Conference: Ninth Annual NASA Project Management Challenge 2012

Track Preference: People and Teams

Presentation Title: Leveraging Independent Management and Chief Engineer Hierarchy

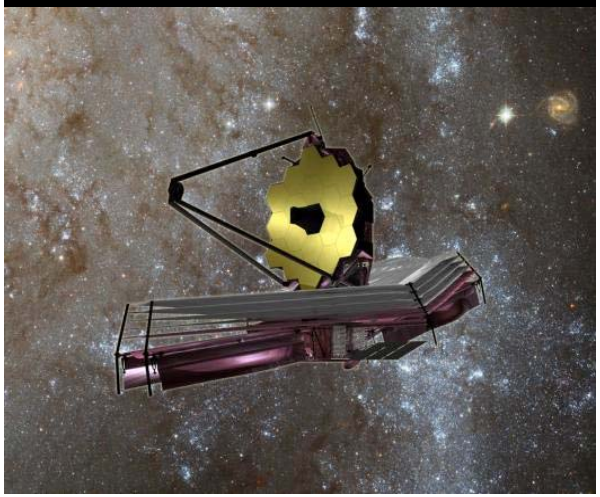
Synopsis:
This presentation explores the organizational complexities of integrating project management and NASA's chief engineering and technical authority hierarchy throughout the development of deep space missions. It describes unique difficulties of providing vertically- and horizontally-derived technical value at the project, implementing center, program, and directorate level and provides recommendations for addressing these challenges.

Abstract:
In the development of complex spacecraft missions, project management authority is usually extended hierarchically from NASA's highest agency levels down to the implementing institution's project team level, through both the center and the program. In parallel with management authority, NASA utilizes a complementary, but independent, hierarchy of technical authority (TA) that extends from the agency level to the project, again, through both the center and the program. The chief engineers (CEs) who serve in this technical authority capacity oversee and report on the technical status and ensure sound engineering practices, controls, and management of the projects and programs. At the lowest level, implementing institutions assign project CEs to technically engage projects, lead development teams, and ensure sound technical principles, processes, and issue resolution. At the middle level, programs and centers independently use CEs to ensure the technical success of their projects and programs. At the agency level, NASA's mission directorate CEs maintain technical cognizance over every program and project in their directorate and advise directorate management on the technical, cost, schedule, and programmatic health of each. As part of this vertically-extended CE team, a program level CE manages a continually varying balance between penetration depth and breadth across his or her assigned missions. Teamwork issues and information integration become critical for management at all levels to ensure value-added use of both the synergy available between CEs at the various agency levels, and the independence of the technical authority at each organization.

Bio:
Bryan Barley is currently the deputy chief engineer for NASA HQ’s Science Mission Directorate. Prior to this Mr. Barley was the chief engineer for NASA's Lunar Quest Program and the Discovery Program as part of NASA’s Science Mission Directorate. Mr. Barley has worked for NASA Marshall Space Flight Center (MSFC) for over 18 years. He has served as a lead systems engineer on various projects including for the development of crew training systems and for the development of International Space Station flight hardware and flight simulators. Mr. Barley also supported Spacelab on-orbit experiment operations as an astronaut crew training manager for science payloads and as a crew interface communicator for on-orbit science payload operations. Mr. Barley is currently focusing on the agency-level technical oversight of the Science Mission Directorate’s various programs, projects, and technology development efforts. Mr. Barley is the recipient of the NASA Space Flight Awareness Honoree Award and the NASA Exceptional Service Medal. Mr. Barley is married with four children. He enjoys traveling and family activities. He has participated as a youth soccer coach for the past 15 years and loves every minute of it. Mr. Barley is also a percussionist who actively performs in his local area and operates a percussion education studio.

