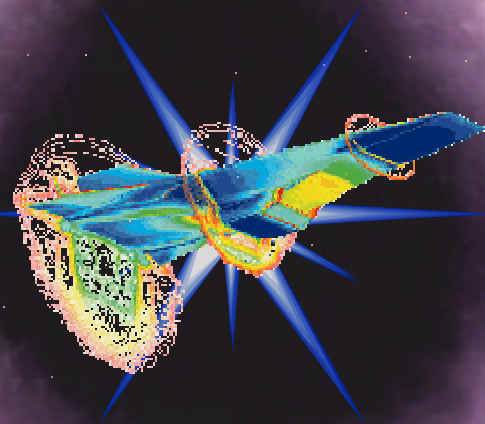




Learning to Work in Collaborative Environments



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Increasingly, the teamwork and the tools of engineering are moving to the Internet ...

The Oracle logo consists of the word "ORACLE" in white, uppercase, sans-serif font, centered on a red rectangular background.

Larry Ellison sets the challenge of e-engineering the whole of Oracle's business by the end of 2000



Company official delivers briefing to Automotive Management titled " E-Engineering: Enabling Collaboration in the Next Century"



Industry Advisory Board features a keynote address titled " E-Engineering and the Networked Economy"



SPC's Eight Annual Executive Roundtable "E-Engineering: An Executive Perspective"

E-ENGINEERING – WHAT IS IT?

Distributed collaboration in cyberspace using leading edge technologies enabling physically-dispersed, diverse teams to learn and to create integrated, innovative and competitive products, systems, and services.

Old Dominion University e-engineering Task Force, Dec 2000



***If e-engineering is the solution,
what is the problem?***



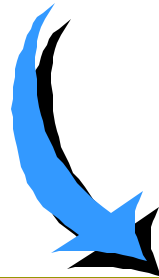
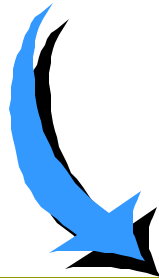
Global Product Development Environment Challenges

Geographic distribution

Diverse cultures

Member unfamiliarity

Team instability



Global Product Development Environment



Short / combined development cycles

Engineering complexity

Increased integration

Tighter budgets

TRENDS/ISSUES OF MAJOR CONCERN IDENTIFIED IN A SURVEY OF 300 CEO'S

- **Globalization (94%)**
- **Improving knowledge management (88%)**
- **Cost and cycle time reduction (79%)**
- **Improving supply chains globally (78%)**
- **Manufacturing at multiple locations in many countries (76%)**
- **Managing the use of more part-time, temporary, and contract workers (71%)**

REQUIRED (NEW) SKILLS FOR THE “E” IN E-ENGINEERING

- **Computational Modeling and Software**
- **Human Centered Computing**
- **Hardware and Networks**

NAE/NRC STUDY ON ADVANCED ENGINEERING ENVIRONMENTS

-
- **Distributed Collaborative Teaming**
 - **Virtual Collaborative Project Management**

OLD DOMINION COLLEGE OF ENGINEERING AND TECHNOLOGY



“BARRIERS TO E-ENGINEERING REMAIN AT MANY UNIVERSITIES”

Design in the New Millennium, NAE/NRC Report on Advanced Engineering Environments

- **Reward system**
- **Faculty appreciation for e-engineering**
- **Lack of time/resource for interdisciplinary program development**
- **Industry and government view of academia**
- **Lack of proven methods for preparing students**

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-SOME OF OUR STRENGTHS-

DISTANCE LEARNING/E-LEARNING

19,000 REGISTRATIONS

54 SYNCHRONOUS SITES IN U.S.

ASYNCHRONOUS PROGRAMS

NAVY COLLEGE



NUCLEAR NAVY MASTERS PROGRAMS



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VISION

- **Transform the College of Engineering and Technology from an engineering to an “E-engineering” institution.**

Create an effective industry collaborative model, or center, involving ODU faculty, students and staff with industry, government, and academia in order to address E-engineering workforce and technology development issues.

WE CAN'T DO IT ALONE.....

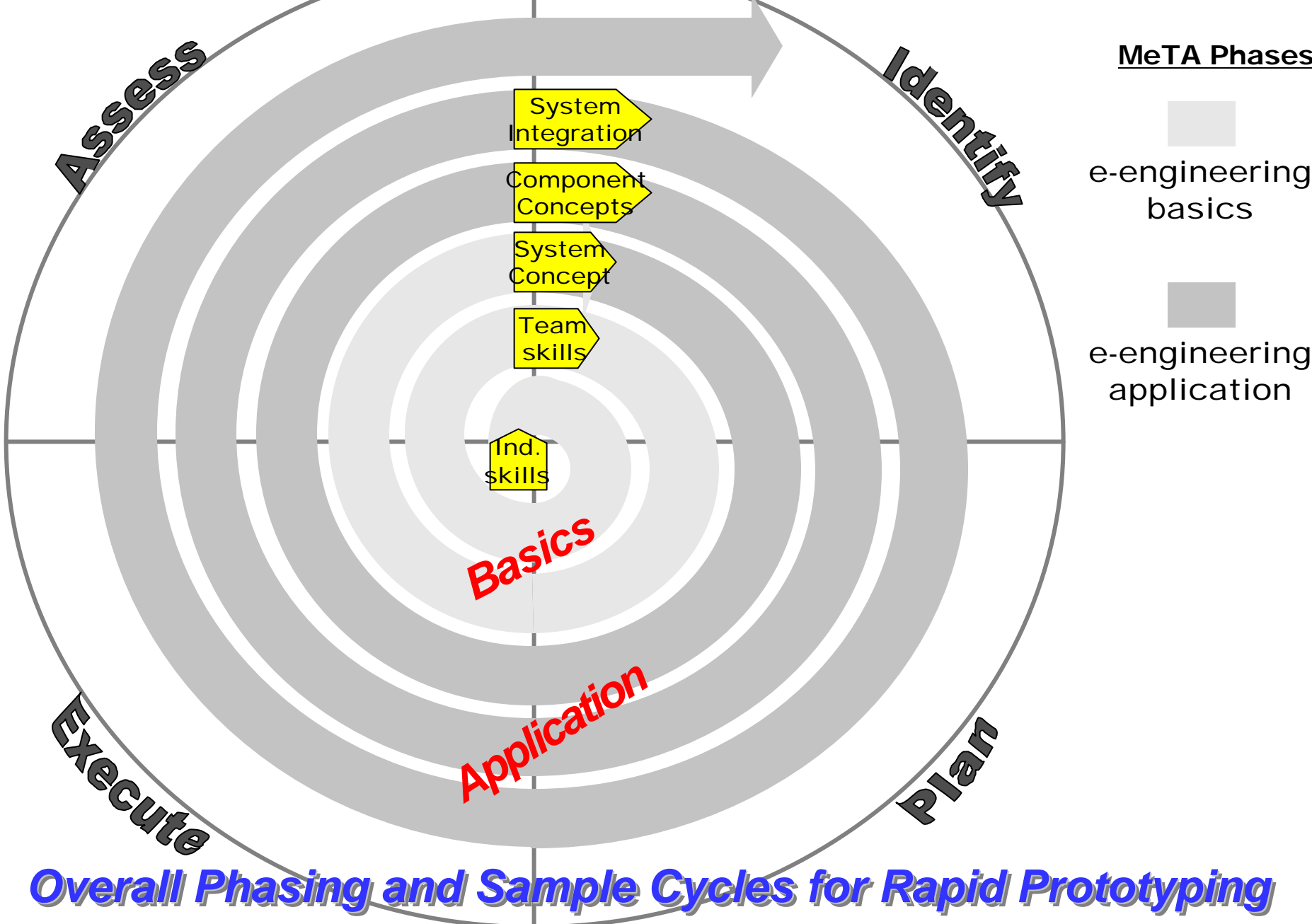
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WHO NEEDS E-ENGINEERING SKILLS?

