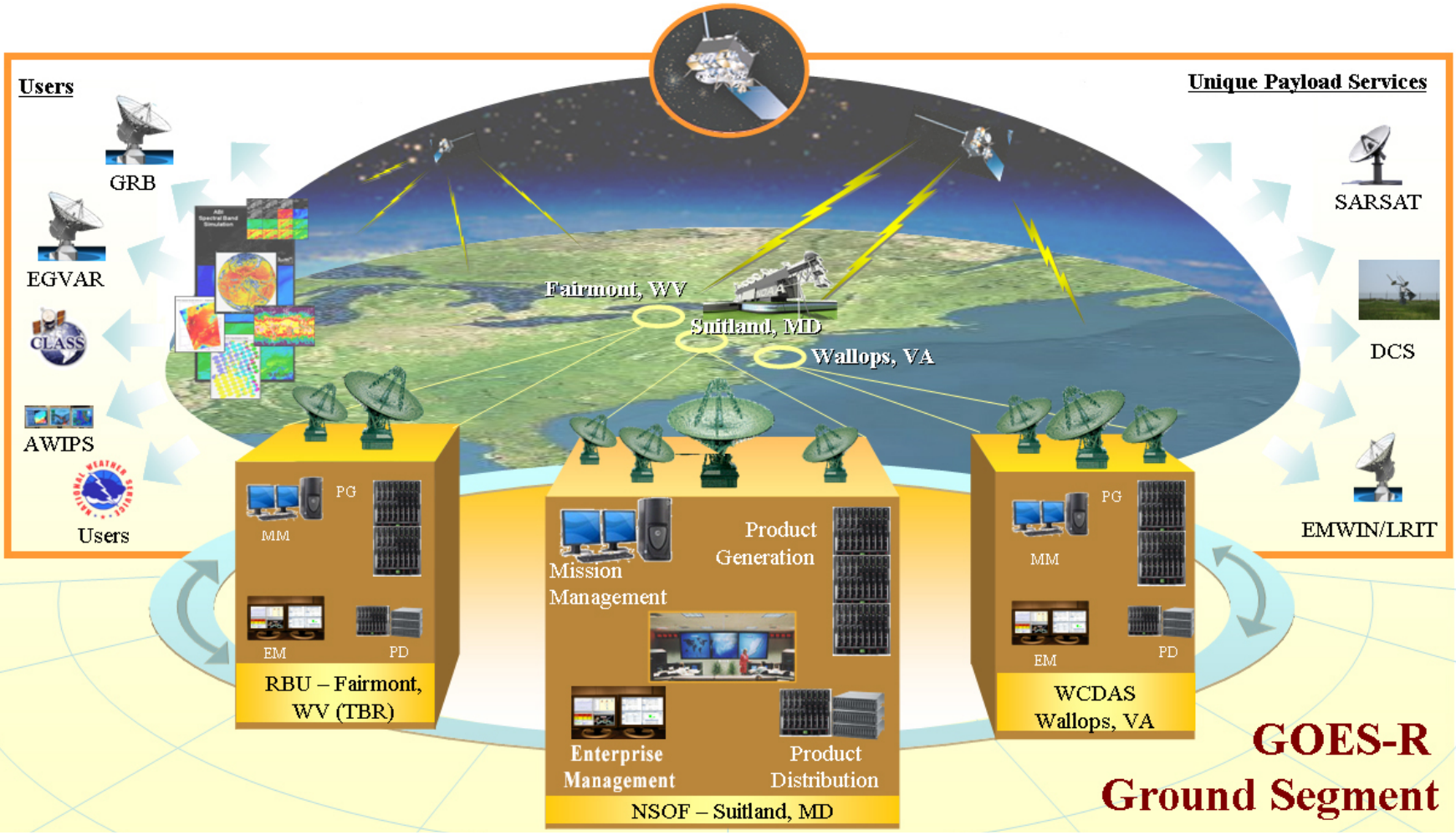
Product Assurance

Assurance that the enterprise designs, implements, tests, and delivers the product to the customer's requirements