# Leveraging Independent Management and Chief Engineer Hierarchy

## Vertically and Horizontally-derived Technical Authority Value



*Ninth Annual NASA PM Challenge 2012*

*Bryan Barley, NASA HQ/MSFC*

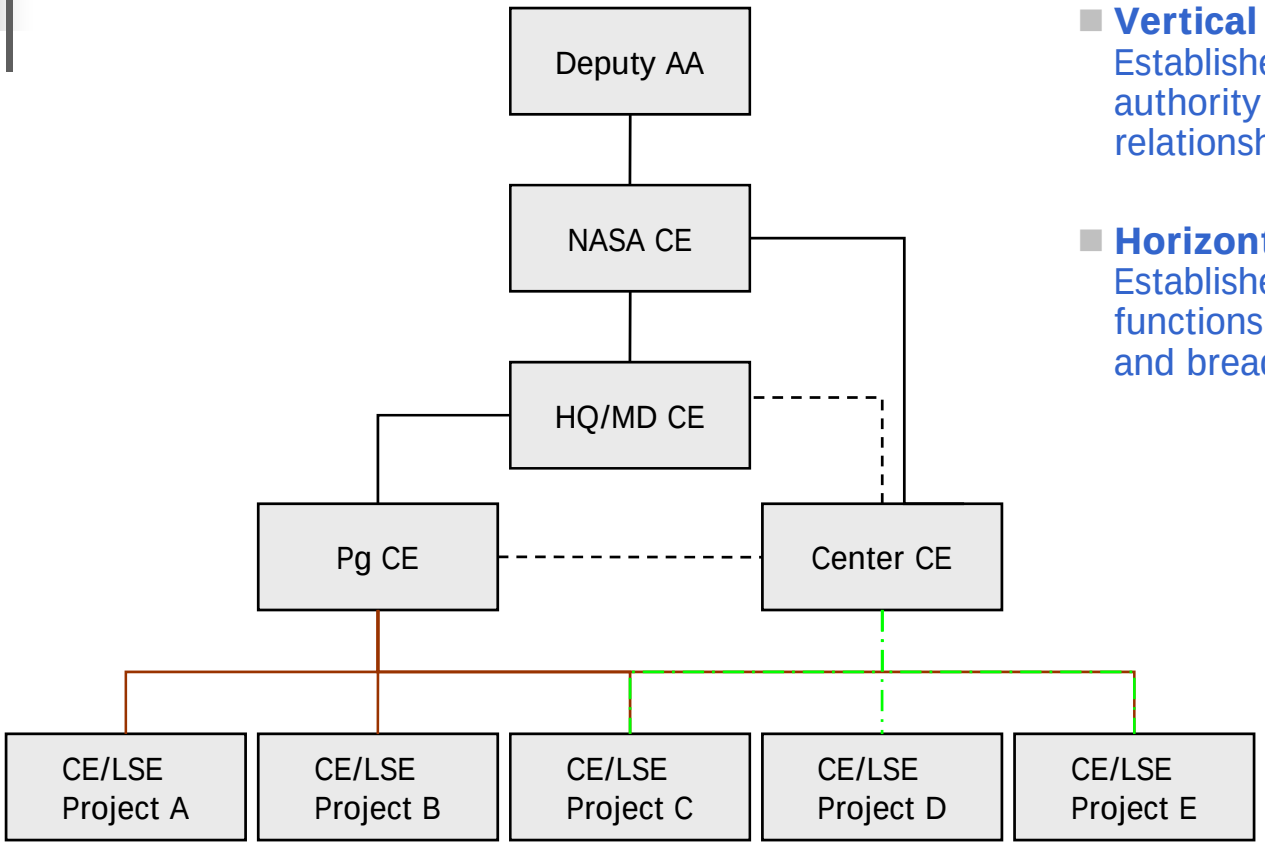
# Introduction

- NASA's chief engineering (CE) and/or technical authority (TA) hierarchy is a *vertically*-derived structure with strong *mechanistic* characteristics, as designed
  - Stable environment with Predictable behavior
  - Published standards and processes
  - Defined reporting mechanisms and periods
  - Holding people accountable – no specific CE teaming
- CE roles are hierarchically differentiated – vertically & horizontally
  - Vertical authority, rank, and reporting through the CE levels
  - Horizontal task specialization, responsibility, and *efficiency* at one's perspective level
- Explore unique challenges and difficulties at the project, implementing center, program, and mission directorate (MD) levels
- Provide recommendations to address the challenges.

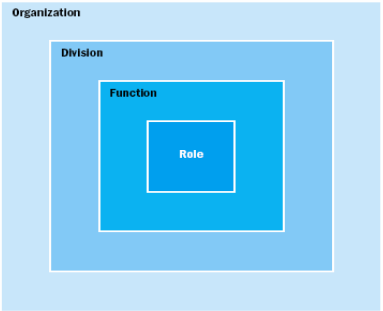
# Key Terms

- **Hierarchical**: CE levels of responsibility and rank.
- **Differentiation**: establishes the task and authority relationships that allow the CE hierarchy to meet its responsibilities.
- **Mechanistic**: stable environment, numerous standards, and repeatable with minimal changes.
- **Organic**: addresses the functional flexibility to adapt to environment changes/issues.
- **Project level CE**: assume to be same role as the Lead Systems Engineer (LSE) at the project level; for the purpose of this briefing only.
- **Implementing center or Center**: includes every NASA center/FFRDC/etc. except NASA HQ.

