

# Institutionalizing Best Practice SE with a Collaborative Engineering Environment

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*Lockheed Martin NE&SS - Undersea Systems*

# Agenda



- ***SE performance challenges***
- ***Collaborative Engineering Environment concepts***
- ***SE best practice deployment***
  - CEE process introduction
  - Inspection process example
  - Multi-disciplinary engineering example
- ***Summary***

# SE Performance Challenges



- ***Bridging geographical, organizational and disciplinary boundaries***
  - Spanning continents, companies and cultures
- ***Consistent process execution***
  - May be well defined and documented
  - Inconsistent in execution
- ***Information access and delivery***
  - Right person at the right time in the right format
  - “80% of cycle time and 50% of costs incurred between processes” - Deloitte Consulting
- ***Tools change from project to project***
  - Training / context switching
  - Information stovepipes

# NE&SS-Undersea Systems

## Product Diversity



### Submarine Systems

- *Combat Systems Integration*
- *Non-Propulsion Electronic Systems Integration*
- *Fire Control Systems*
- *Inboard Processing*
- *TRIDENT Navigation*
- *Arrays*
- *Real Time Data Processing*
- *Training Systems*

### Surface ASW/Mine Warfare

- *Anti-Submarine Warfare*
- *Torpedo Defense*
- *Integrated Power Systems*
- *Sensors*
- *Data Fusion*
- *Towed Arrays*
- *Underwater Labs*
- *Classified Applications*
- *High Frequency Sonars*
- *Unmanned Underwater Vehicles*

### Surveillance Systems

- *Shore-Based Processing*
- *Sensors*
- *Mobile Sensors and Processing*
- *Wet-End Sensor Systems*
- *Nuclear, Biological, Chemical Detection and Filtration*

### Maritime Systems

- *Anti-Submarine Warfare*
- *Maritime Patrol*
- *Strategic Communications*
- *Acoustic Signal Processing*
- *Mission Planning Systems*
- *Training Systems*

# NE&SS-Undersea Systems

## Geographically Distributed Organization



### **Syracuse, NY**

- Employees: 204
- Surface Ship ASW; Domestic Sub AN/BSY-2; Mine Warfare/UUVs; Acoustic Arrays; Shipboard EW



### **Sunnyvale, CA**

- Employees: 19
- Undersea Vehicles; LSV-2



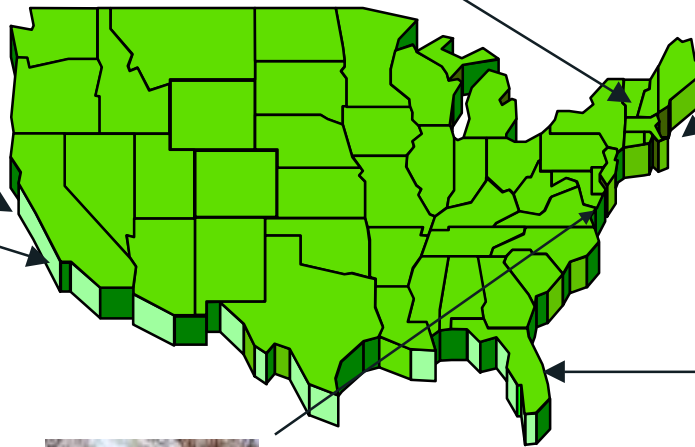
### **Mitchel Field, NY**

- Employees: 416
- Trident Navigation & Guidance; Positive Train Control; Oil Exploration



### **Irvine, CA**

- Employees: 51
- Trident Missile Hot-Gas Valve



### **Manassas, VA**

- Employees: 1200
- Domestic Subs: VA Class C3I, ARCI; Surveillance Systems; Trainers; Maritime Systems; NBC Systems; Int'l Subs C3I
- Coastal Systems



### **Riviera Beach, FL**

- Employees: 140
- Minehunting Vehicles, RMS

# NE&SS-Undersea Systems

## Key Competencies



- ***Core Competencies***

- Undersea Acoustics
- Fire Control
- Command and Control Systems
- Distributed Networking
- Large Complex System Architecture and Integration
- Leveraging Commercial Technologies
- Minehunting
- Precision Navigation
- Hot Gas Valves
- NBC Defensive Systems
- Unmanned Underwater Vehicles

- ***Emerging Competencies***

- Life Cycle Management
- Full Service Contracting
- E-Based Supportability
- CAIV Modeling and Management

# NE&SS-Undersea Systems

Documented processes and continued process improvement



## *Required*

ISO 9001 Compliance  
SEI Level 2

## *Desirable*

ISO 9001 Registration  
SEI Level 3

## *Manassas*

ISO 9001 Registration  
SEI Level 5  
ISO 14001 Registration  
AS9000 and DCMA  
ISO 9001 qualified



Manassas is certified by all 3 worldwide ISO 9000 registrars, and has been approved by DCMA to replace MIL-Q-9858A on all applicable contracts with ISO 9001.

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# The Collaborative Enterprise

