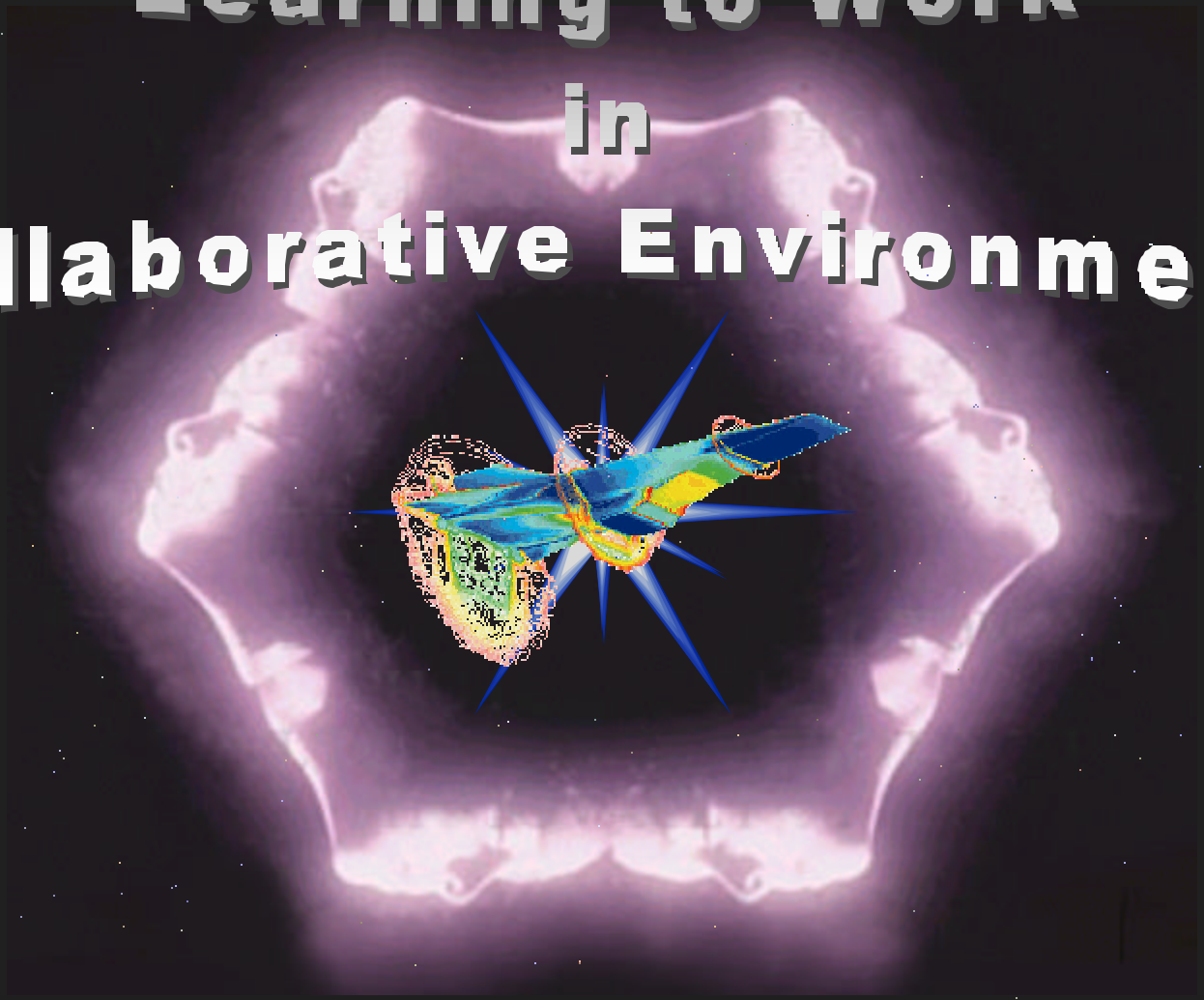
Learning to Work in Collaborative Environments



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

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"

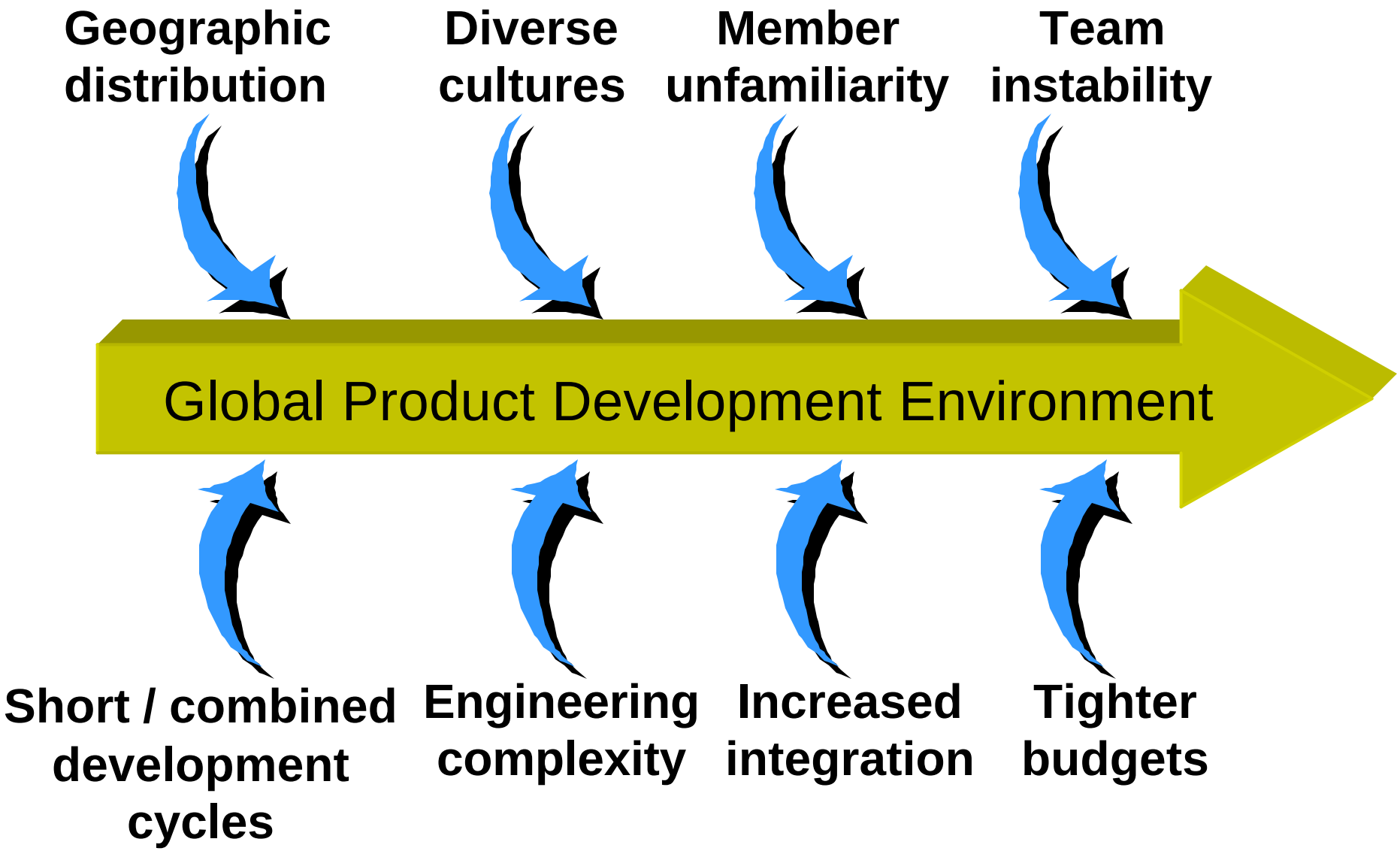
E-ENGINEERING – WHAT IS IT?