Quality Assurance

Inspection of manufacturing and production processes to ensure that what is being built and tested adheres to engineering design

GOES-R Ground Segment Overview



Harris' Approach to Mission Assurance and Mission Success

- Proposal work led Harris management to reconsider its approach to mission success and mission assurance
- Until this time:
  - Mission success was everyone's job, without functional oversight
  - Risk reduction functions were independent of one another
  - Quality Product Assurance was as close to formal MA as any organization came
  - Product history demonstrated that this approach was adequate

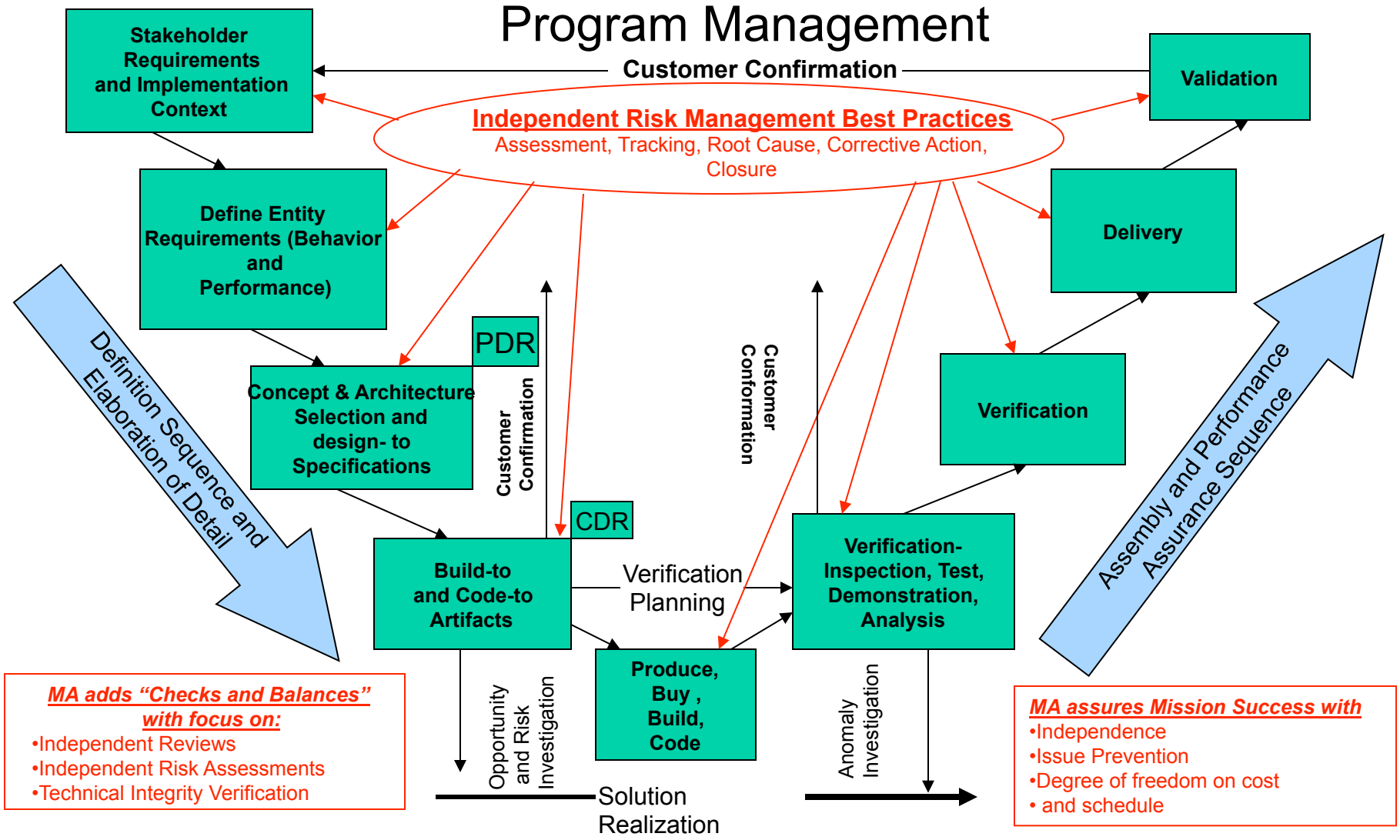
Change in Harris' Approach to Mission Assurance