# Chief Engineer (CE) Hierarchy



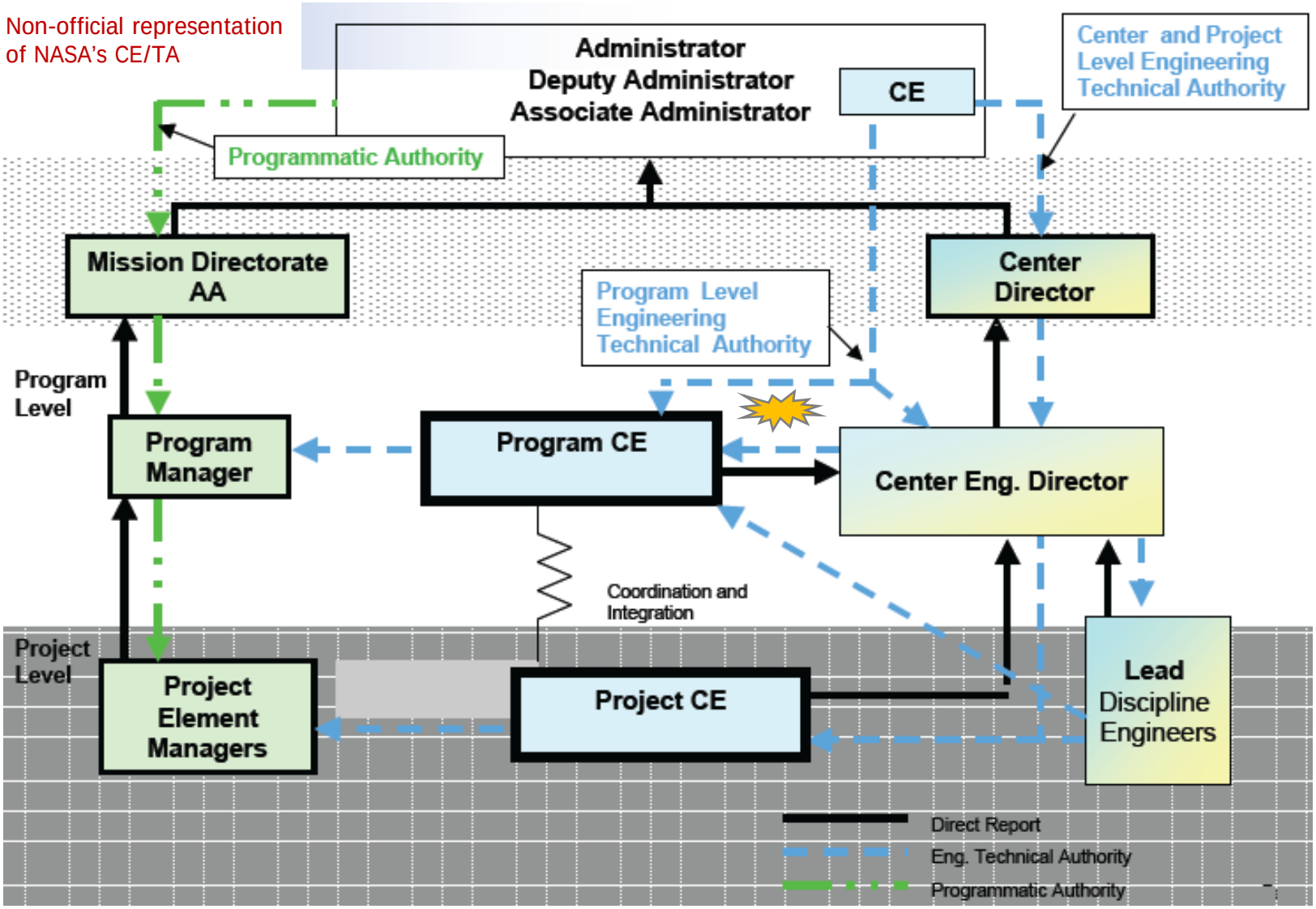

- **Vertical Differentiation:** Establishes the distribution of authority and reporting relationships between CE levels
- **Horizontal Differentiation:** Establishes hierarchical CE functions according to their tasks and breadth of responsibilities