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



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 SYNCHROUNOUS 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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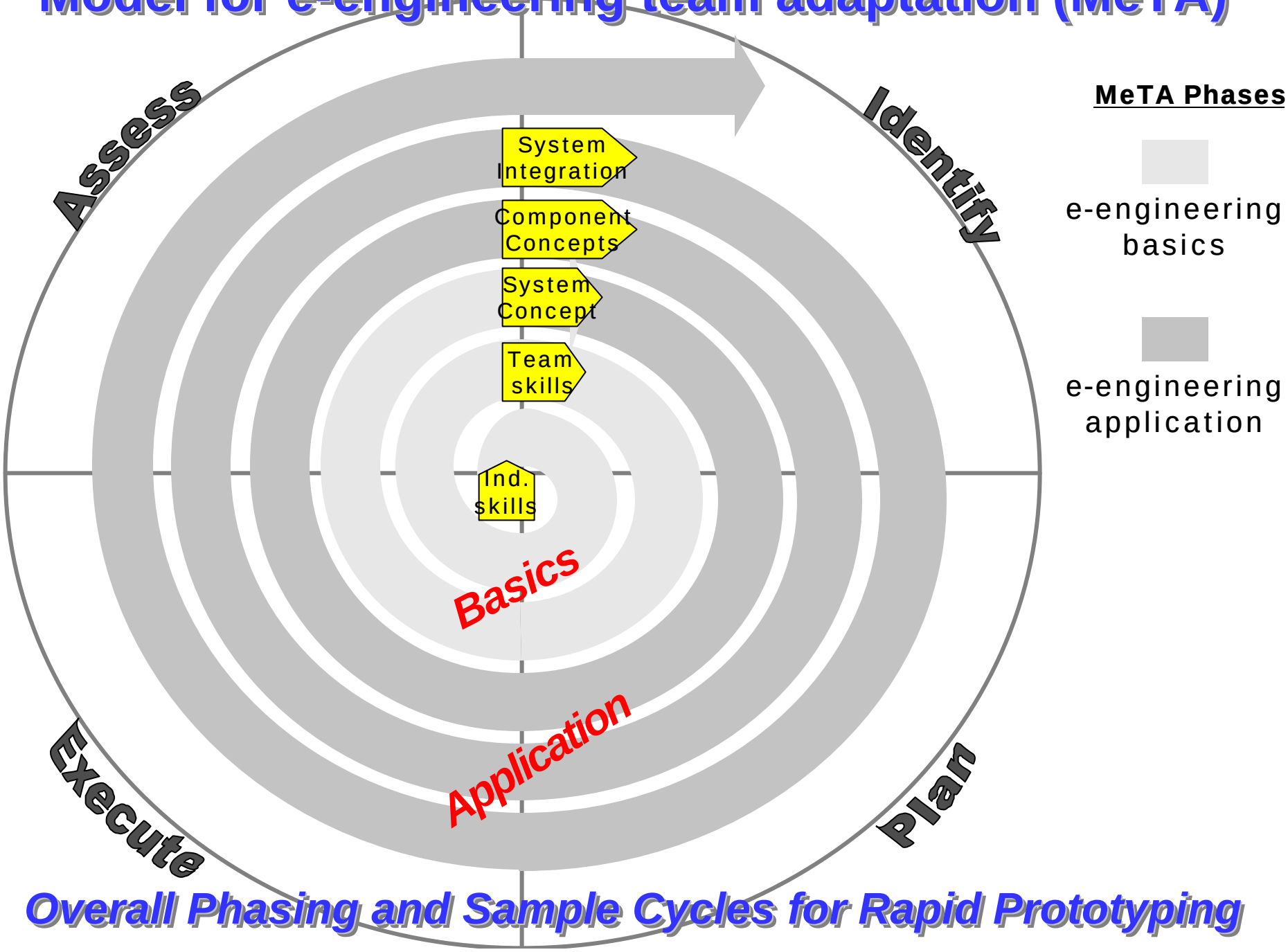
WHO NEEDS E-ENGINEERING SKILLS?

- NEW GRADUATES
- CURRENT WORKFORCE

Model for e-engineering team adaptation (MeTA)