- A decision was made to re-structure Harris' informal approach to MA
- MA and key risk reduction disciplines were consolidated in a functional department, including: Safety, Reliability, Maintainability, Availability, Human Factors and Components

What is Mission Assurance

- MA is defined as the disciplined application of general systems engineering, quality, and management principles toward the goal of achieving mission success. In the process, MA provides confidence in its achievement.
- MA focuses on the detailed risk and mission validation and, toward this objective, uses independent technical assessments as a cornerstone throughout the entire concept and requirements definition, design, development, production, test, deployment, and operations phases.

Program Life Cycle with Systems Engineering, Risk Management, and Mission Assurance



What is Mission Assurance? (continued)

- MA is not an organization that combines or replaces established functional disciplines, such as System Safety, Reliability and Maintainability, Systems Engineering, or Quality Assurance.
- MA does not assume responsibility for overall program success from the Program Manager—it validates that success.
- MA is not an independent review or a policing function to monitor all program activity for compliance.
- While all MA organizations work closely with the program or project to uncover and reduce risk to ensure mission success, MA is done independently of the program.
- In all cases, MA is structured as a functional organization (as are Engineering, Quality, HR, etc.) with reporting relationships ultimately to the Business Unit President level.

Mission Assurance Questions

- Key considerations to determine Harris' path to help ensure probability of mission success:
  - What MA objectives will best ensure mission success?
    - *How is MA defined by others?*
    - *How should MA be defined at Harris?*
  - Who should be responsible to meet those objectives?
    - *New Functional Department?*
    - *Part of Engineering ,Quality or new MA function?*
  - How should mission success objectives be met?
    - *Benchmarking showed that each of the primes takes a slightly different approach to meeting processes*

Who Should Have the Responsibility at Harris?

- Benchmarking helped provide guidance in determining whether MA should be a functional department or included in another venue.
  - Benchmarking to establish Best Practices included input from MA management at Boeing, Northrop Grumman, Lockheed, Raytheon, and the Jet Propulsion Laboratory.
  - Later benchmarking efforts with General Dynamics, Orbital, different divisions of Boeing, Raytheon, and Northrop Grumman, confirmed the earlier conclusions.

Mission Assurance Structure Industry Best Practices

- A successful MA program has the ability to be independent and is viewed as value-added.
- MA should have institutional buy-in and form a partnership with the project/program team, line organizations, program manager, and chief systems engineer.
- MA should be a proactive, fully integrated office with defined roles and responsibilities with well documented requirements, policies, processes and procedures.

What is Industry's Approach?

- Risk reduction has always been a major effort with programs and projects.
- Until the 1980s when MA was introduced, the approach was to look at individual events and analyze those events independently.
- The current industry standard is to mitigate risks by having an independent team (outside the program) in addition to program assessment of program risks.
  - This keeps group think to a minimum and lessens the impact of schedule and other program pressures on the risk process.
- This task usually falls to an MA Department that reports to the executive level.

How Should These Objectives Be Met?

- Benchmarking efforts and industry best practices:
  - MA is the disciplined application of industry best practice system engineering, risk management, quality, and management principles to achieve mission success.
  - A disciplined MA process has independent technical assessment throughout the entire design, development, testing, deployment, and operations process.
  - MA should monitor a rigorous problem and corrective action reporting process and, where possible, incorporate lessons learned into operations.
  - MA managers rank equally with the Mission Systems Engineer under the Program Manager on the program organization chart.