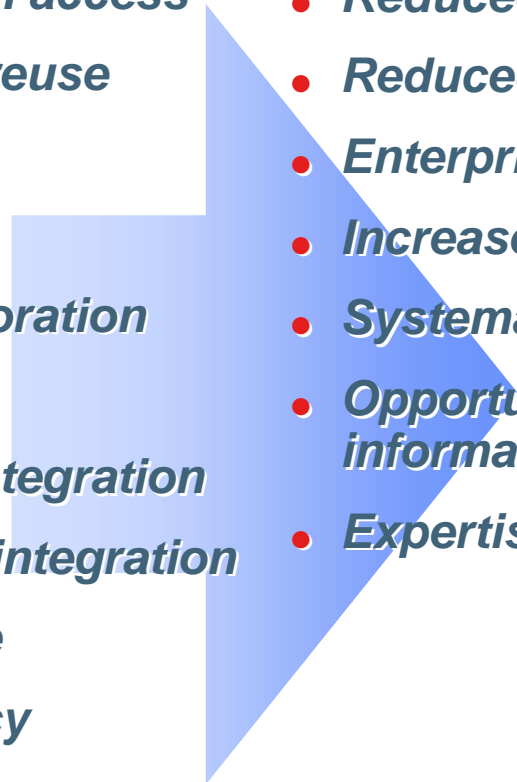


## ***Enterprise Enablers***

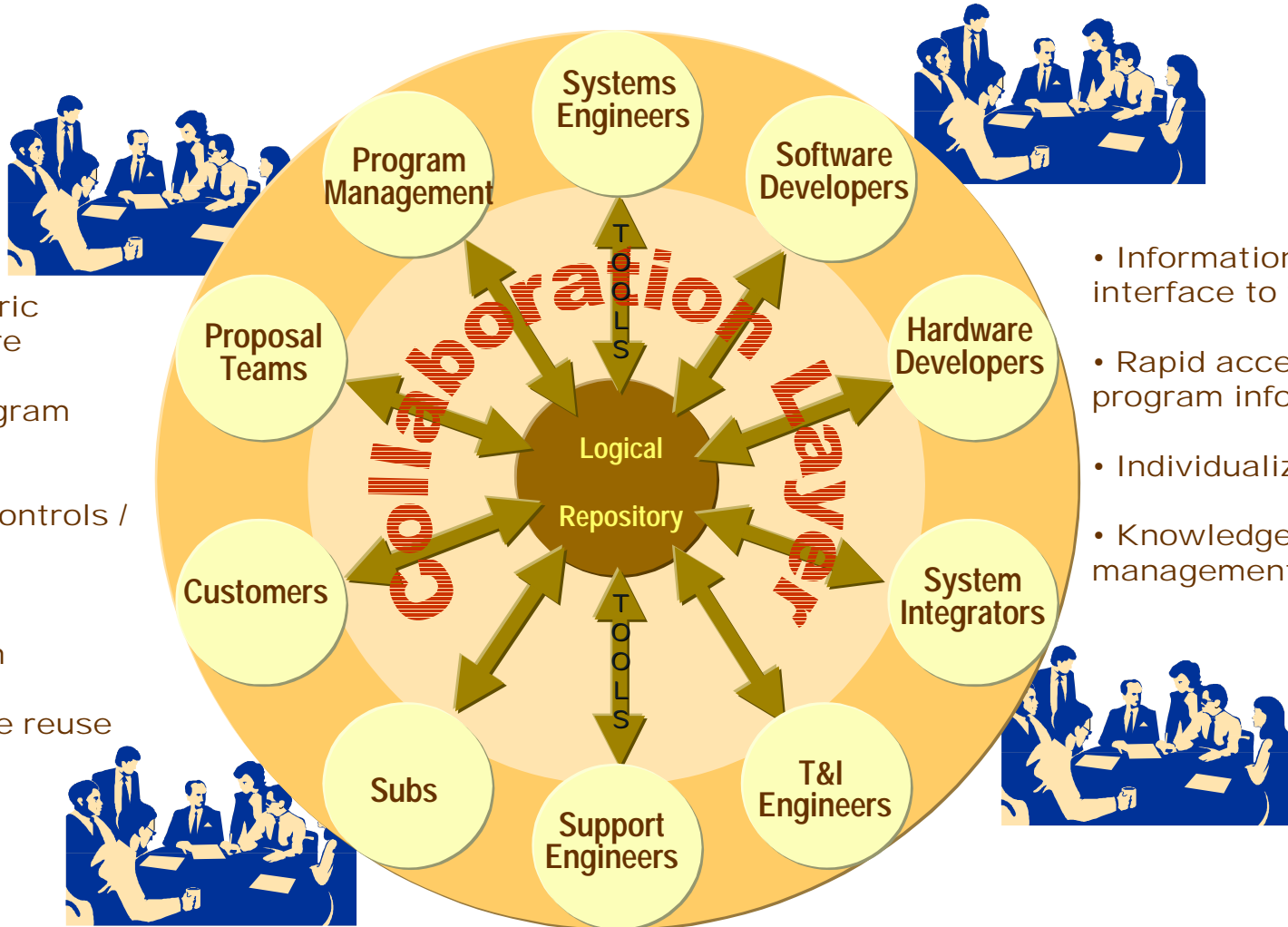
- *Rapid secure information access*
- *Systematic information reuse*
- *Process consistency*
- *Process automation*
- *Multi-disciplinary collaboration*
- *Tight decision loop*
- *Adaptable consortium integration*
- *Electronic supply chain integration*
- *Extensible infrastructure*
- *Localized business policy optimization*

## ***Business Discriminators***

- *Reduced cycle time*
- *Reduced cost*
- *Enterprise agility*
- *Increased product integrity*
- *Systematic process control*
- *Opportunity leverage based on information capital base*
- *Expertise multiplication*



# CEE Concept

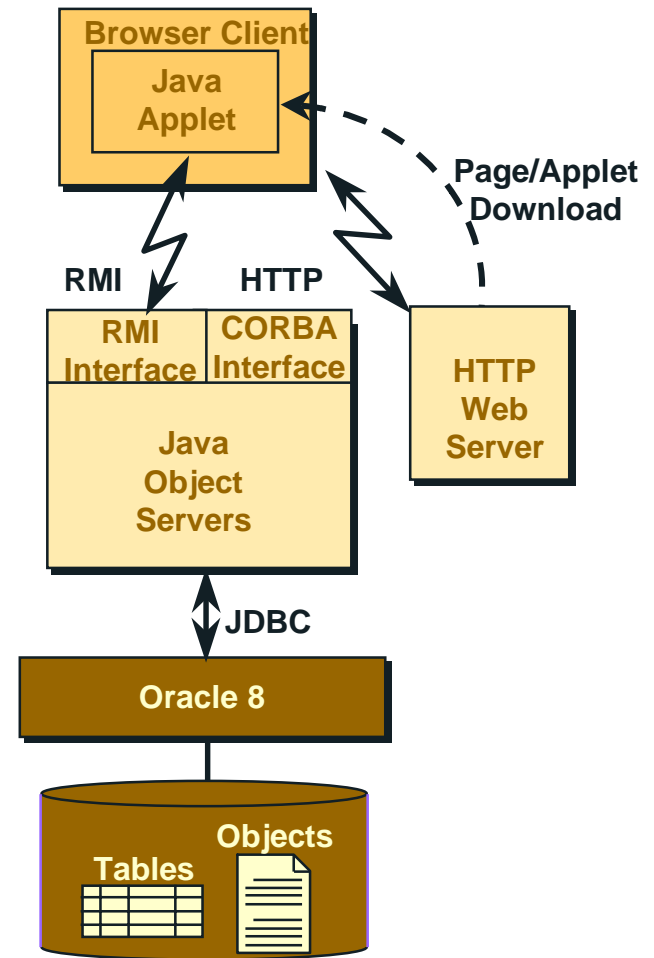


- Web centric architecture
- Multi-program support
- Access Controls / Security
- Process automation
- Enterprise reuse

- Information push/pull interface to tools
- Rapid access to all program information
- Individualized Views
- Knowledge management