Overall Phasing and Sample Cycles for Rapid Prototyping

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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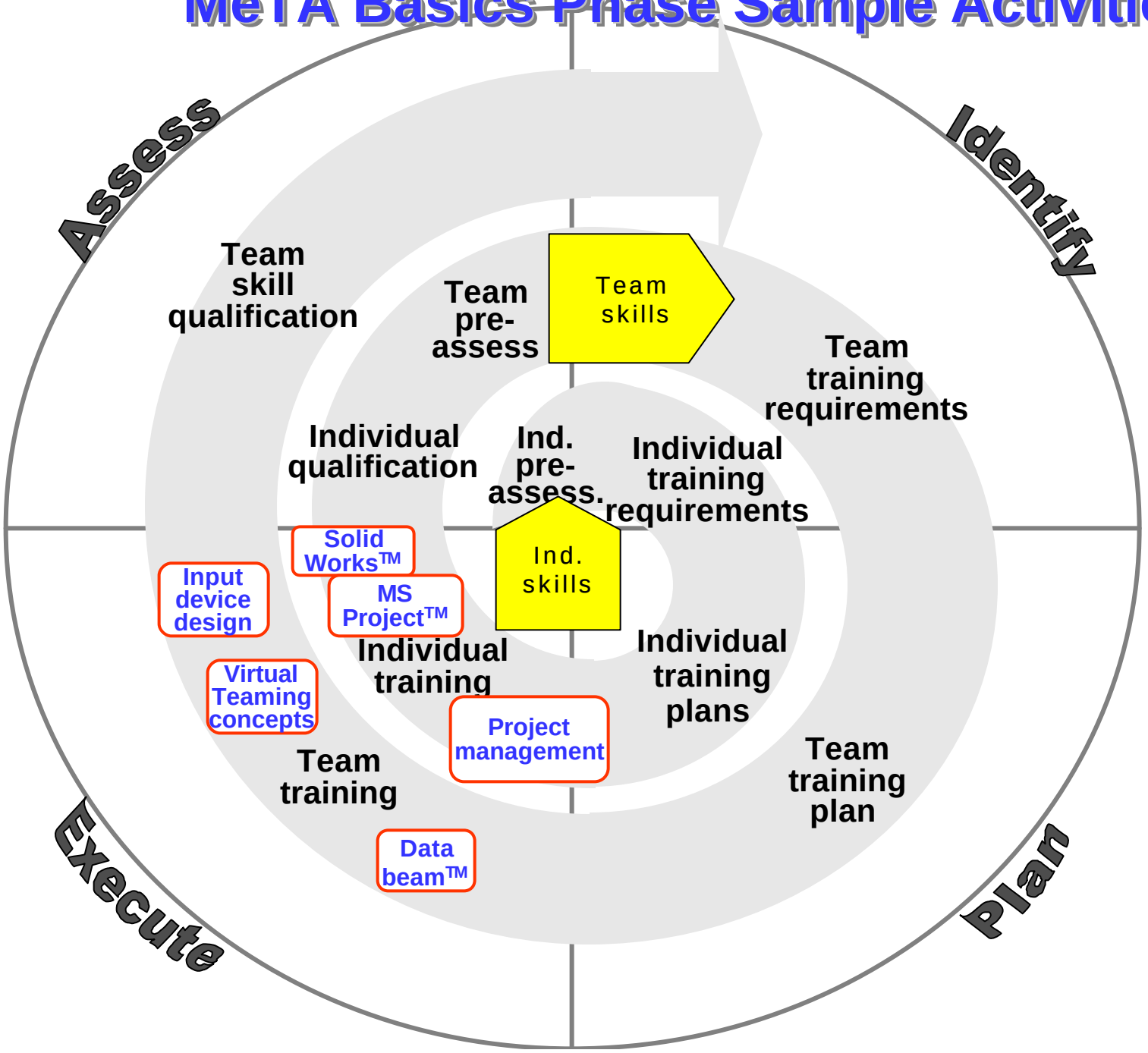
MeTA Basics Phase Sample Activities



MeTA Phases

e-engineering basics

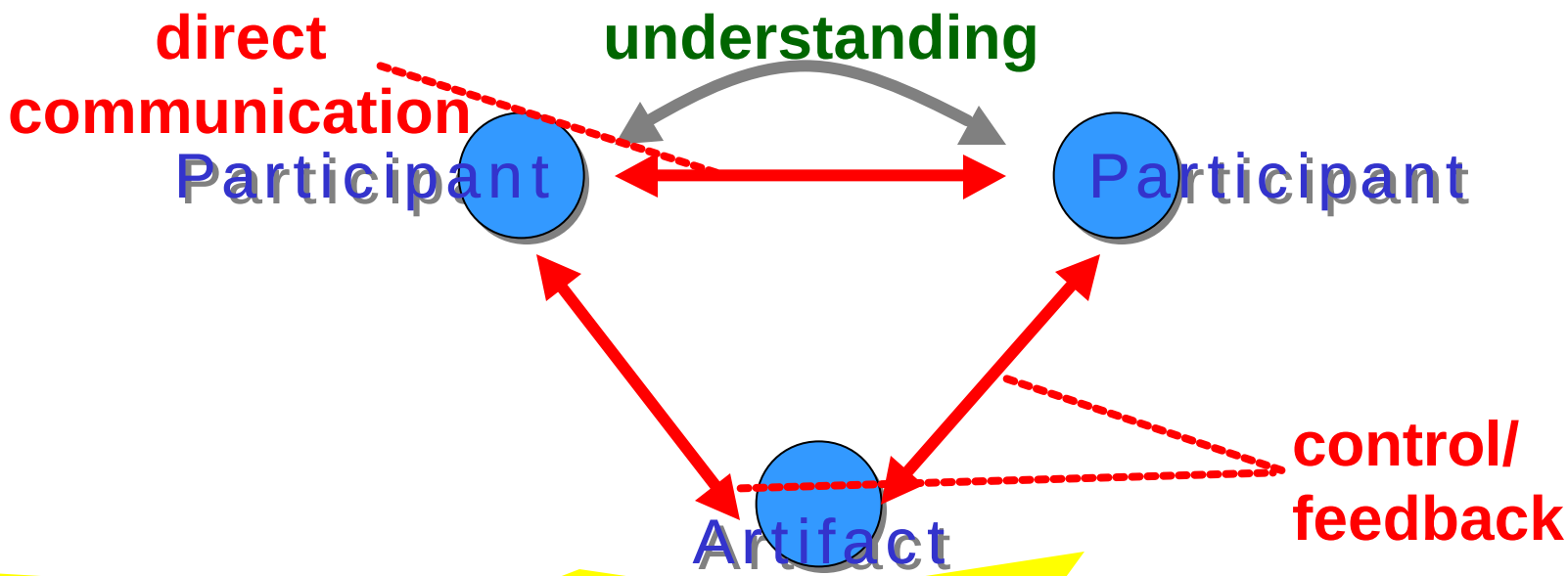
Selected Pilot Study Modules

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 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