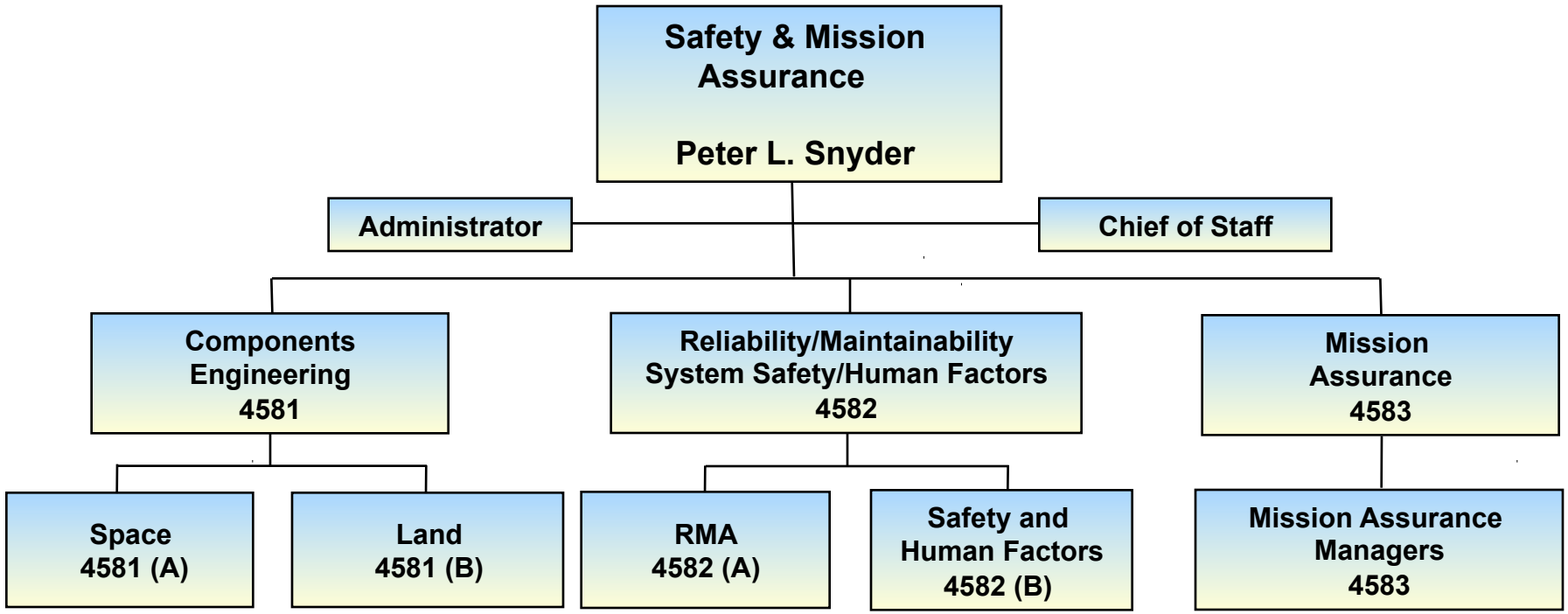
How Should These Objectives Be Met? (continued)

- Benchmarking efforts and industry best practices (continued):
  - All MA managers are engineers with ten or more years of technical experience. Many are experienced systems engineers.
  - MA managers all have access to a list of subject matter experts outside the program who they can enlist for support; They also conduct independent reviews with these experts prior to milestones.
  - In most companies, a tour in MA is a part of the engineering career path.
  - Senior MA managers are drawn from the engineering ranks and also have a wide range of experience in program management, supplier management, or systems engineering.

Harris' Safety and Mission Assurance Department (S&MA)

- Incorporates industry best practices.
- Independently assesses program risk or health, validates the product to the mission, and monitors program compliance to Harris' core processes.
- Meets contract requirements that require programs to incorporate MA.
- Meets special Business Area requirements.
- Aligns with major customers' MA organizations.