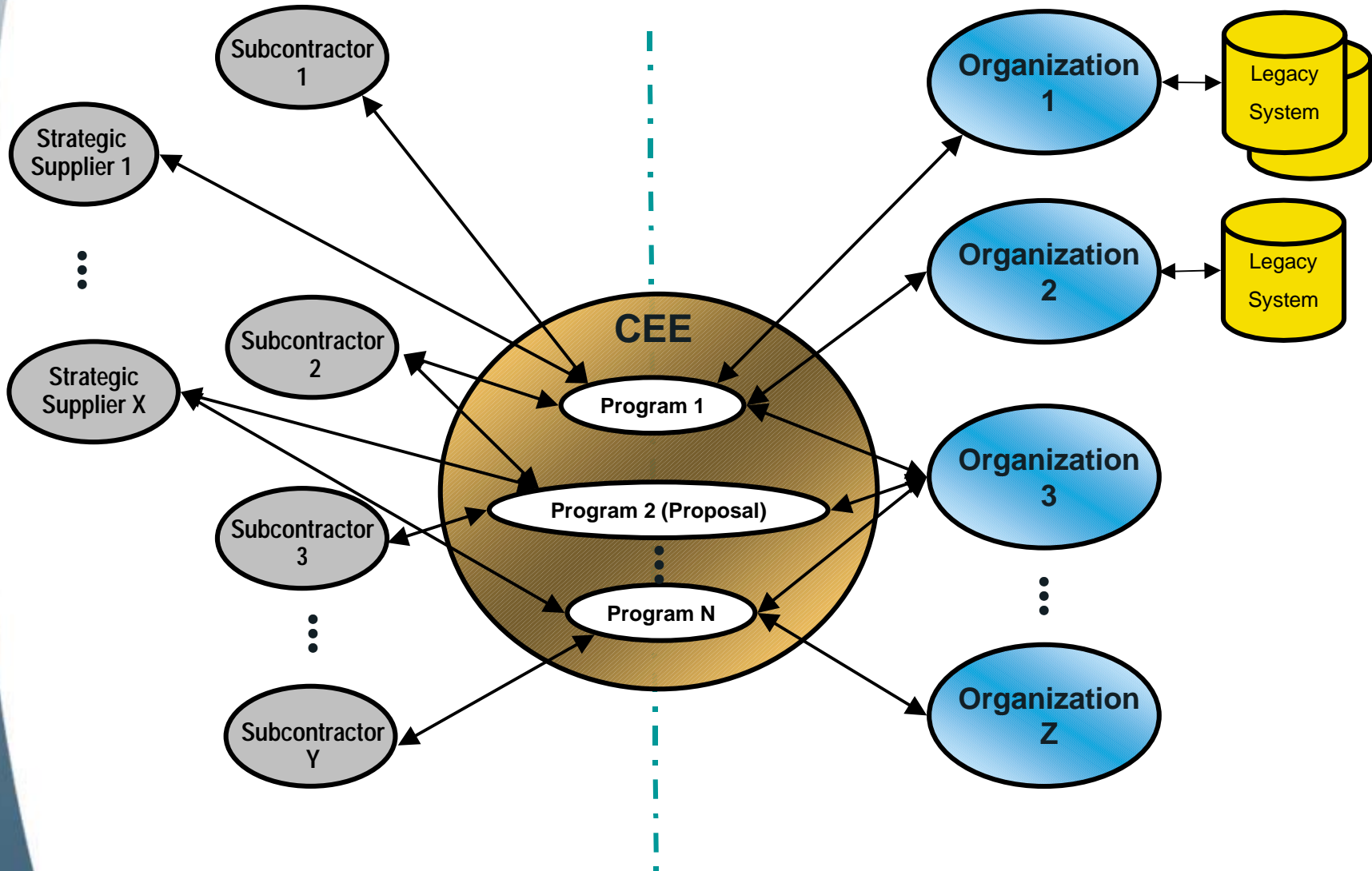
# CEE Concept

## Mapping to Architecture



# CEE Concept

## Virtual Extranets



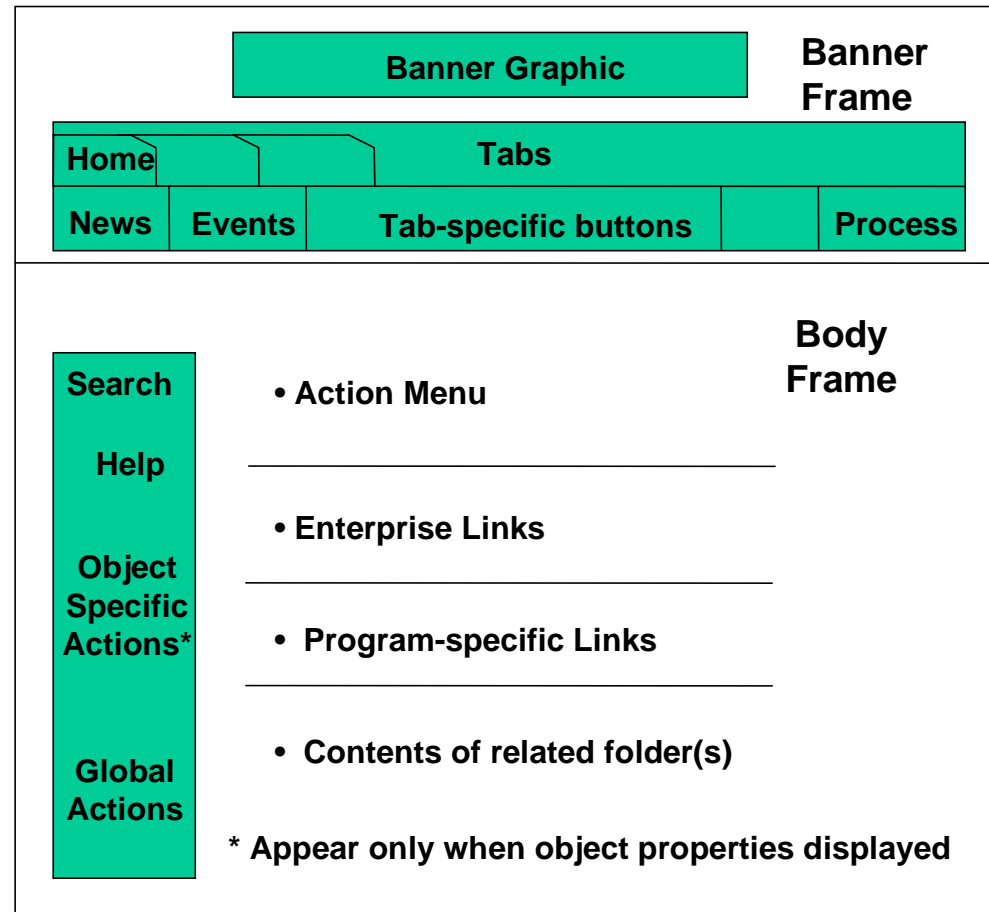
# CEE Design Discriminators



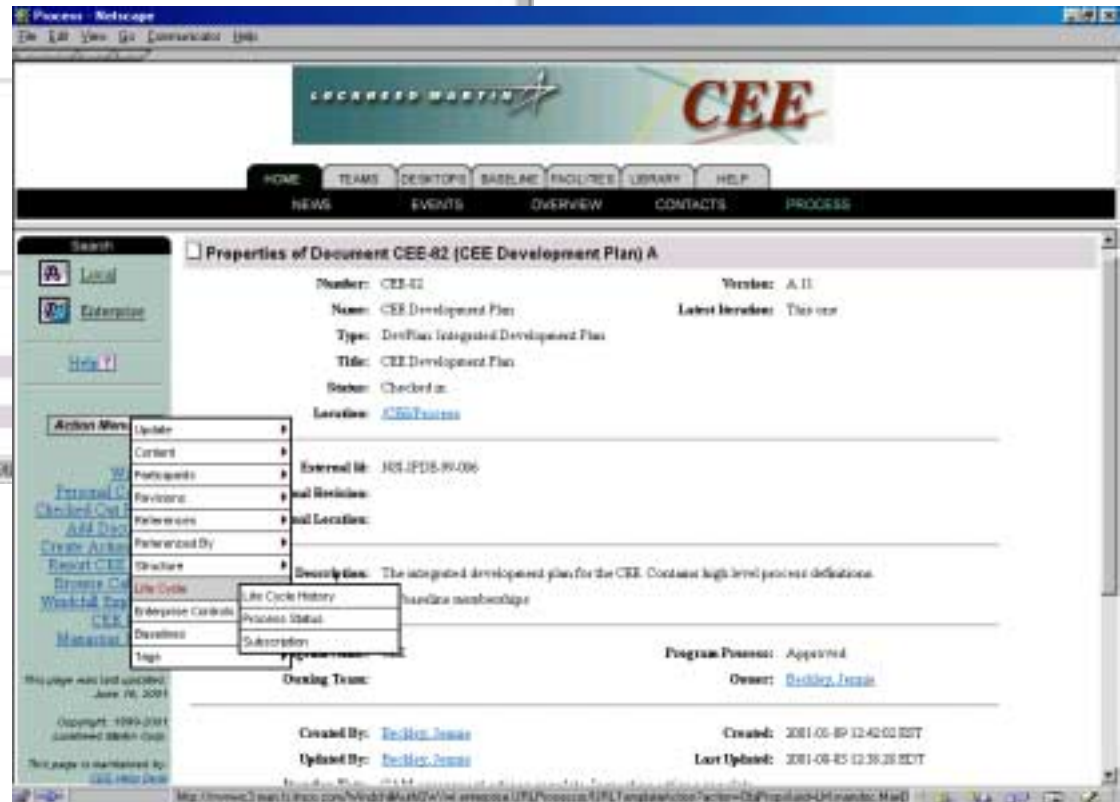
- *Support multiple diverse programs*
  - Timely support for new programs
  - Ease of administration
- *Encapsulate each program's business object policy decisions*
  - Enforce consistency
  - Shield user from unnecessary complexity
- *User-friendly access for both casual and power users*
- *Consistent program "look and feel"*
- *Flexibility for program customization and local administration*
- *Product centric focus*
- *Leverages COTS and existing toolsets*
- *CEE software integrity*

# CEE Framework

- *Program centric view*
  - Home page
  - Information organization
