Collaborative Engineering

JPL Facilities and Software for Collaborative Design

1994 – Present

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Collaborative Engineering

Background

- PDC opened in June 1994 to improve JPL proposal and study processes
- Develops and supports use of Collaborative Engineering Processes
- Four resident Design Teams:
  - Team X for Mission Studies and Proposals
  - Team I for Remote Sensing Instruments
  - Team In-Situ for In-Situ experiments, rovers and drills
- First Distributed Collaborative Session demonstration in 1998 – included JPL, The Aerospace Corp. and TRW
- CSMAD opened in 2000
  - Hosts New Process Design Team (NPDT)

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PDC Objectives and Scope

- Improve quality of JPL studies and proposals by:
  - Facilitating assessment of costs and cost risks
  - Facilitating analyses of system / mission performance and trade offs / de-scope options
- Increase efficiency of Proposal Processes
  - Through Concurrent Engineering
  - Develop / adopt computer-aided design tools
  - Improve quality and speed of interdisciplinary communications

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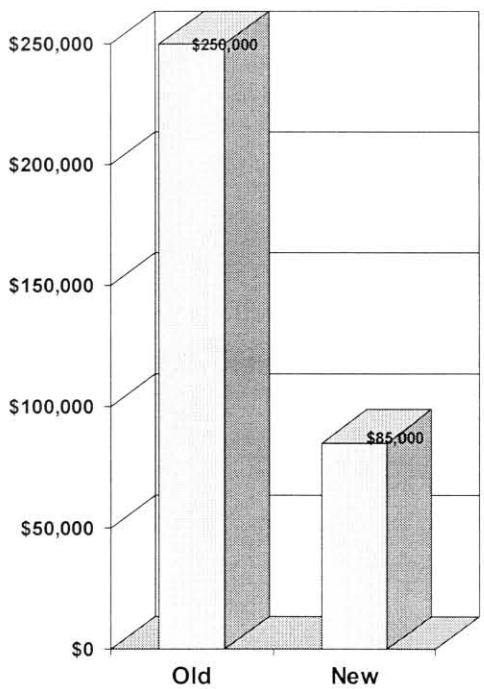
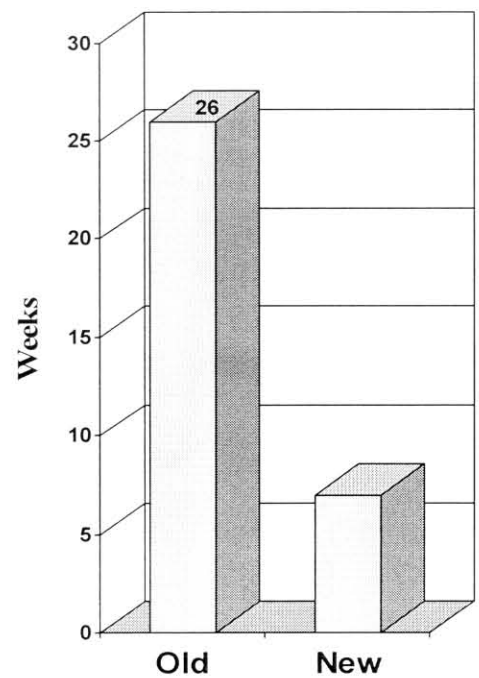
Project Design Center Today

Mission Design Metrics (Conceptual Mission / Spacecraft Designs)