GCSD Operations – Mission Assurance



Harris' Safety and Mission Assurance Organization

- Harris' MA function has started supplying MA managers for programs that have a contract requirement or for business units that request them.
- As the new function is absorbed into the Harris culture, MA managers will be supplied to all critical programs.
- The first MA managers have systems or project engineering experience.
  - The transformation of systems engineers into MA managers provides the means to evaluate and analyze raw data, produce essential information, and ascertain whether the accumulated risk on a program is acceptable.
  - During transition, quality engineers fill some MA management positions, with training from senior MA leaders.

Harris' Safety and Mission Assurance Organization (cont)

- The MA organization reports directly to the MA executive, not through Quality Assurance.
  - This prevents independent assessment from becoming secondary or non-existent.
    - Quality Assurance management remains the job of the QE.
  - On major or challenging programs, the MA manager and QE functions should be separate.
    - On small programs, due to budget constraints, they may be combined.

Safety and Mission Assurance Core Processes

- A primary MA responsibility is to ensure, by monitoring, that GCSD core processes are followed.
- Core process are those that should not be tailored out or waived.
  - Risk Assessment is conducted at the technical level as well as in the aggregate context of the project's overall interdependencies.
  - Requirements Analysis and Validation entails the rigorous review of formally specified user requirements and their consistency with formally or informally specified user needs and expectations. Cost and schedule are independently evaluated to ensure that realistic targets are being used and that adequate reserves exist to handle unforeseen problems.
  - Design Assurance is a set of planning, analysis, and inspection activities to assess whether the evolving designs can produce a system that will perform as intended over all operating conditions and through its design life.

Safety and Mission Assurance Core Processes (cont)

- Manufacturing Assurance seeks to ensure that the planned manufacturing processes are repeatable and reliable and can produce the system as designed.
- Integration, testing, and evaluation is a broad process intended to verify that assembled components meet requirements individually and as part of a finished system.
- Operations Assurance deals with the possibility of direct or indirect loss resulting from the failure caused by people, technology, or external events.
- Program Assurance deals with the process intended to verify that the project and its processes meet mission demands.
- MA Technical Reviews, Audits and Readiness Reviews facilitate understanding of the interfaces and composite performance of a system while synchronizing expectations.

Mission Assurance Supporting Disciplines

- **Risk Management** is a structured approach to identify and evaluate risk and risk control measures and communicating mission threats to stakeholders.
- **Reliability Engineering** encompasses a set of activities that cover the entire system life cycle.
- **Configuration Management** seeks to control the technical hardware and software baselines of a program and report on and verify the physical and functional configuration.
- **Parts, Materials, and Processes** engineering seeks to provide a standard set of qualified components from which to build a reliable product at a reasonable schedule, cost and risk.
- **Software Assurance** seeks to ensure that system software will meet performance requirements and user expectations and will be dependable, maintainable, and applicable to the operational environment.
- **System Safety Assurance** applies engineering and management principles and techniques to control system hazards within the constraints of operational effectiveness, schedule and cost.
- **Quality Assurance** is the engineering and management discipline intended to ensure that a product meets the specified performance parameters.