- NEW GRADUATES
- CURRENT WORKFORCE



Model for e-engineering team adaptation (MeTA)



Pilot Study Focus Areas

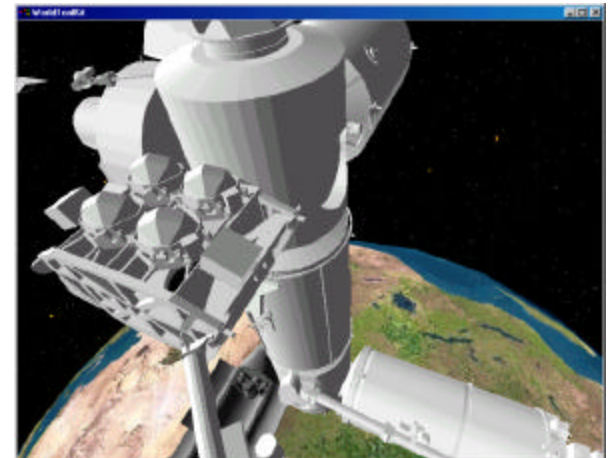
– Basics Phase

- Virtual Teaming
- Project Management

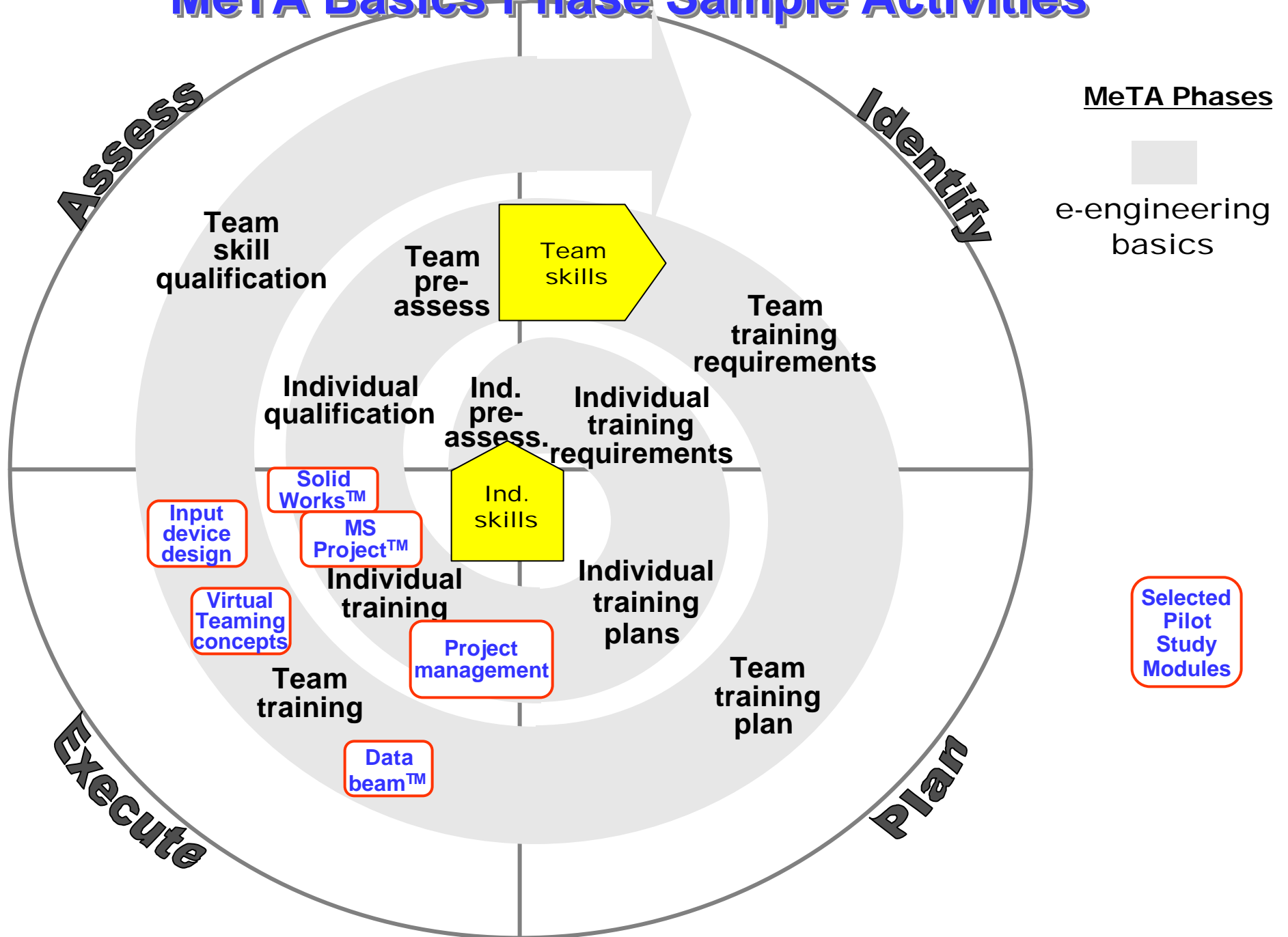
– Application Phase

- Product Scenario/Customer Meeting
- User Interface Design
- Solid Models, Rapid Prototyping/Fabrication
- Product Testing/Competition
- NASA Customer Presentation

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MeTA Basics Phase Sample Activities



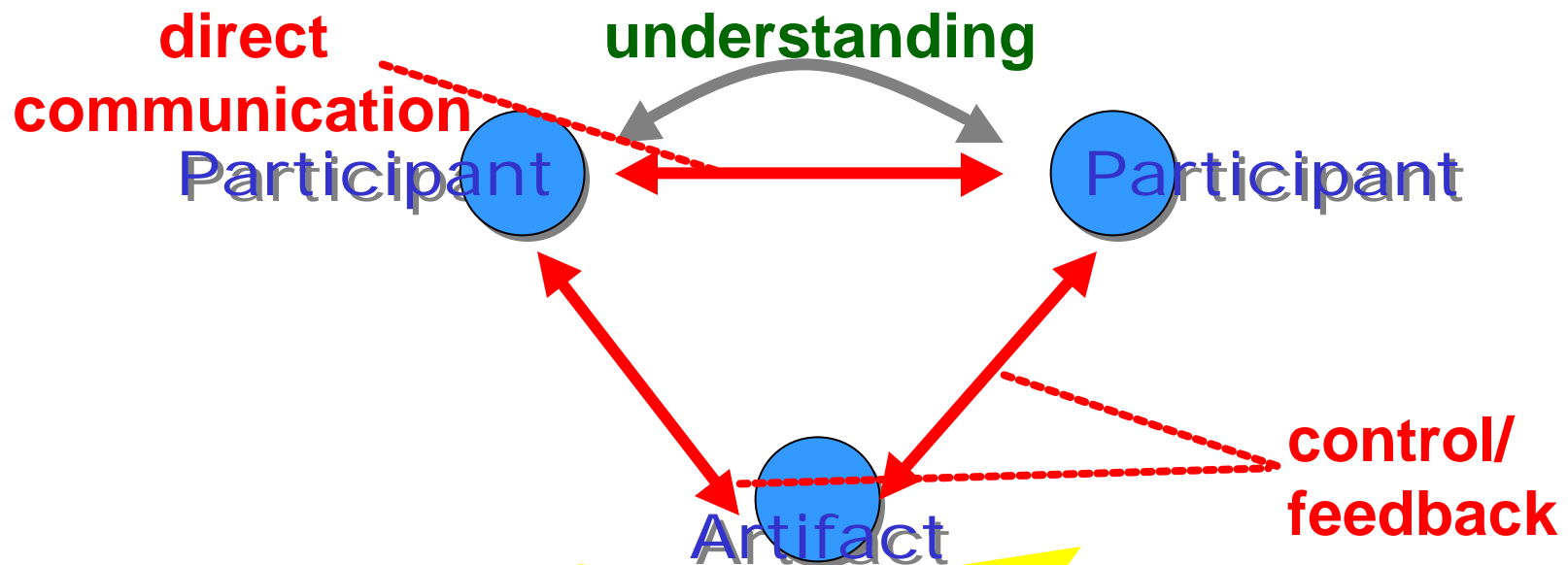
MeTA Basics Phase Focus

- **Team quickly reaching proficiency in basic e- engineering processes**
- **Individual and team e- engineering skill cycles addressed**
- **Individual**
 - E-engineering skill deficiency areas identified
 - Individual training planned and executed to achieve proficiency
 - Individual qualification assessments to establish proficiency
 - Individual skills include
 - Collaboration tool skills and virtual team process concepts
 - Project management and scheduling
 - Engineering-discipline skills required for specific project scenarios
- **Team**
 - Initial proficiency assessments of the team's e-engineering performance, by the team itself or by external evaluation
 - Team training and exercises planned and executed to achieve proficiency
 - Team qualification assessment to establish proficiency
 - Teaming skills include
 - Virtual team task and social dynamics
 - Working effectively using distributed synchronous and asynchronous collaboration tools