  - Object Association
  - Policy encapsulation
- *Power/casual user access*
- *Product centric focus*
- *Dynamic page generation*
  - User interface consistency
  - Currency of content
  - Tool-based customization
- *Efficient administration*
  - Timely automated setup
  - Single codebase
- *Navigation/search/actions*
- *Rapid extensibility*



# CEE Framework Example



# Selected CEE Applications



- *Document management*
- *Product structure management*
- *Configuration management*
- *Change management*
- *Action items*
- *Events*
- *Product catalog*
- *Cost as an Independent Variable (CAIV)*
- *Knowledge management*
- *Search, subscription*
- *Program administrator helper*
- *CEEView Publisher*

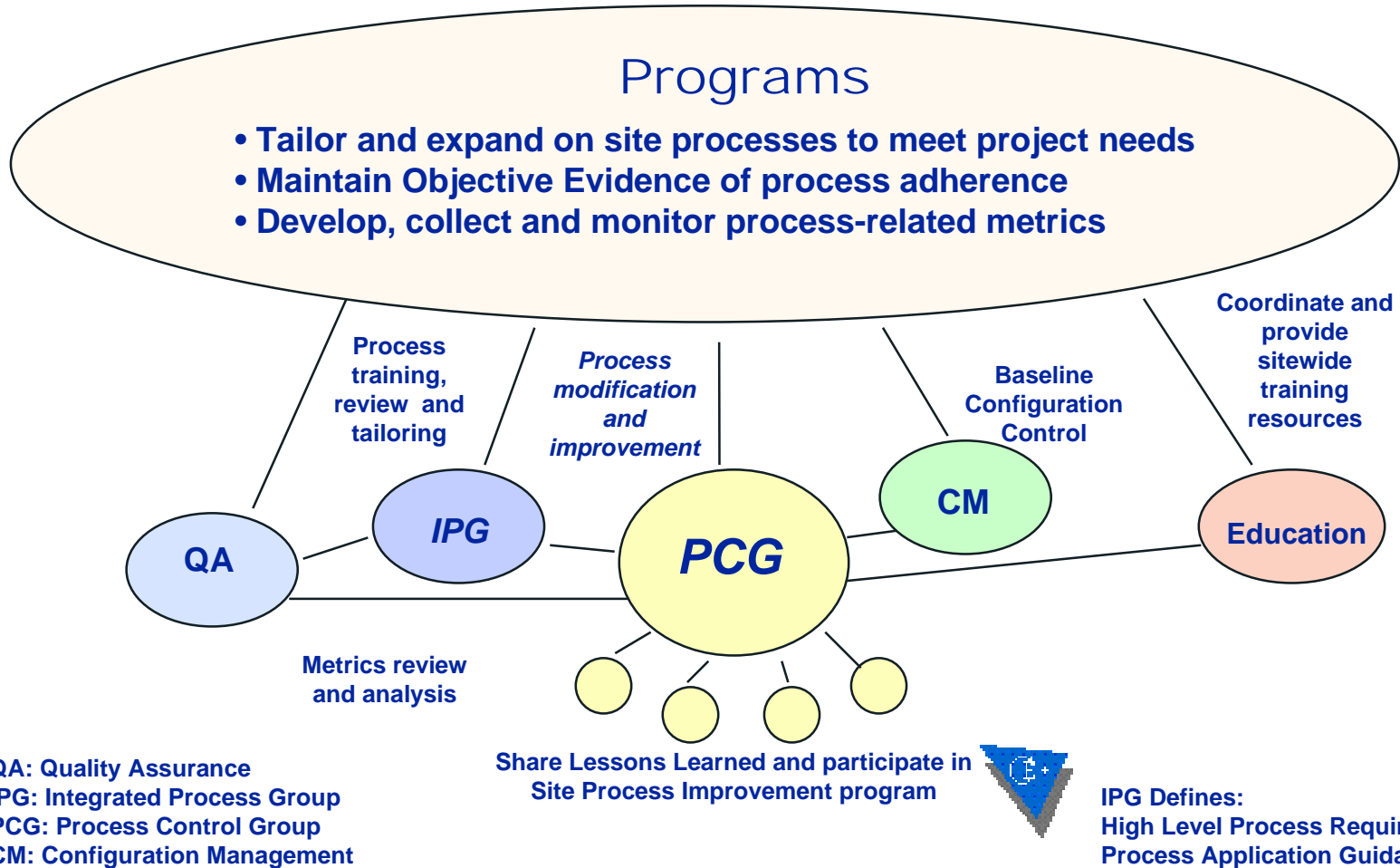
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# NE&SS-Undersea Systems