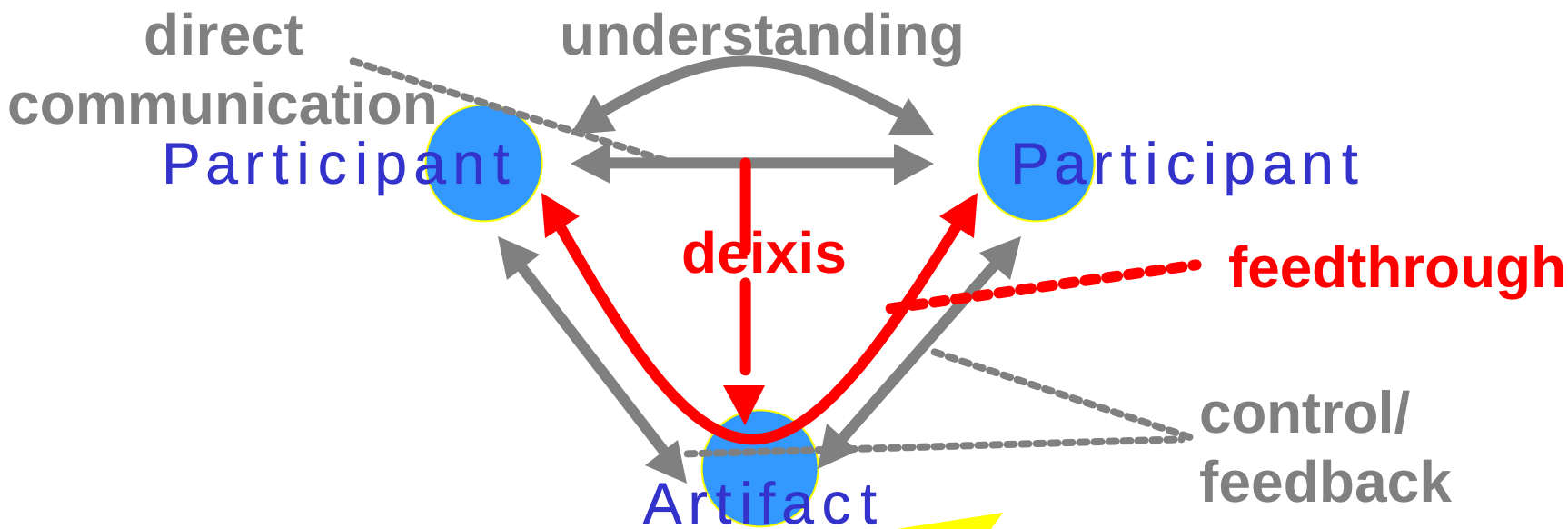
- Common understanding - argumentation tools, meeting rooms, shared work surfaces
- Direct communication - email, electronic conferences and video connections
- Control and feedback from shared artifacts - shared PCs and windows, shared editors, co-authoring systems, shared diaries



Integrating Communication and Work

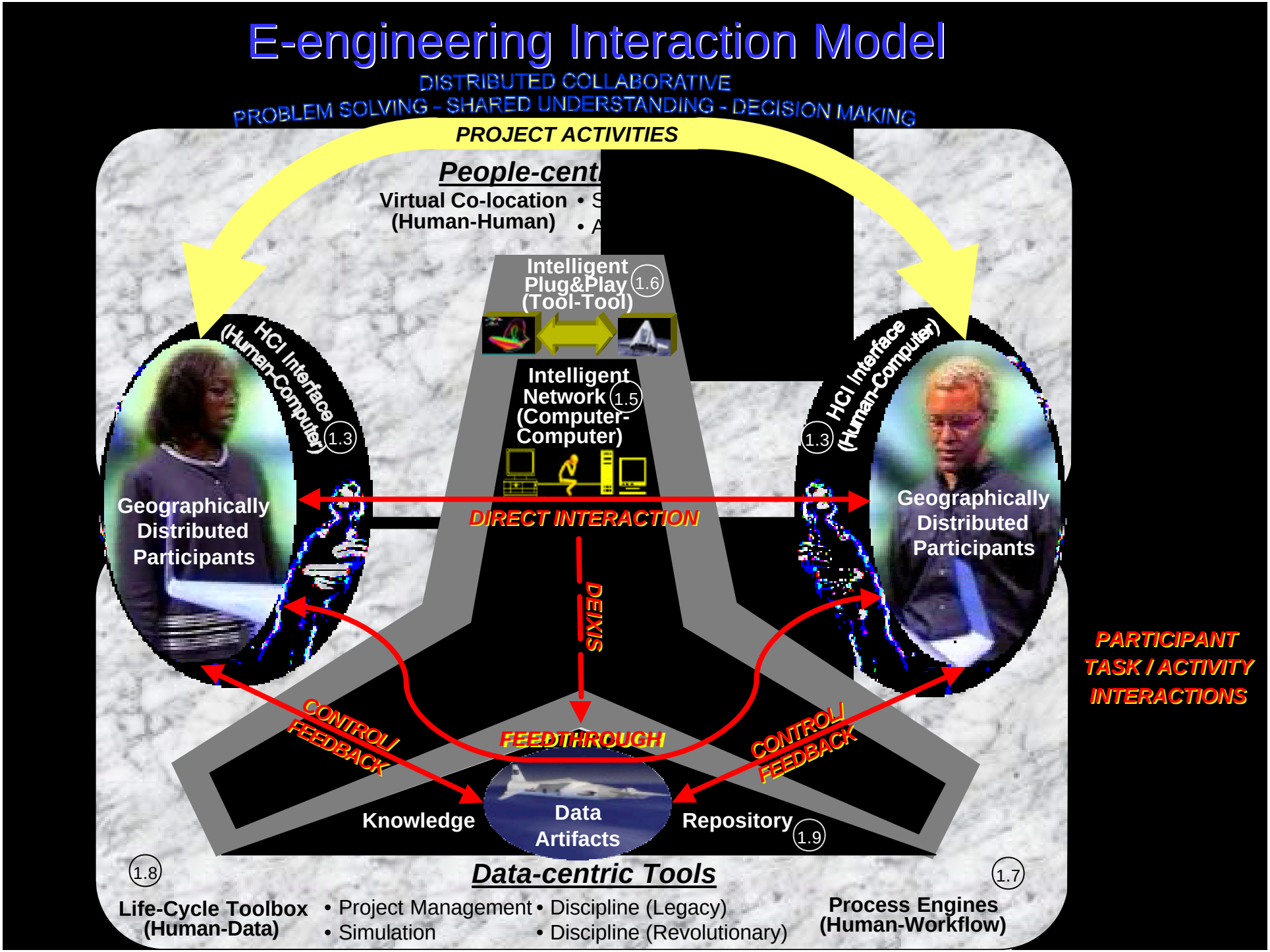
Distributed Collaborative Environment
Indirect Interactions