Distributed Collaborative Environment

Direct Interactions

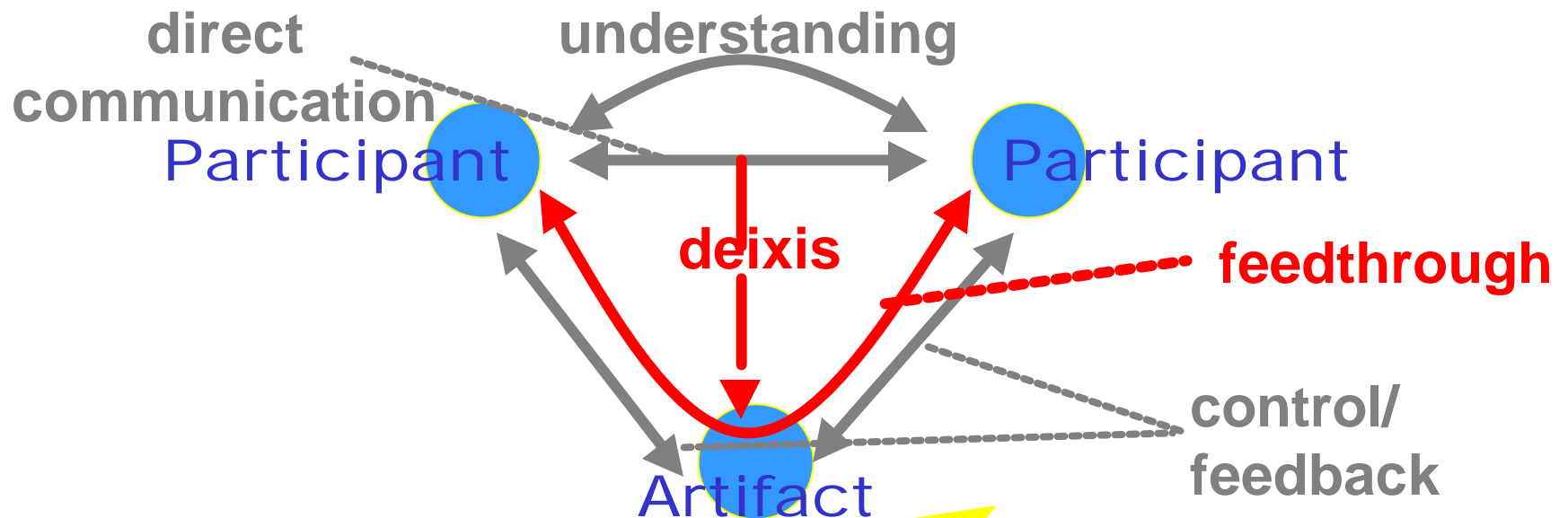
- **Common understanding** - argumentation tools, meeting rooms, shared work surfaces
- **Direct communication** - email, electronic conferences and video connections
- **Control and feedback from shared artifacts** - shared PCs and windows, shared editors, co-authoring systems, shared diaries



Integrating Communication and Work

Distributed Collaborative Environment Indirect Interactions

- **Deixis** - pointing out artifact aspect to group
- **Feedthrough** - manipulation of artifact (shared objects)
observed by others



Integrating Communication and Work

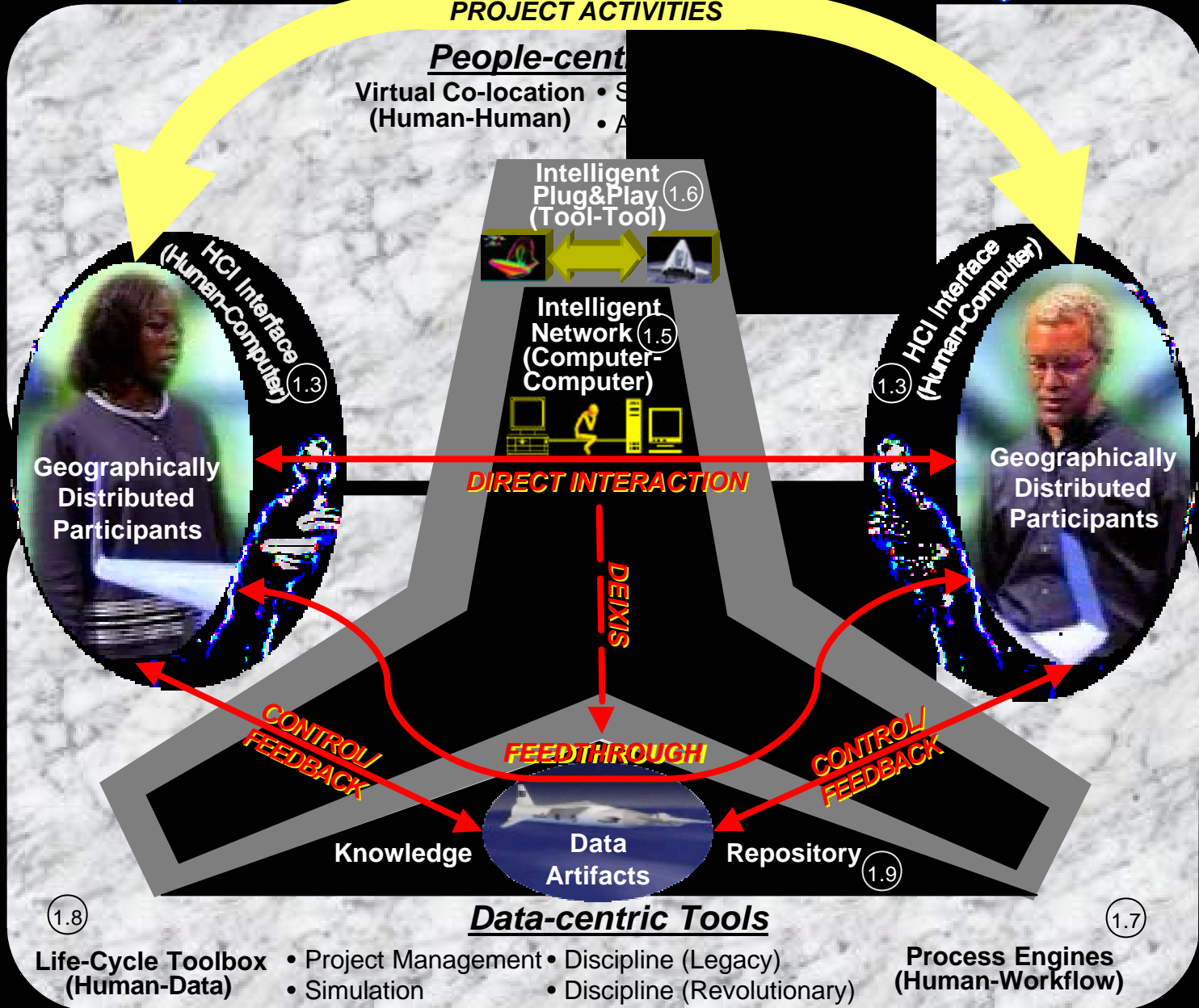
E-engineering Interaction Model

DISTRIBUTED COLLABORATIVE
 PROBLEM SOLVING - SHARED UNDERSTANDING - DECISION MAKING

PROJECT ACTIVITIES

People-cent

Virtual Co-location • S
 (Human-Human) • A



**PARTICIPANT
 TASK / ACTIVITY
 INTERACTIONS**

Starting a Virtual Team

- **Identifying team sponsors, stakeholders, and champions**
- **Develop a team charter – purpose, mission, goals**
- **Select and assign team members**
- **Team-orientation session**
 - **Orientation to the task**
 - **Technological planning**
 - **Communication planning**
 - **Team building**
- **Develop team processes**