## Process roles and responsibilities



QA: Quality Assurance  
IPG: Integrated Process Group  
PCG: Process Control Group  
CM: Configuration Management

Share Lessons Learned and participate in  
Site Process Improvement program



IPG Defines:  
High Level Process Requirements  
Process Application Guidance

# CEE

## System roles and responsibilities



- ***CEE Development Team***
  - Produce software product
- ***CEE Systems Administration Team***
  - Provide non-program specific administration
  - Provide system management, backup, and recovery services
- ***CEE Help Desk***
  - Answer user questions
  - Forward problem reports to systems administration and development teams
- ***Program Administrator(s)***
  - Tailor the program environment for optimized program support
  - Interface with the CEE Development and Systems Administration teams

# CEE Program Environment Tailoring



- *Program environment tailoring is not required*
  - Useable defaults
- *Tailorable program environment characteristics*
  - **Program groups**
    - Specified for access controls or process role mappings
  - **Program policies**
    - Process definition and object handling (documents, etc.)
  - **Program base properties**
    - Teams, impact assessment policies
  - **Program domain policies**
    - Access controls, search indexing rules, automatic notification
  - **Program web pages**
    - Adding links, developing and linking custom pages
  - **Category specification**
  - **Program policy documentation**

# Program Administrator Tools

## Example



The screenshot shows a Netscape browser window titled "Desktops - Netscape" with a menu bar (File, Edit, View, Go, Communicator, Help) and a toolbar. The main content area displays the "LOCKHEED MARTIN" logo and the "CEE" logo. Below the logos is a navigation bar with buttons for HOME, TEAMS, DESKTOPS, BASELINE, FACILITIES, LIBRARY, and HELP. A dropdown menu is open under "DESKTOPS", showing "Program Administrator".

On the left side, there is a "Search" section with "Local" and "Enterprise" options, and a "Help" link. Below this is a list of links: "Worklist", "Personal Cabinet", "Checked Out Folder", "Add Document", "Create Action Item", "Report CEE Issue", "Browse Cabinets", "Windchill Explorers", "CEE Portal", and "Manassas Home".

The main content area is titled "Program Administrator Actions:" and contains a dropdown menu with the following options: "Select an action", "Select an action", "Program Administrator Helper", and "Bulk Load/Unload". Below this is a section titled "Enterprise Program Administrator Links:" with links to "Program Administrator's Guide", "New User Spreadsheet", "Iteration Report", and "Document Bulk Load Spreadsheet".

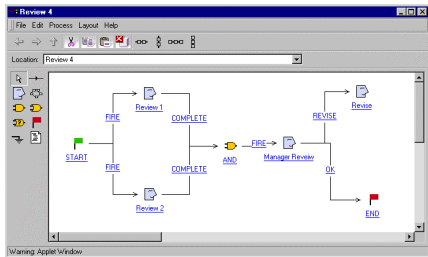
Below that is a section titled "Program Program Administrator Links:" with links to "User/Group/Domain Administrator", "Project Administrator", "Workflow Administrator", and "Life Cycle Administrator".

At the bottom of the main content area, it says "Contents of /CEE/Desktops/ProgramAdministrator: 0 items" and "folder.asp?dir".

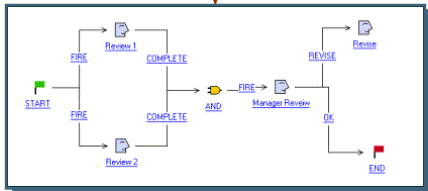
On the right side, there is a "PROGRAM ADMINISTRATOR HELPER" window. It has a title bar and a "Program:" dropdown menu set to "CEE". Below this is a list of buttons: "Groups", "Projects", "Policies", "Base Properties", "Domain", "Links", and "Categories". At the bottom of the helper window are "Exit" and "Help" buttons.

The status bar at the bottom of the browser window shows "Document Done".

### Workflow Definition



Workflow Process Editor



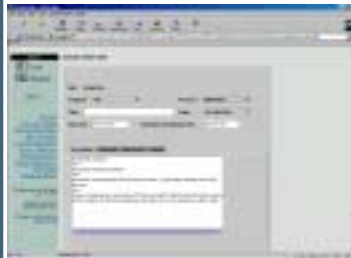
Workflow Process Template

**Developer**

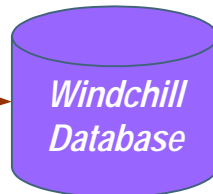
### Workflow Runtime Environment



Personal Work List

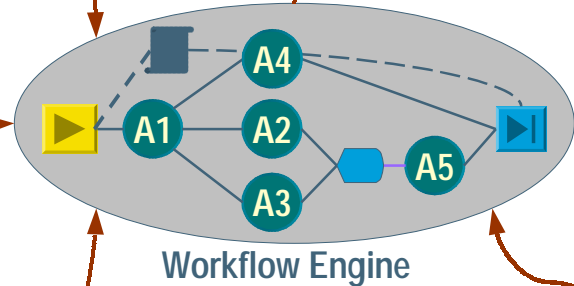


Task Form



Windchill Database

**User**



Workflow Engine

Directory Service

Email

Status Report

**Application**



- ***Processes***
  - Defined by the program
  - Defined for object types (Documents, parts, action items, etc.)
- ***Process definition includes:***
  - Process name
  - Life cycle - object behavior
    - State transitions
    - Work items delivered to process participants
    - Review points
  - Project - process participant resolution
  - Folder - location where object will be created
  - Type - specific to the object (document type - CONOPS)
  - Description - can be created automatically (template)
  - Content file(s) - can be created automatically