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



Integrating Communication and Work

E-engineering Interaction Model



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*

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Team Process Council

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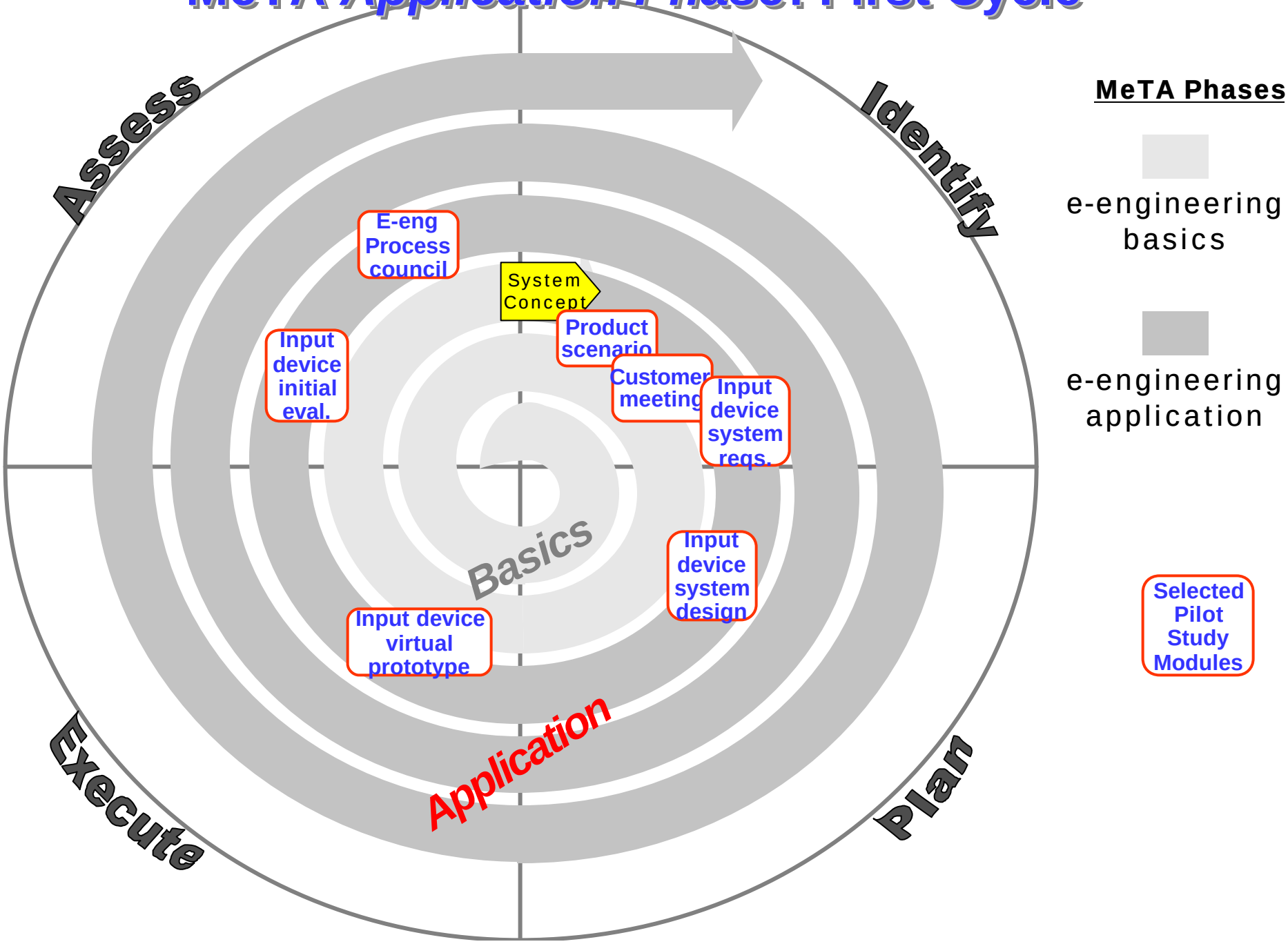
Team Process Council Agenda