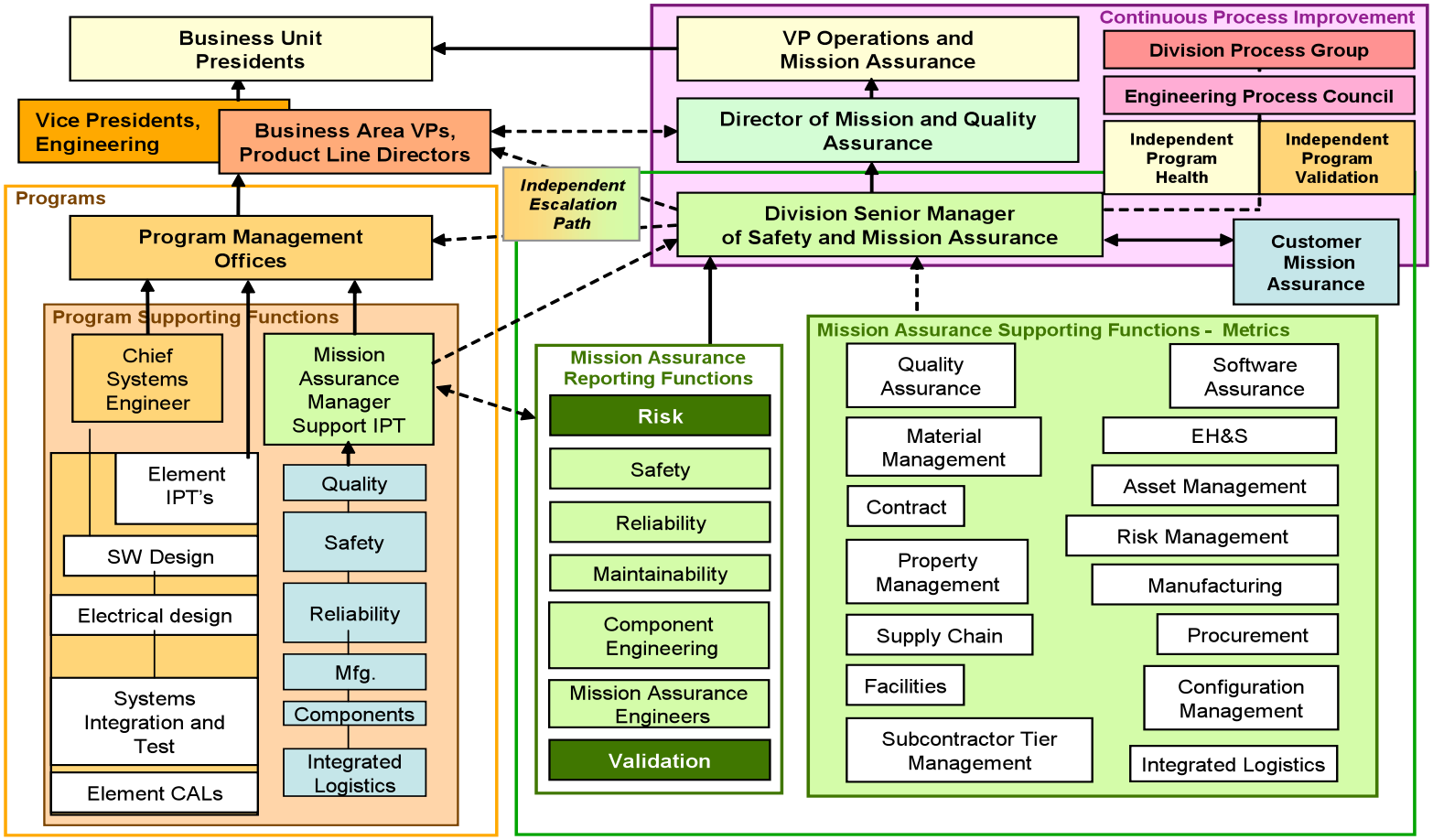
Safety & Mission Assurance Department Interactions and Communications

- Harris' S&MA Department interfaces with the office of the VP of Engineering by discussing: high visibility/ risk issues; cross project issues; program and product assurance waivers; "test as you fly" exceptions; and major technical, design, and test concerns.
- The S&MA Department is also responsible for:
  - Contacting customer S&MA management at all levels to understand not only the requirements but also their unwritten expectations.
  - Establishing a relationship of trust and understanding so the customer knows that Harris is completely aware their programs' "health."

GCSD Mission Assurance Flow Chart

HARRIS

Notional Independent Path



Safety and Mission Assurance Summary

- Harris assessed their path to mission success and instituted improvements.
- The MA Department employs industry best practices to help ensure mission success.
- Harris has formalized independent risk management and mission validation.
- With little cost, MA can be implemented with proper program structure.
- MA provides a second set of eyes to ensure that core processes are followed and inherent risk is managed.