# Project Management and CE Hierarchy

## *Two Lines of Authority: Programmatic and Technical*

Non-official representation of NASA's CE/TA



# Contrasting the Vertical and Horizontal:

## *Characteristics, Strengths and Weaknesses*

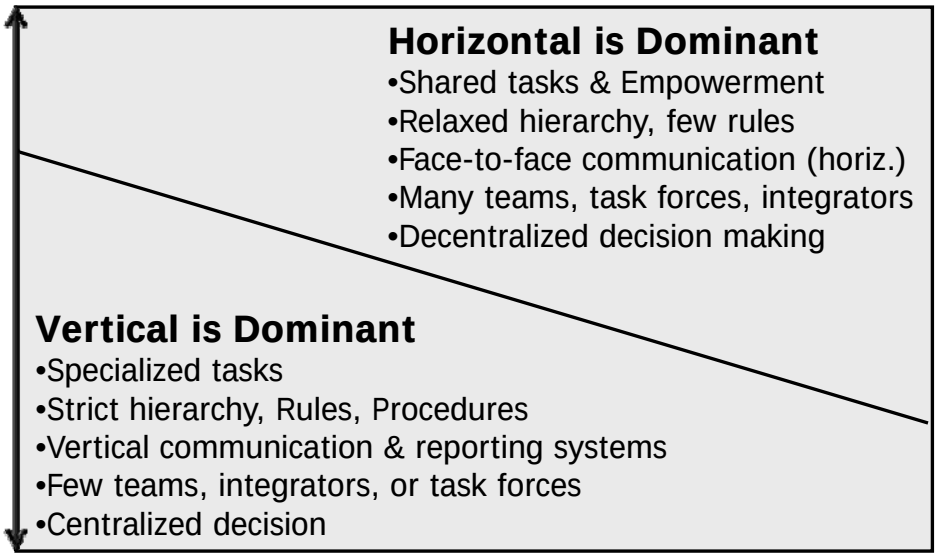
**Vertical Strengths:**

- Functional efficiency
- In-depth knowledge of task/skill
- Accomplish functional goals
- Best with one or similar products

**Vertical Weaknesses:**

- Slow response to environmental changes
- Hierarchy overload, decisions pile-up
- Poor Horizontal Coordination
- Restricted view of org. goals

Horizontal Org. for Flexibility [organic]




Vertical Org. for Efficiency [mechanistic]

**Horizontal Strengths:**

- Flexible & rapid change response
- Focus on production and delivery
- Staff has broad view of org. goals
- Teamwork, collab. – common commitment
- Share responsibility, decisions