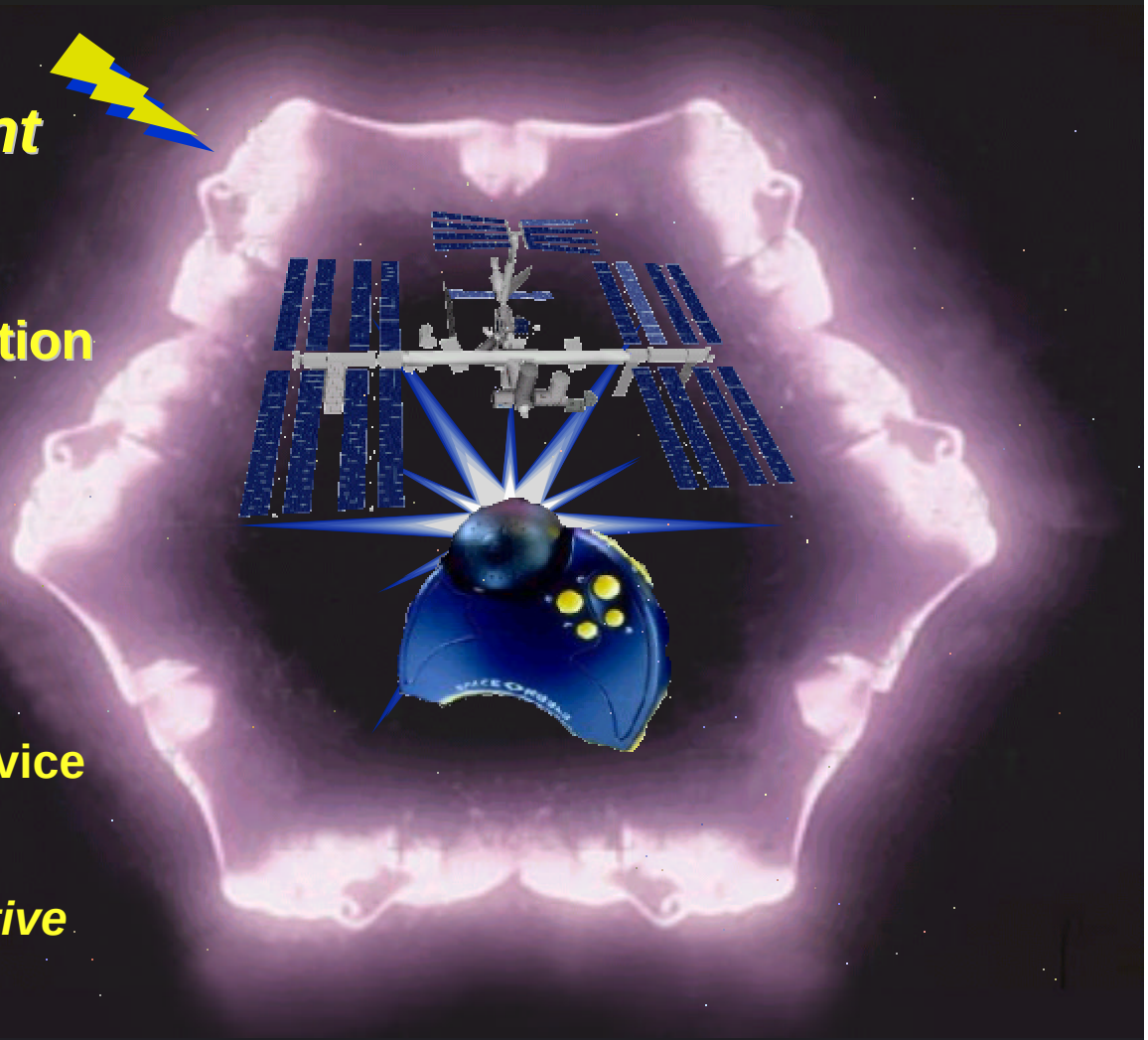
- **Guidelines**
  - Focus on processes, not personal references/attacks
  - Designate a note taker to record council meeting
  - These meetings part of project continuous process improvement
- **Identify process good, bad, and ugly – each team member contributes good and bad aspects for the below areas – 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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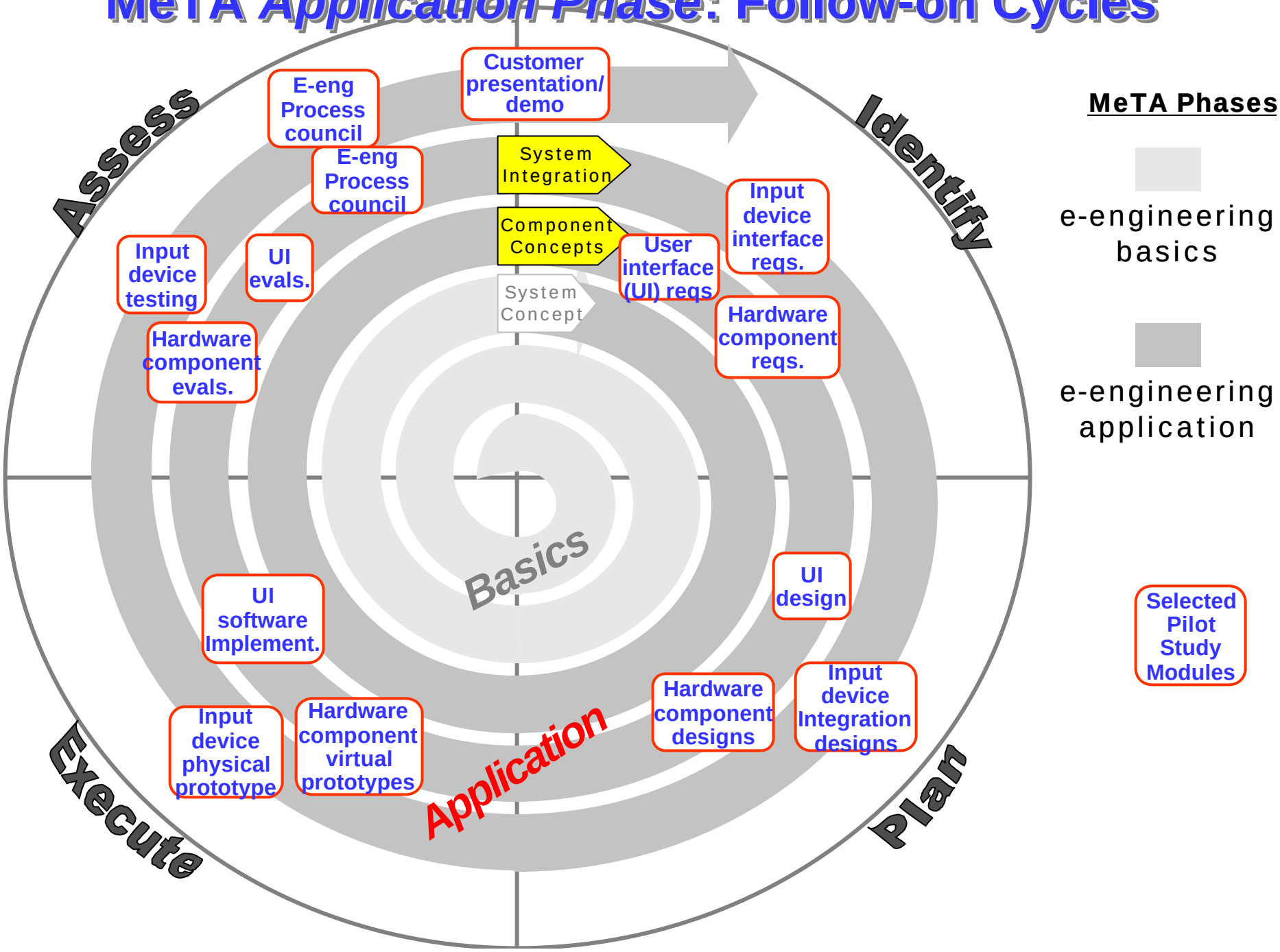
Pilot Study

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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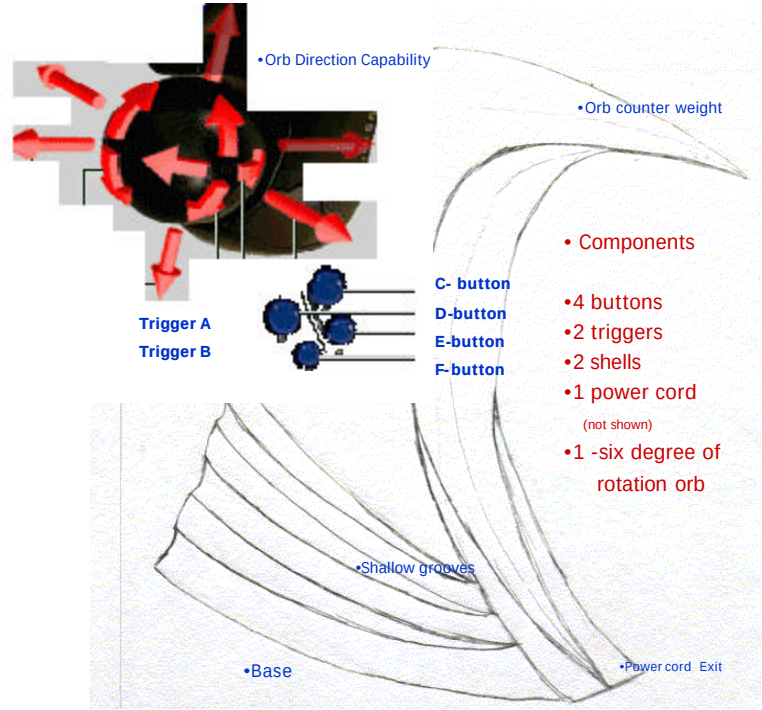
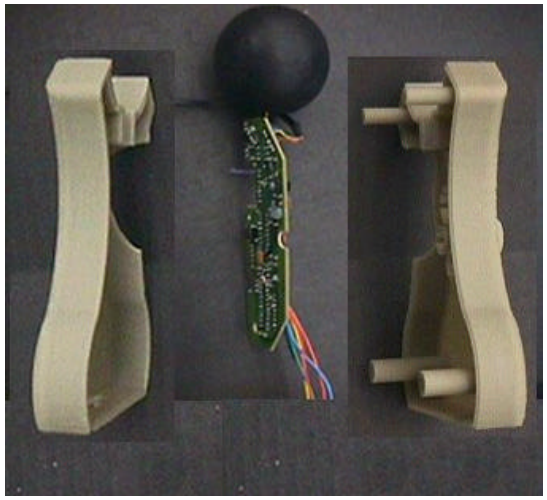
Pilot Study