A sample of best practice – Virtual Team Leader Sarah

- **Prefers initial face-to-face meeting**
- **Prior to meeting**
 - Tries to visit each team member, major stakeholder, sponsor, and champion
 - At very least, phone calls with team members to
 - Review project fundamentals
 - Introduce herself
 - Find out a little about individual team members and backgrounds
 - Ask about each team member's communication capabilities and computer hardware and software applications/experience
 - Sends relevant project information (draft charter, etc)

Team-orientation Session

- **Ideal is face-to-face meeting attended by all team members**
- **Agenda**
 - **Orientation to team's task**
 - Overview of team's charter
 - Opportunity for team members to react and offer feedback
 - Review of team member's expertise and accountabilities
- **Development of team norms, technology plans, and communication plans**
 - **Team norms**
 - Virtual conferencing etiquette and protocols to ensure participation from all members
 - Guidelines concerning when to use e-mail and expected reply time frame
 - How will work be reviewed and approved for submittal higher
 - Procedures for scheduling meetings
- **Team building**
- ***Continuous e-engineering improvement***

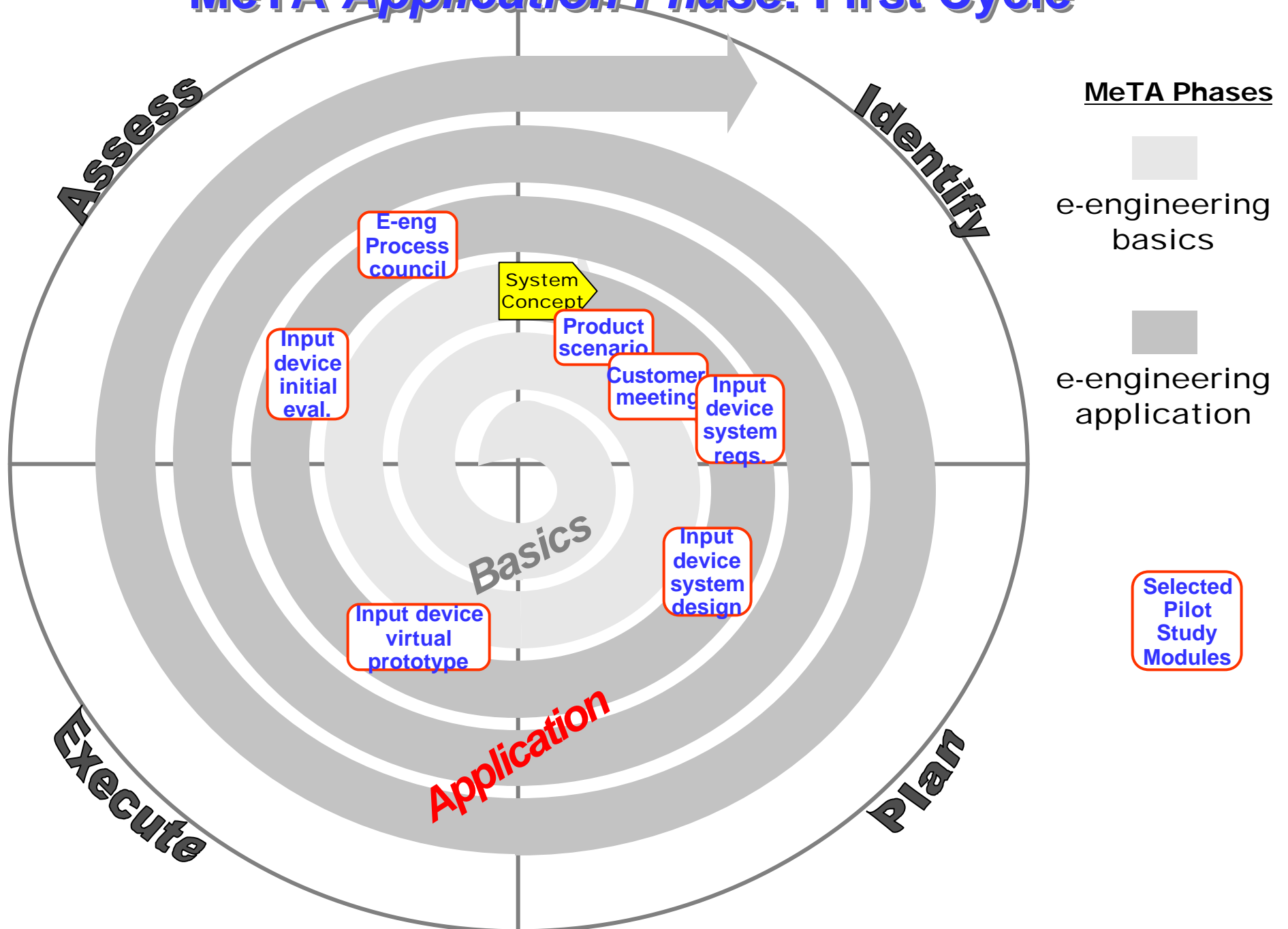
e-engineering Team Process Council



e-engineering Team Process Council Agenda

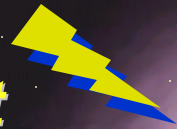
- **Guidelines**
 - Focus on processes, not personal references/attacks
 - Designate a note taker to record council meeting
 - These meetings part of project continuous process improvement
- **Identify process good, bad, and ugly – each team member contributes good and bad aspects for the below areas – for bad, suggest a solution**
 - Team communication
 - Team deliverable so far – (meeting customer expectations? meeting team expectations? quality of product?)
 - Team participation and workload (members proactive? sharing the workload?)
 - Team organization and work structure (are members aware of what each other is doing? are milestones, internal reviews happening?)