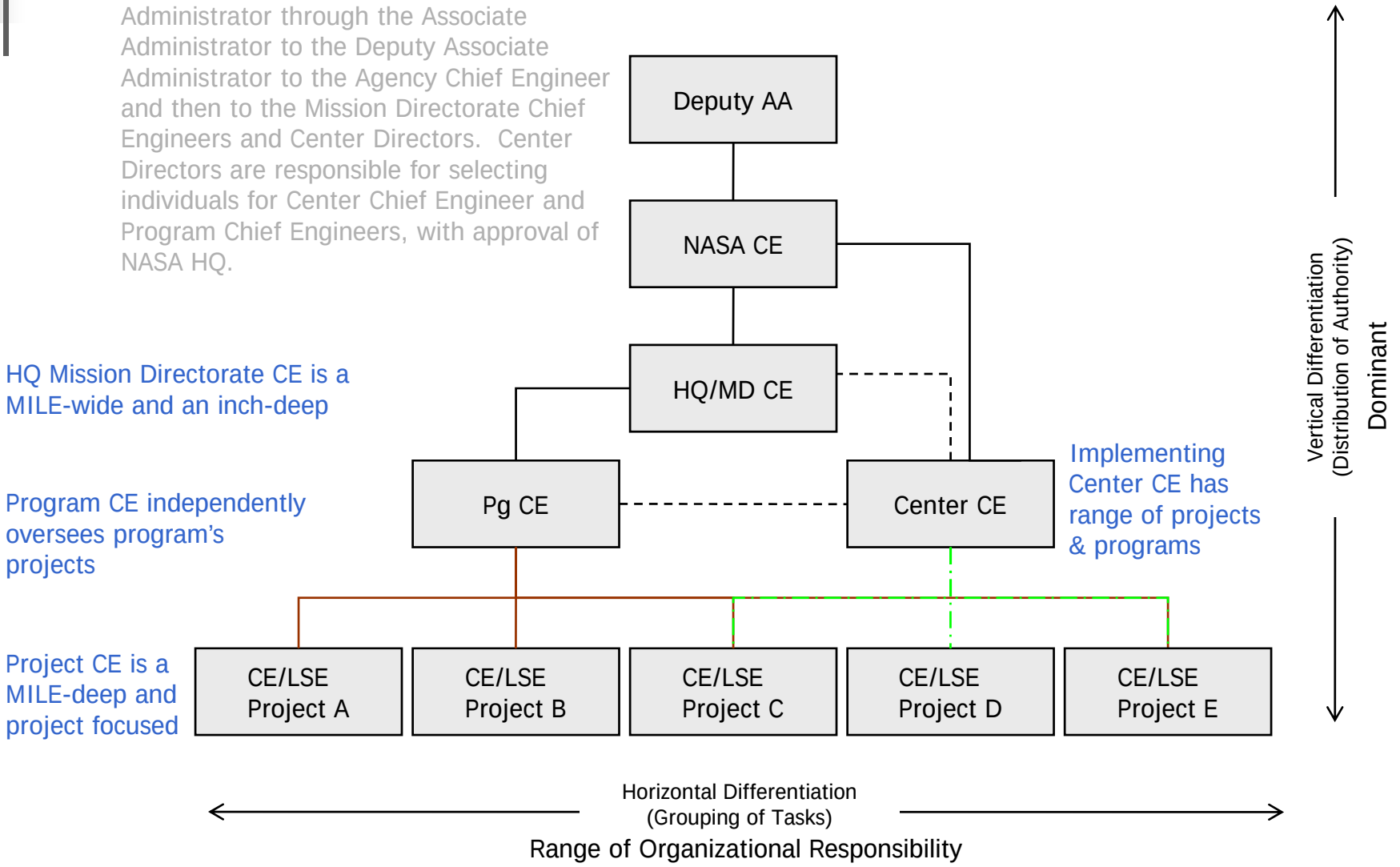
**Horizontal Weaknesses:**

- Not as functionally efficient
- Power, authority spread across hierarchy
- Can limit in-depth skill development

Sources/Adapted: Robert Duncan, Frank Orstoff, Richard L. Daft,

# CE Hierarchy and Responsibilities

Technical Authority flows from the Administrator through the Associate Administrator to the Deputy Associate Administrator to the Agency Chief Engineer and then to the Mission Directorate Chief Engineers and Center Directors. Center Directors are responsible for selecting individuals for Center Chief Engineer and Program Chief Engineers, with approval of NASA HQ.



# The CE Hierarchy Value Proposition

- Knowing the strengths/weaknesses of a vertically dominant structure and the level-dependent roles and responsibilities of each CE, are there opportunities for vertically-derived and horizontally-derived value added improvements within the CE hierarchy?

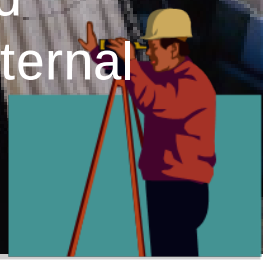
***The Value Proposition***

- At each level there is opportunity for improvement and to further solidify the chain of chief engineers' value. The *program chief engineer* position enjoys a unique opportunity in this hierarchy to contribute to the synergy between the CE levels and the technical independence position.

# Level-Dependent Views of The World

## Mission Directorate CE is a MILE-wide and an inch-deep

- ✓ Technical excellence and adherence to NASA policies, procedures, best engineering practices
- ✓ Monthly technical, cost, schedule performance of programs and projects
- ✓ Lead assessor for Administrator and contributes to external reporting



## Project CE is a MILE-deep and project focused

- ✓ Technical excellence of development team and meeting requirements
- ✓ Adherence to NASA and Center policies, procedures, best engineering practices
- ✓ Monthly technical performance against design allocations/margins/trades/orders, etc.
- ✓ Identify project level technical issues and risks to development and bring forth to

# Level-Dependent Views of The World

*(cont'd)*

## Implementing Center CE has range of projects/programs

- ✓ Technical excellence and adherence to NASA and Center requirements, policies, procedures, best engineering practices
- ✓ Tracks the technical performance of the center's programs and projects for trends
- ✓ Delves into technical issues according to severity
- ✓ Coordinates with HQ OCE