SAMPLE WORK



An example of initial design work

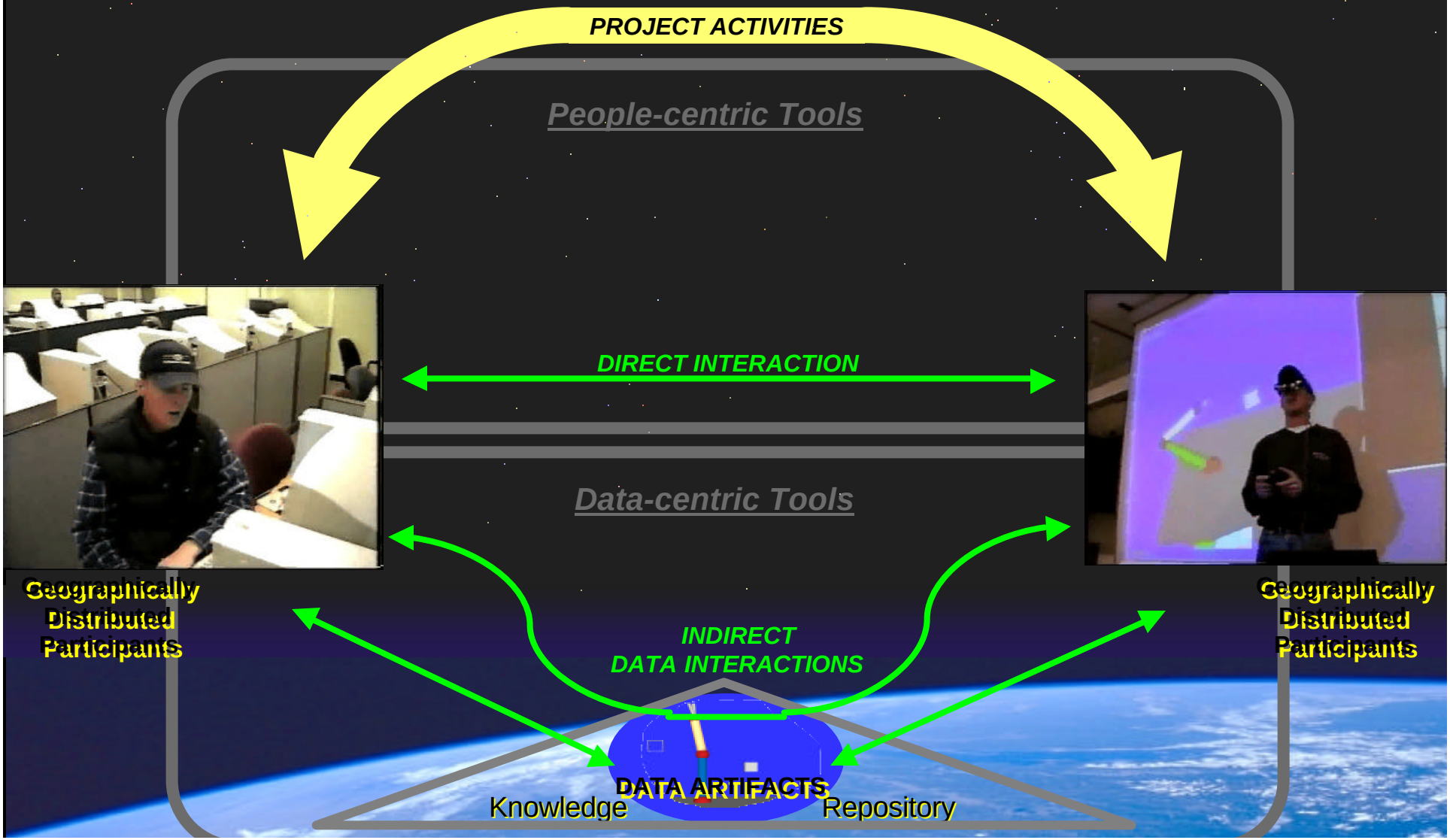
Top and bottom exterior component virtual CAD prototypes