MeTA Application Phase: First Cycle



Pilot Study Product Scenario

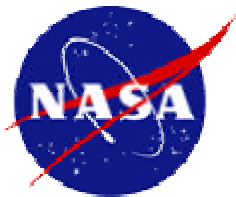
- **Create atmosphere of *engineering excitement***
 - NASA collaborative engineering theme
 - International Space Station environment
- ❖ **Product-centered team development effort**
 - Enough complexity to be *interdisciplinary*
 - Example:
Virtual Engineering Input Device
- ❖ **Module themes**
 - Learn to *think like innovative engineers*
 - *Remote collaboration*
 - *Global teams turning concepts into reality*

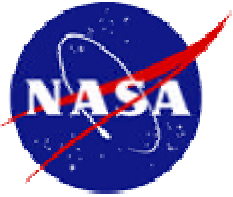


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Pilot Study Project

RE-ENGINEER THE SPACE ORB VIRTUAL ENGINEERING INPUT DEVICE





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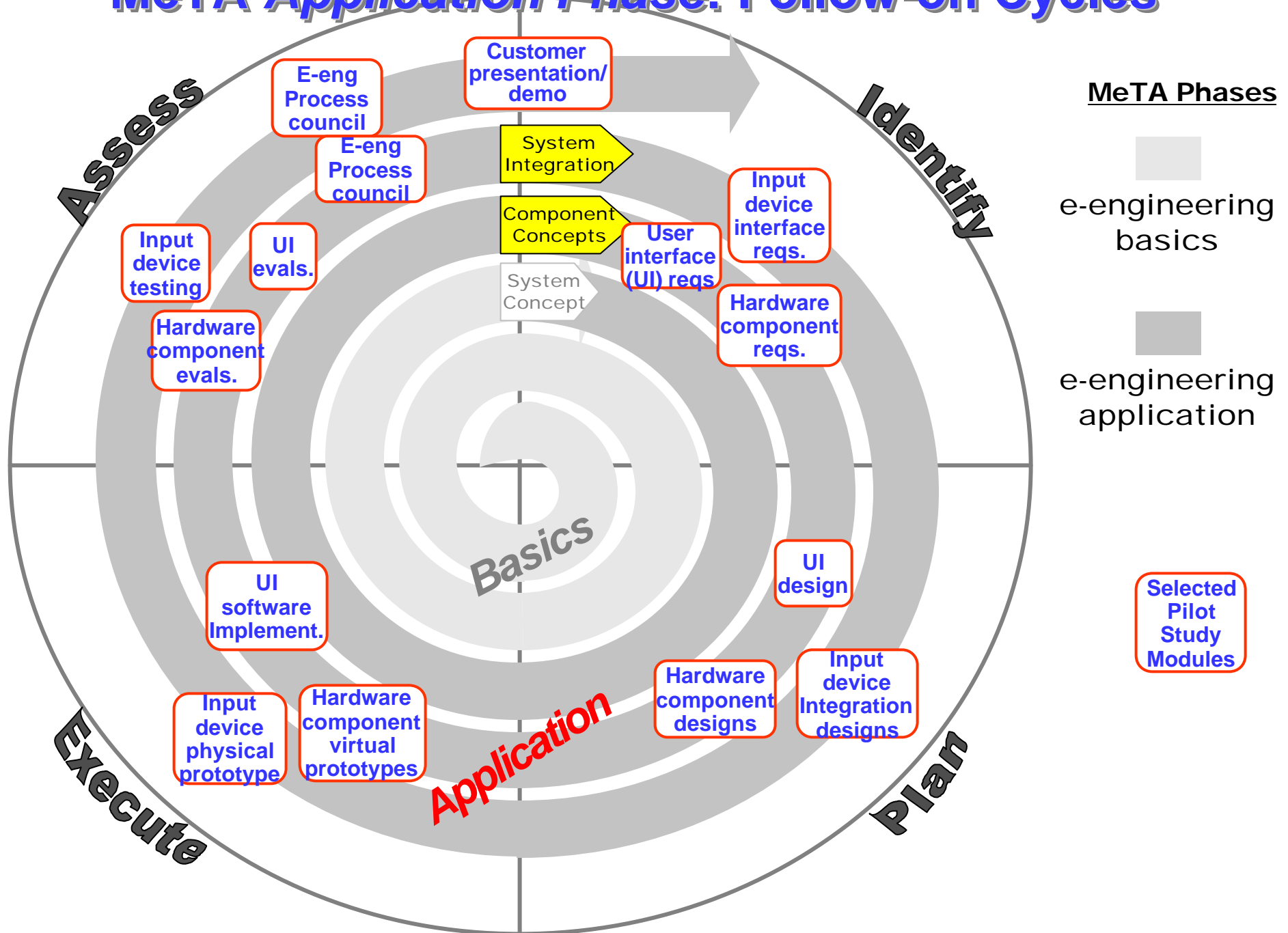
Pilot Study

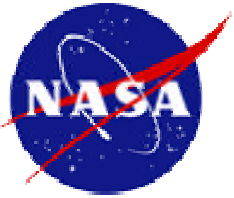
Customer Meeting / Task Analysis

- Familiarization with NASA Intelligent Synthesis Environment (ISE) program and International Space Station (ISS) programs
- Enhance project Statement of Work (SOW)
- Discuss desired device functionality details and capture task use cases
 - Navigation
 - Selection/Manipulation
 - Mode changes
- Conduct task decomposition on critical task use cases