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# Benefits

## Automation of the enterprise inspection process



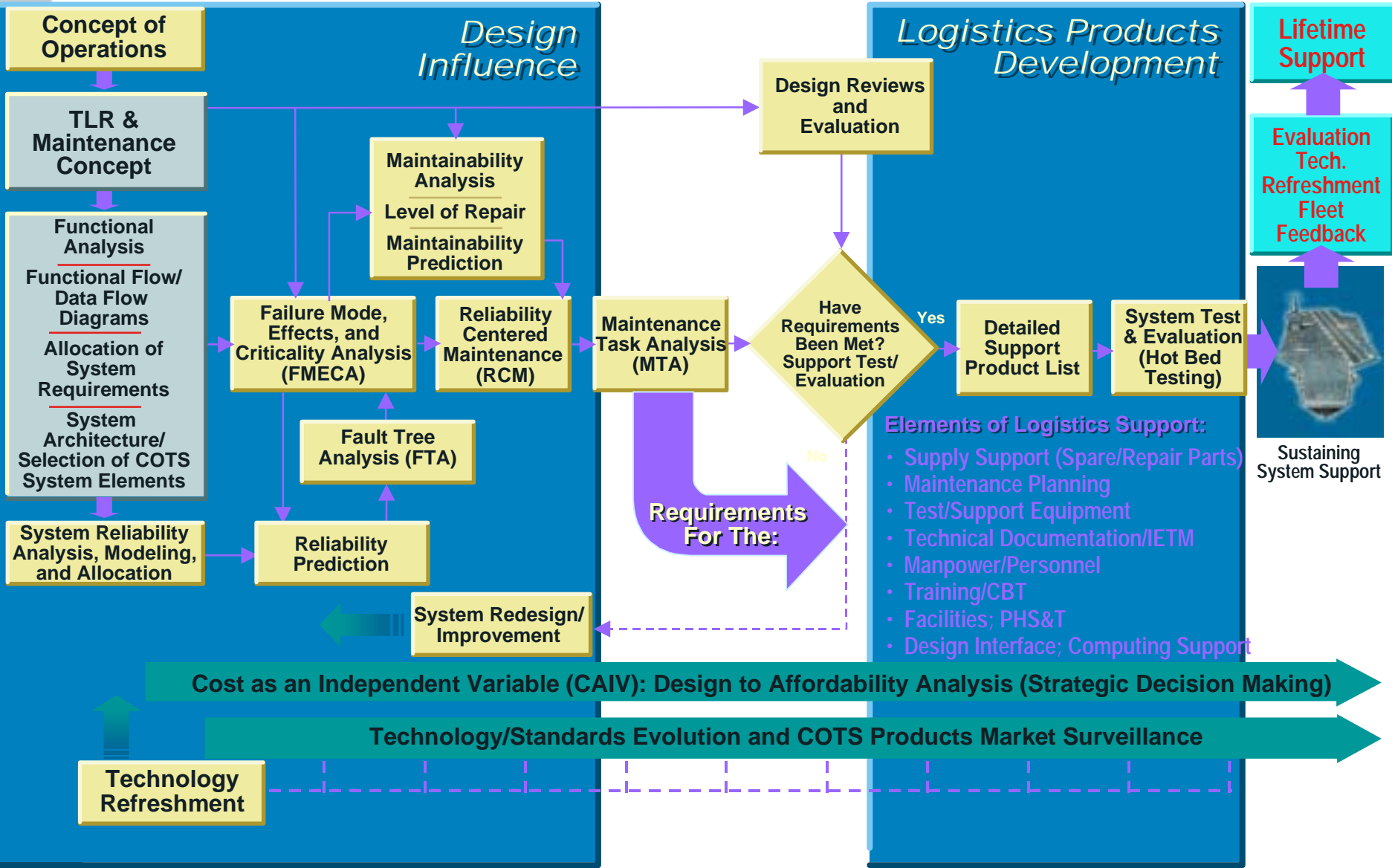
- *Ensures process consistency across utilizing programs*
  - May be geographically distributed teams
- *Delivers tasks and information to the “right person at the right time and in the right format”*
  - Individualized inspection tool file(s)
  - Option to reference subject content
- *Assists user with instructions on tasking*
- *Automates tool file manipulation for moderator*
- *Provides real-time inspection status*
- *Records inspection history*
- *Reduces inspection cycle time and coordination costs*
- *Simplifies enterprise process improvement deployment*

# Agenda

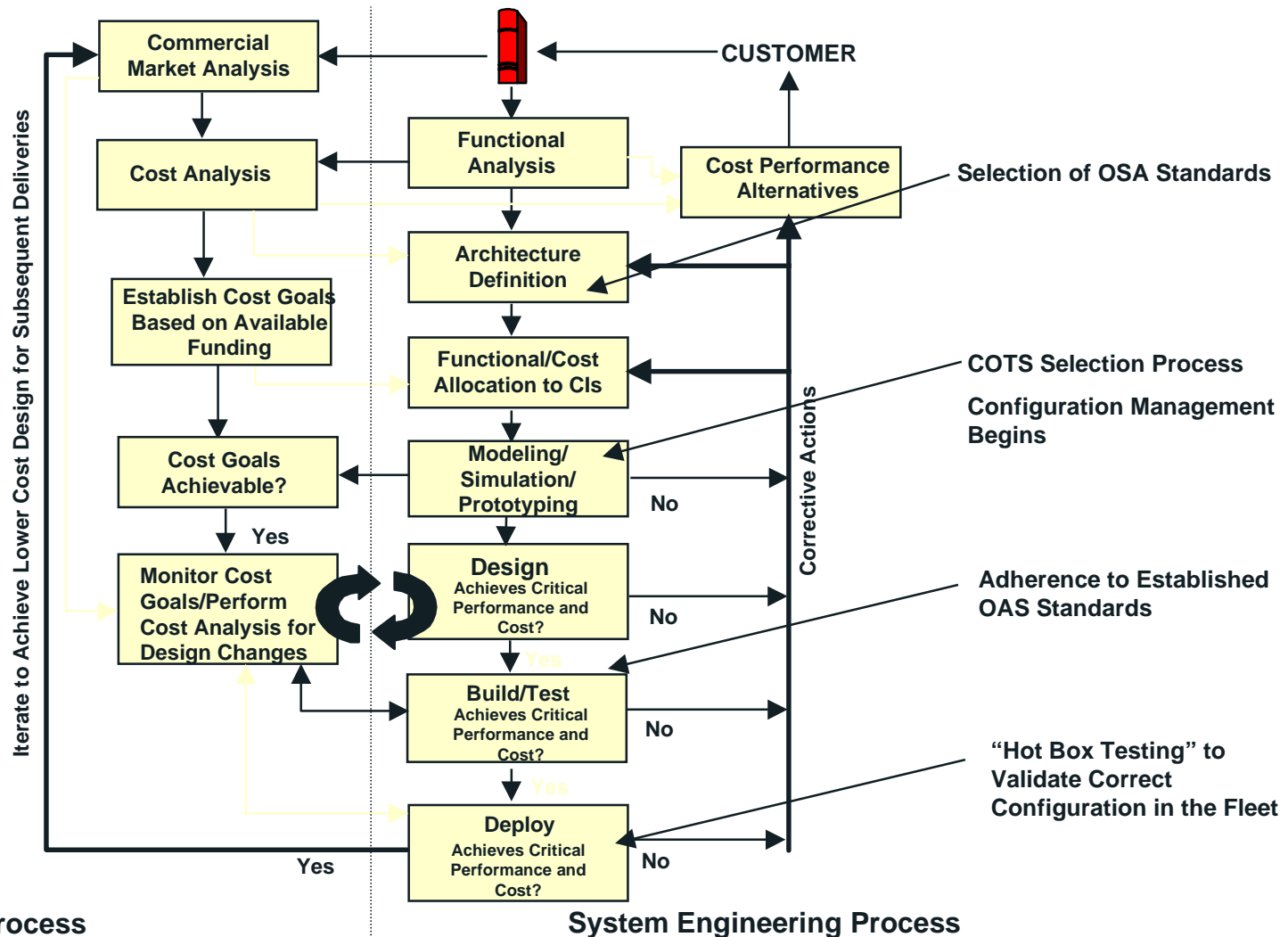


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# RM&S Engineering and Analysis Process