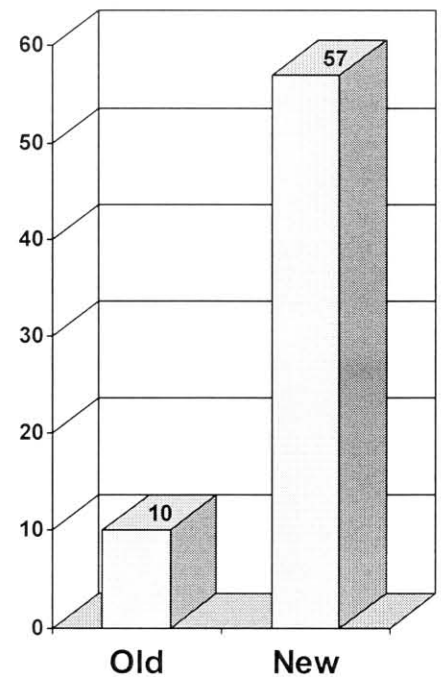
Average Cost* to Prepare



Average Time to Prepare



Number of Missions Studied Per Year



Changes Along the Way

- Concurrent Engineering – include downstream disciplines in team
- Include cost expert(s) on design team
- Employ real-time system design sessions
- Establish permanent design team(s)
  - Potential for customer / supplier implementation
- Provide adequate institutional support

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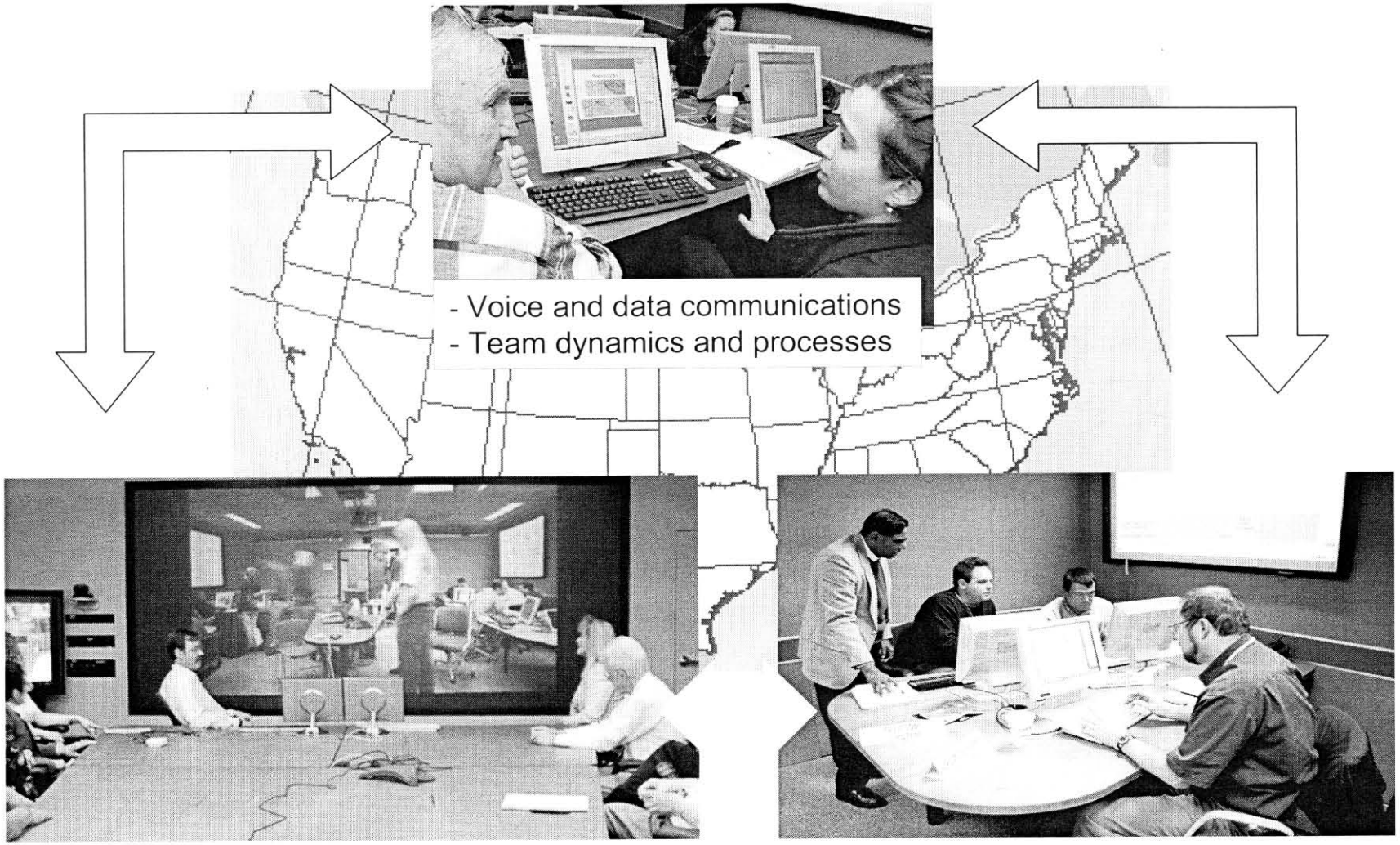
Distributed Design