MeTA Application Phase: Follow-on Cycles

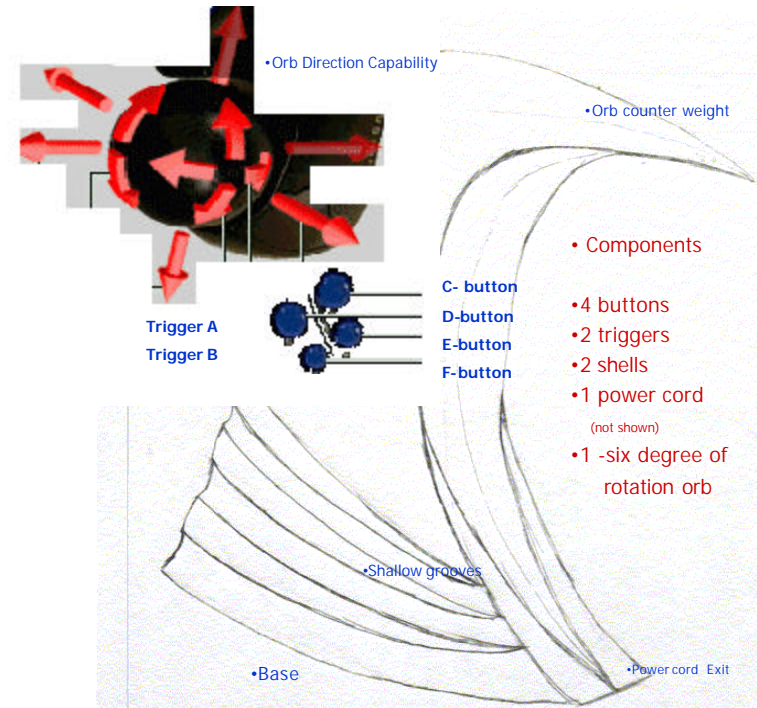




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Pilot Study

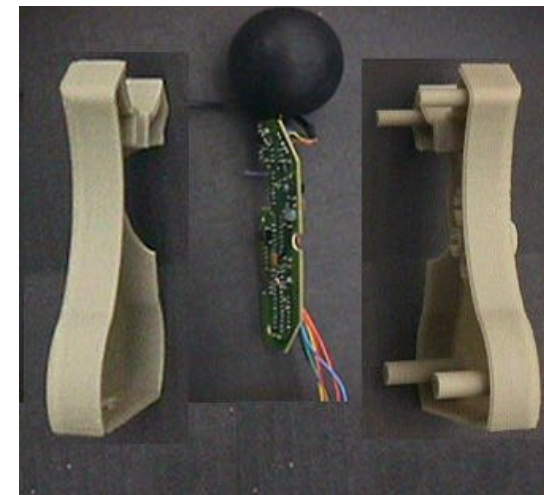
SAMPLE WORK



An example of initial design work



Top and bottom exterior component virtual CAD prototypes



Re-engineered Space Orb physical prototype components

Virtual Team Interactions

Example: User interface design brainstorming and refinements considering customer needs in *distributed virtual environment*