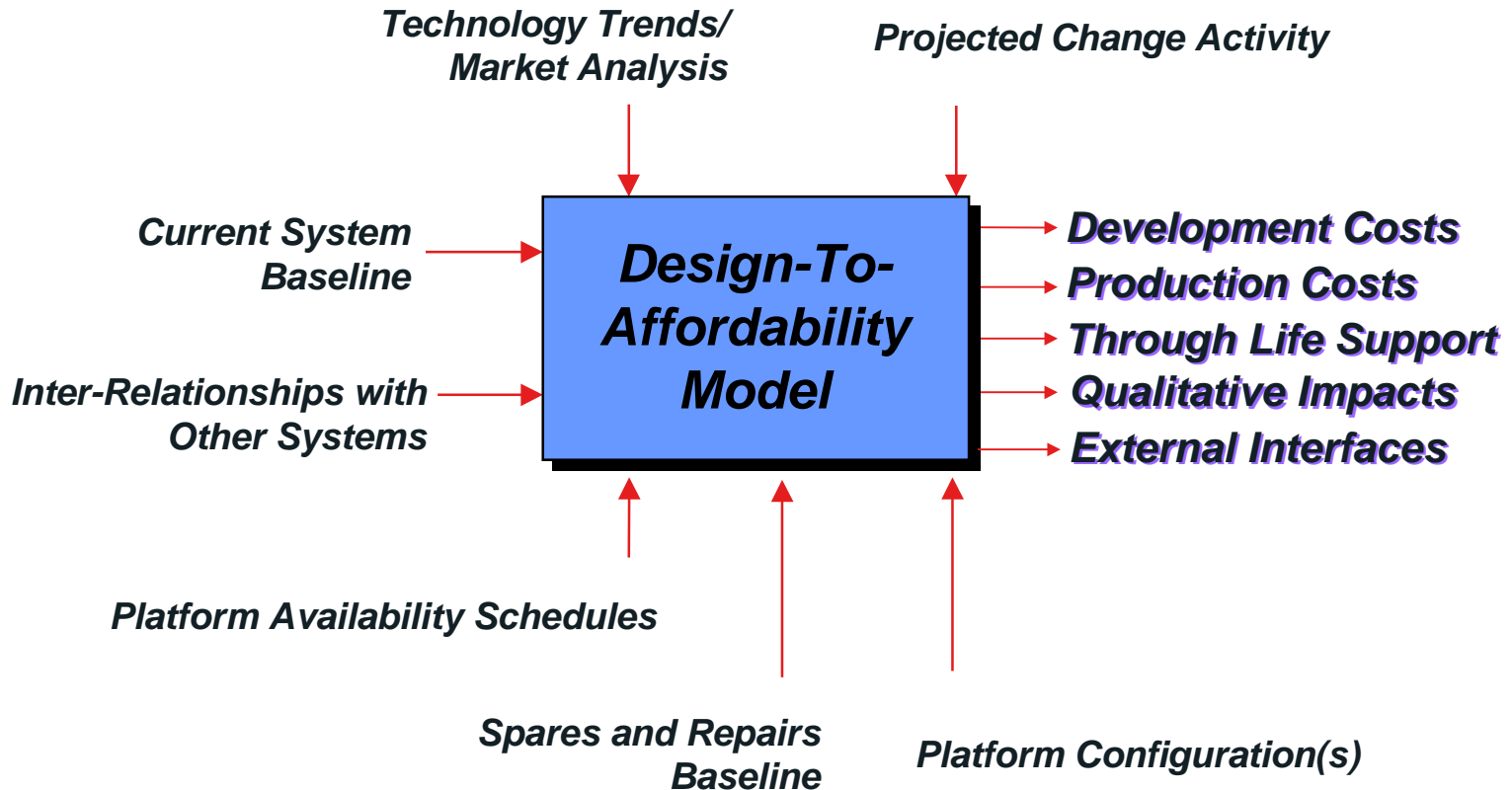
# Cost As An Independent Variable (CAIV) Integrated with the System Engineering Process