Re-engineered Space Orb physical prototype components

Virtual Team Interactions

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



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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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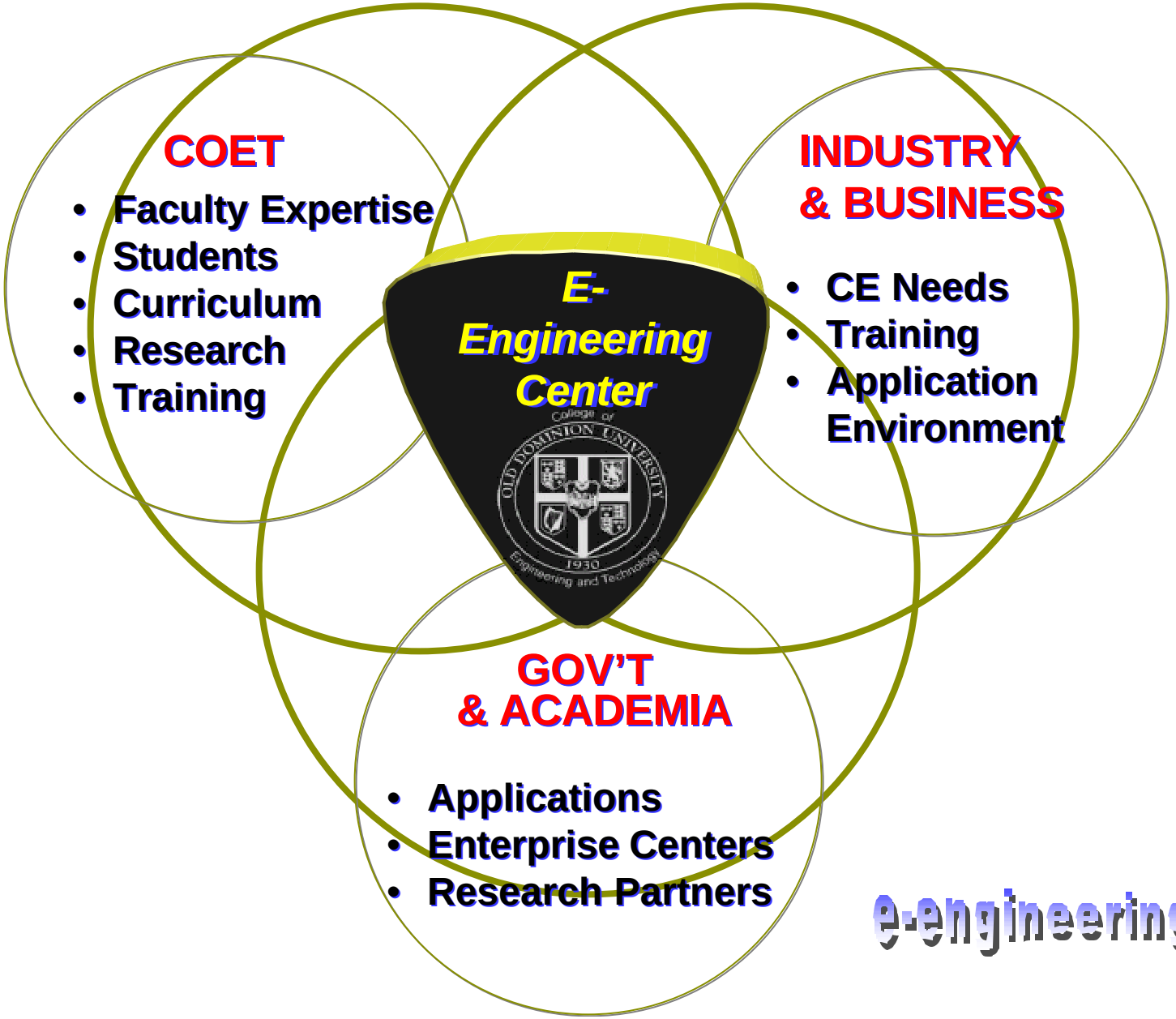
MULTI/RE-USABLE CONTENT LEARNING MODULES

- **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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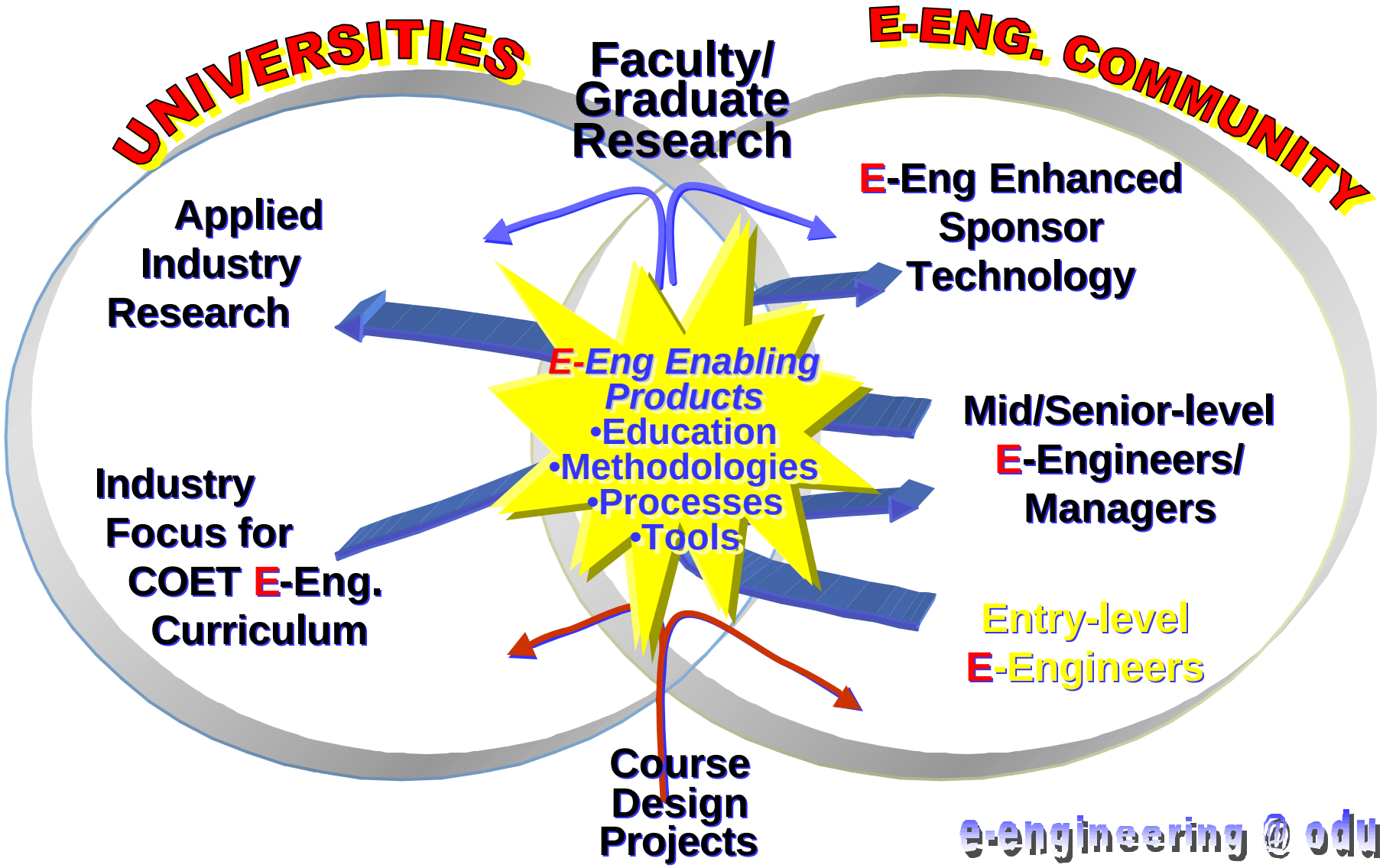
E-Engineering Synergy

-Advantages and Benefits-