PROJECT ACTIVITIES

People-centric Tools

DIRECT INTERACTION

Data-centric Tools

INDIRECT
DATA INTERACTIONS

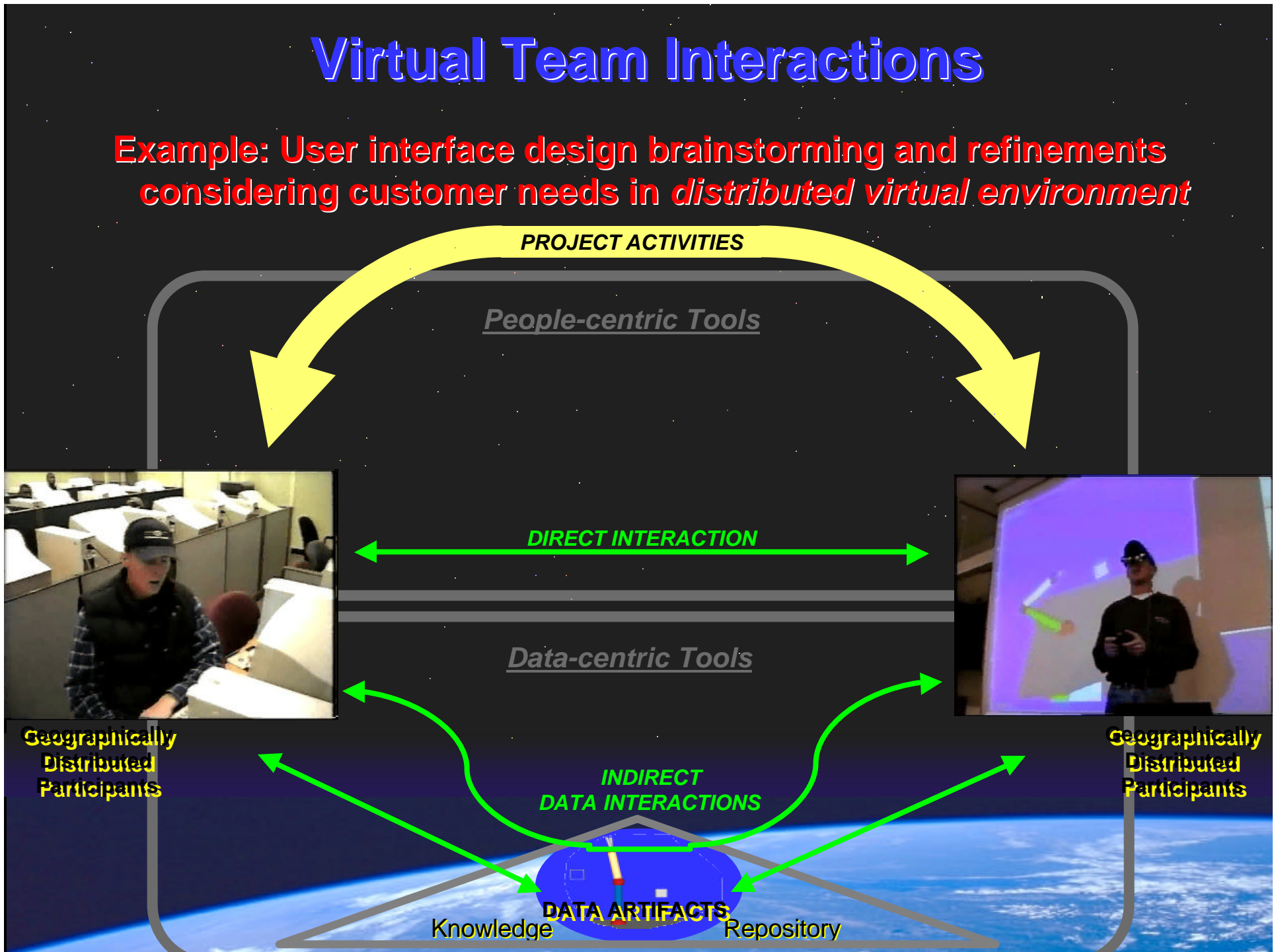
DATA ARTIFACTS

Knowledge

Repository

Geographically
Distributed
Participants

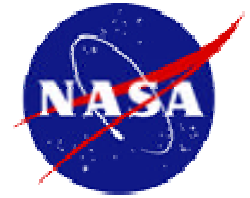
Geographically
Distributed
Participants





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Transformation



Collaborative infrastructure challenges

- * **Asynchronous communication in the form of bulletin board.**
- * **Synchronous communications that will include chat, whiteboard and application sharing capabilities, enhanced by the addition of audio and video channels.**
- * **Applications for recording sessions, including audio and video channels**