CAIV Process

System Engineering Process

# Tools and Processes

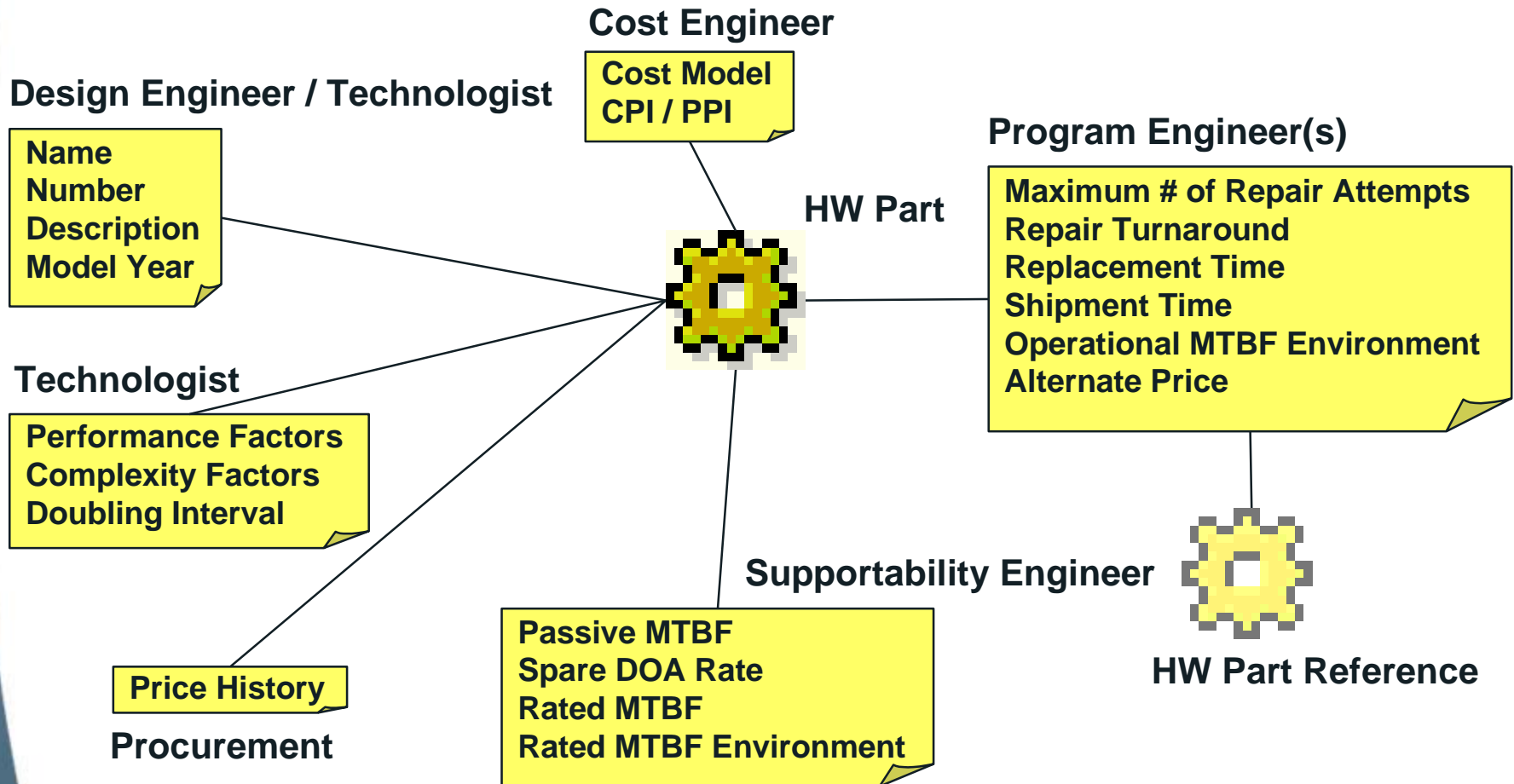


# Part characteristics customization

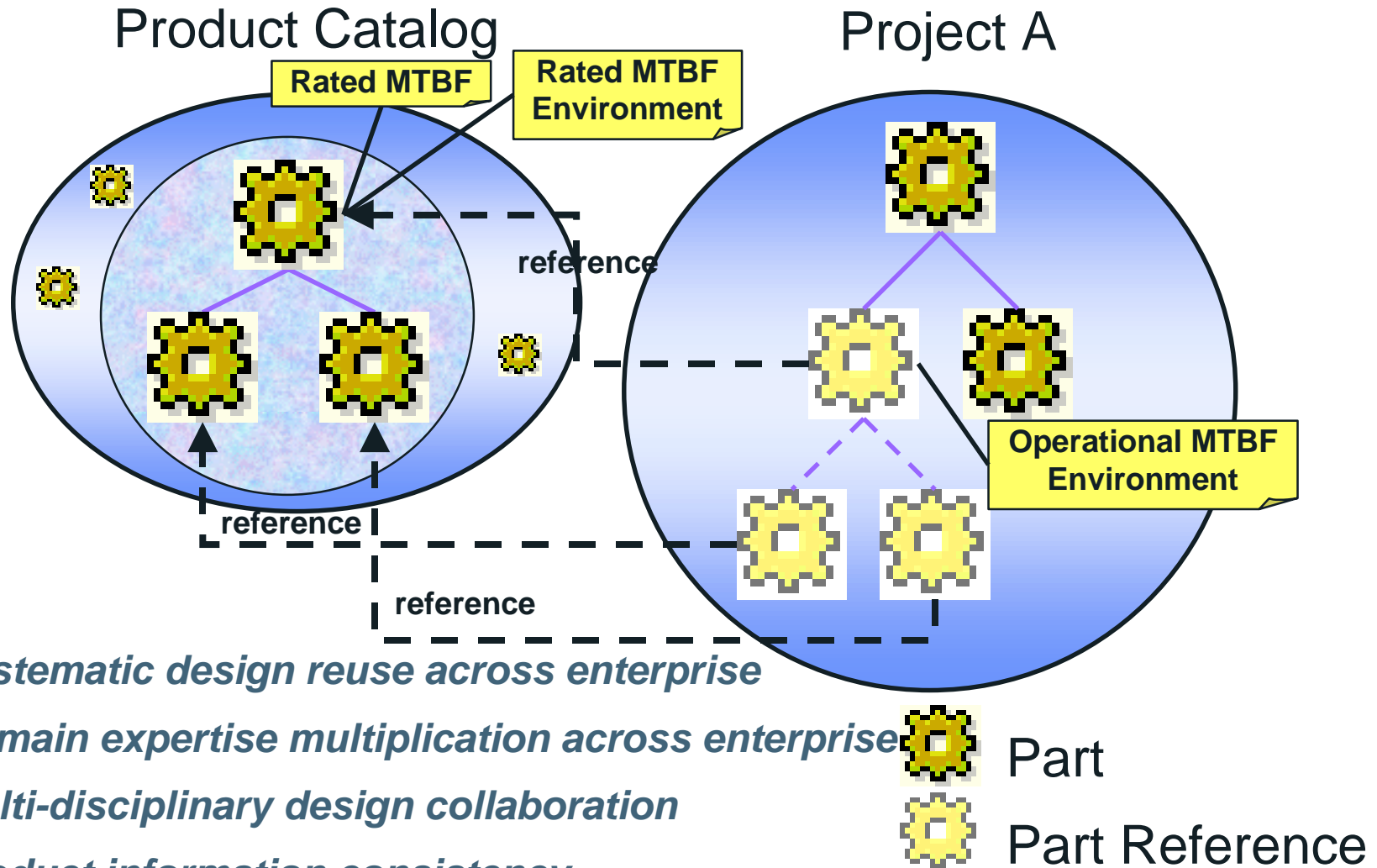


## Master Characteristics

## Program-Specific Characteristics



# Product catalog concept



- *Systematic design reuse across enterprise*
  - *Domain expertise multiplication across enterprise*
  - *Multi-disciplinary design collaboration*
  - *Product information consistency*
  - *Localized application flexibility*
- Part  
Part Reference

# Benefits

## Multi-disciplinary engineering



- *Enables ubiquitous application of engineering process*
- *Ensures information consistency across utilizing programs*
  - Information reuse
  - May be geographically distributed teams
- *Injects multi-disciplinary expertise across enterprise*
  - Expertise multiplication
  - Delivers information to the “right person at the right time and in the right format”
- *Enterprise product information consistency enables productization*
- *Substantial reduction in cycle time supporting decisions*
  - System cost report reduced from 4-6 weeks to several days
- *Enables program “tailoring” of catalog parts*

## ***CEE provides business discriminating capabilities***

- ***Integration of diverse teams across geographical, organizational and disciplinary boundaries***
- ***Ensures consistent process execution across enterprise***
- ***Delivers information to the right person at the right time in the right format***
- ***Users have a consistent interface with the environment***
- ***Enables best practice institutionalization through capture, exploitation and execution of processes and information***