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Team X Tools

- Team X uses interconnected Excel spreadsheets for data communication
- Spreadsheets contain mission design data such as:
  - Costs
  - Mass
  - Parts data
  - Risks
- Subsystem tools link to spreadsheets
- CAD tools run separately—usually not critical to Team X studies

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Software Architecture Timeline

- 1996 Original implementation used Apple Macintosh
  - Excel spreadsheets
  - Publish and subscribe automatic
  - Peer-to-peer setup
    - Work stations talked directly to each other
    - Work stations may have any tool set to augment analysis
- 2001 Moved from Apple to Windows platform
  - Data sharing via Object Linking and Embedding (OLE)
  - Work stations talk to central spreadsheet
  - Need to deliberately send and receive
  - Considered moving to centralized database
    - Design snapshots, data mining, more efficient re-use

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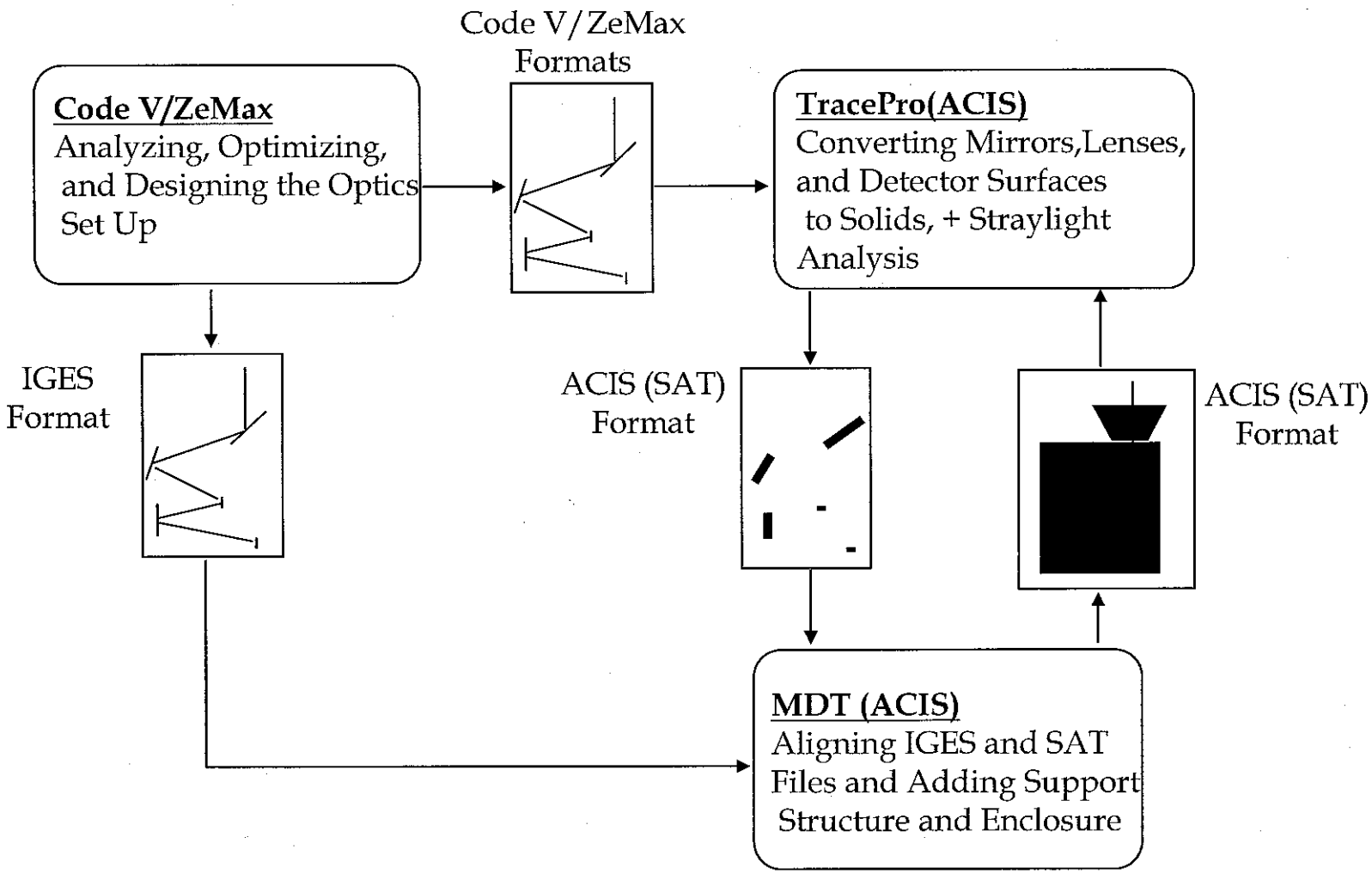
Facility Design Principals