## Program CE independently oversees program's projects

- ✓ Technical excellence and adherence to Program, NASA, Center requirements, policies, procedures, best practices
- ✓ Monthly tracks technical performance of all projects
- ✓ Delves into technical issues based on risk-based insight severity
- ✓ Identify programmatic level technical issues and risks to development and bring forth to

# Unique Difficulties and Challenges

## HQ/MD CE

- Projects and programs too numerous for equal in-depth technical cognizance
- Very limited time for project technical penetration (issues, risks, & costs)
- Minimal face-to-face interface with lower level CEs
- No formal vertically integrated reporting structure in the CE hierarchy to support monthly assessment

## Project CE or LSE

- Frequent requests for information data and technical discussions of him/her and team
- Technical authority chain can be unclear: How does it work for project CE? Through center CE and/or Program CE?
- Pg CE interfaces with the project on a regular basis – weekly to monthly: assesses the technical success

## Overarching Challenges

- Honest, non-filtered vertical communication
- Currently no planned interface & info exchange between CE levels
- Agency monthly assessment (BPR); a lot of detailed project data to vet

# Unique Difficulties and Challenges

*(cont'd)*

## Center CE

- Projects and programs are numerous and varied at the center and must be sufficiently technically cognizant of all
- Each program has a Pg CE at the same hierarchical level whom centers CE must interface
- Has to seriously address issues/concerns brought by Pg CE
- Concerned that project CE will be confused regarding technical authority flow and my inadvertently take direction

## Program CE

- Technical penetration based on perceived project and programmatic risks
- Balance the breadth of projects with required technical penetration
- New projects don't trust the Pg CE – especially at onset
- Frequent and periodic face-to-face with project; how do I use it to ensure technical excellence?
- Defining the interface relationship with the Pg CE's home Center CE

# Recommendations

- Value proposition revisited:
  An adapted Program CE concept with the appropriate organic characteristics and horizontally differentiated aspects will be added value to the overall vertical integration of the NASA CE chain.
- Tom Burns and G.M. Stalker
  There is a need to adapt a structure to respond to changes in the environment and control their activities; organic aspects are effective in changing environments.

- The following recommendations predominantly focused on Pg CE
  - Program CE position has a unique placement within the CE hierarchy
  - The right adaptations allow the Program CE to contribute value to integrating the overall vertically extended technical authority chain.

# Recommendations for Program CE

*(cont'd)*

- Provide independent technical assessments and top risks for each project & program in their purview to HQ/MD CE monthly
- Establish regular and periodic tag-ups with HQ/MD CE – suggest quarterly
- Implement risk-based insight method at program level to make decisions regarding necessary project technical penetration
- Interface with Center CE when:
  - project is non-responsive to Pg CE
  - Pg CE sees issues or actions for Center CE
  - Pg CE has questions/clarifications regarding center requirements, policies, etc.
- Learn socialization as a skill and technique used to build trust and obtain information and status from the project team members, individually
- Pg CE can uniquely guide projects by providing interpretive data where necessary, via the Pg CE's relationship with HQ/MD CE

- Develop trust through horizontally derived collegial relationships across projects and within centers
- Being physically proximate to the development work is important to ensuring the project is successful; Pg CE should be expected to travel frequently to project development centers
- Unique hierarchical placement and horizontal interfaces allow rapid response to project changes/issues/needs:
  - Pg CE can take-on non-specific task activities with greater flexibility than other CE levels
  - Pg CE can coordinate with and pre-brief HQ/MD CE on late breaking and potential upcoming technical issues/problems early
  - Pg CE shares in the overall responsibility and can be accountable for outcomes
- Requires training – success depends on horizontal team environment to become successful

# Conclusion

- NASA's CE/TA hierarchy is a vertically-derived structure with strong mechanistic characteristics.
- Discussed characteristics of horizontally and vertically dominant organizations and how that pertained to the CE vertical chain.
- Proposed an adaptation or enhancement to Pg CE role:
  - The balance between the horizontal differentiation and vertical integration is the Pg CE's challenge, but its where they bring value to the overall CE structure.
  - Pg CE role should be defined flexibly so it is responsive and adaptable to environmental changes.
  - Pg CE should be an integrator that carries and coordinates technical information and data along the CE chain, including within their center.