- * **Embedded applications to serve as an engineering notebook, where electronic notes, diagrams, and drafts can be displayed and stored for sharing within the virtual environment.**
- * **Integrated engineering tools such as design & solid modeling tools (CAD/CAM).**

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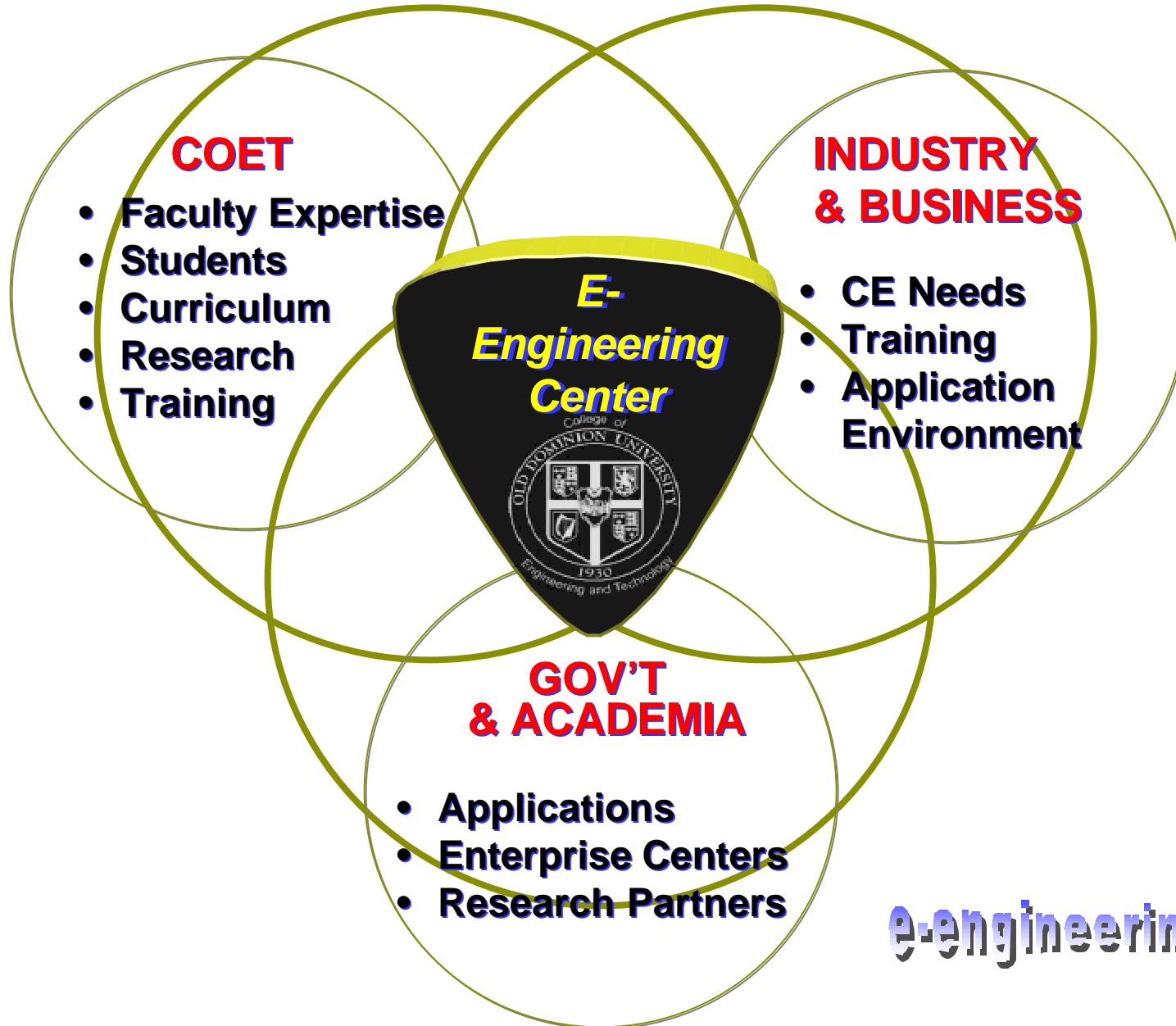
MULTI/RE-USABLE CONTENT LEARNING MODULES

- **SELECTED ATTRIBUTES**

- Incorporates best available experts
- Incorporates multimedia and simulations
- Presents material from a multi-disciplinary context
- Provides interactivity with professor, experts and fellow students
- Electronically storable and deliverable



E- Engineering Collaborative Model



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E-Engineering Synergy

-Advantages and Benefits-