- People are the focus of design
- Make it simple to use
- Seat people according to how often they talk with each other
- The room should also work without technology
- Design the room for optimal audio and video
- Avoid audio re-enforcement if possible
- Listen to your users
- Keep support staff close by

Link Established
Link under Development

Sharing A Common Geometry
Optical<->Mechanical



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Optimized for Group Work

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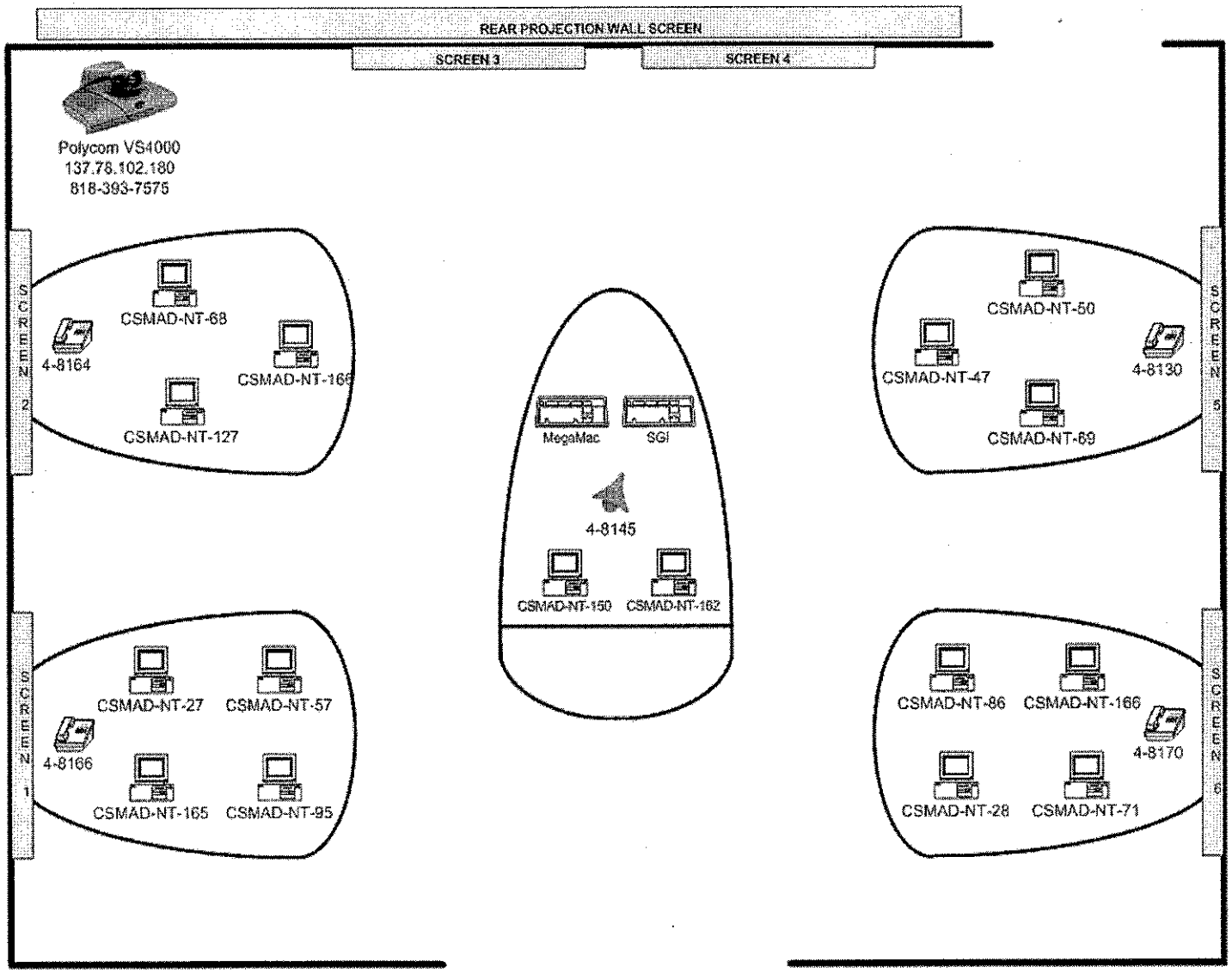
CSMAD Plan View



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CSMAD Facility

- Room designed to support local or distributed team work (up to 20 people at workstations)
  - Optimized to support 4 small groups reporting to a central area
  - 5 conversational islands consisting of:
    - Table with up to four computers
    - One public display per table
    - "Guest" station for laptops
    - Cordless phone with noise canceling headset
- Immersive visualization environment
  - 20' by 6' rear projected 3.5M pixel display via SGI
  - 10' by 6' rear projected 16:9 format video up to HDTV
  - 5' by 13' single Windows desktop at 1.6M pixels

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CSMAD Infrastructure

- 16 Windows 2000 workstations with “core” software
- 4 Linux workstations
- Local file server with file archival
- DVD or CD media creation services
- Support for MacOS X, Linux and Windows
- Enhanced Audio / Visual environment
  - Web-based video switching and room control
  - Six 80” by 60” projection displays distributed over three facility walls
  - Guest ports at each table

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CSMAD Infrastructure cont.

- Dual screen Microsoft Project Machine (Spans across 12' in front of room)
- Any computer or video source can be displayed (DVD, VCR, Cable TV)
- Echo and noise cancellation equipment
- Meeting capture capability

- White board, overhead projector, document camera

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Distributed Collaboration Tools

- Video Connectivity
  - High resolution videoconferencing via Internet (1920 Kb/s) or ISDN (1492 Kb/s)
  - TV resolution videoconferencing via Internet
- Other tools
  - Internet-based IP application-sharing software
    - Chat (via NetMeeting), Same Time, Meeting Place, WebEx
    - Secure distributed file system between NASA Centers (beta)
    - Image viewers for 3D models
    - Alternative voice links (Digital Phone, PBX)

In Development

- Software-based audio switching for videoconferences
- High definition life-size videoconferencing
- Secure synchronous and asynchronous tools between partners
- Pen-based on-screen sketching tool (on request)
- Full resolution computer display without software
- Sidebar conversations using Internet or telephone

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Benefits

- Facilitates design-to-cost
- Facilitates concurrent engineering
- Promotes consensus and real-time decision making
- more comprehensive design space exploration
- Introduces computer-aided design techniques into system and project-level design efforts
- Enables high-quality distributed work