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RT16 Experience Accelerator: Year 1 Summary

By
Jon Wade & the RT16 Team

Annual SERC Research Review
October 5-6, 2011
University of Maryland
Marriott Inn and Convention Center
Hyattsville, MD
www.sercuarc.org

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Experience Accelerator Team

Content:

- Alice Squires – Stevens

Tools:

- Jon Wade, PI – Stevens

Technology:

- Doug Bodner – Georgia Tech
- George Kamberov – Stevens
- Pradeep Jawahar – Georgia Tech
- Brent Cox – Stevens
- Vinnie Simonetti - Stevens
- Remzi Mungan – Purdue

Evaluation:

- Bill Watson, CoPI – Purdue
- Pete Dominick – Stevens
- Dick Reilly – Stevens

SMEs:

- Rick Abell
- John Griffin
- John McKeown

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Overview

- Motivation
- Research Activities
  - Identify critical SE competencies and maturation points
  - Create appropriate learning experiences
  - Define open architecture & technologies
  - Develop & evaluate prototype
- Future Work

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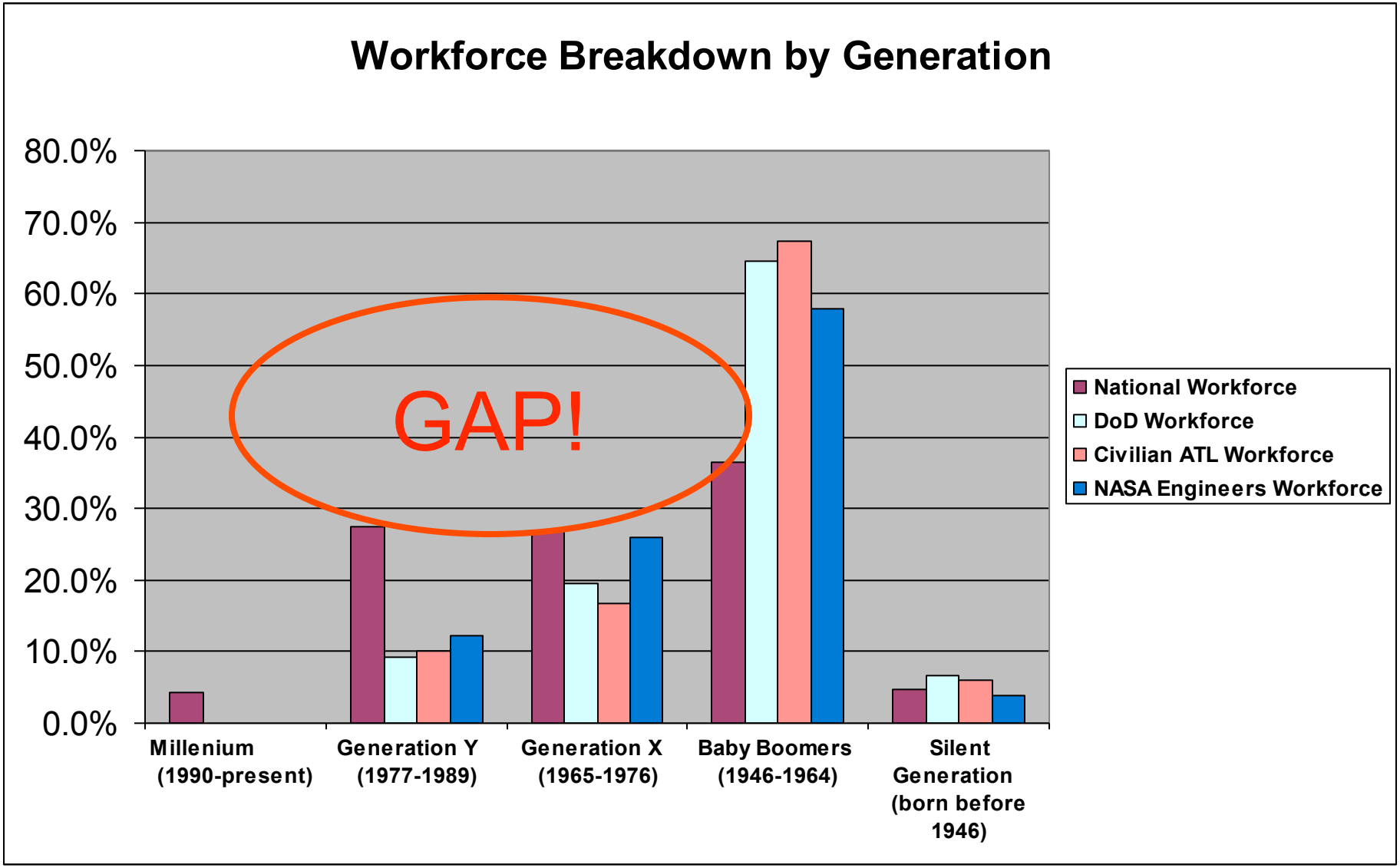
Workforce Demographics



Source: Human Capital Strategy Review", www.dau.mil/doddacm/dod/Juza; NASA Workforce Profile cube, http://wicn.nssc.nasa.bov/cognos/cgi.bin/ppdscgi.exe

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What's More Effective?

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Transforming SE Development

We postulate that the new paradigm must be:

- **Integrated:** Provides an integration point of multi-disciplinary skills and a wide range of Systems Engineering knowledge in a setting that recreates the essential characteristics of the practicing environment.
- **Experience Based**: Providing accelerated learning opportunities through experience-based interactive sessions.
- **Agile:** Allowing for quality, timely development of course material that is most appropriate for the target students.
- **Time/Cost Efficient:** Compressing multi-year lifecycle experiences into a much shorter period of time.

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Hypothesis

By using technology we can create a simulation that will put the learner in an experiential, emotional state and effectively compress time and greatly accelerate the learning of a systems engineer faster than would occur naturally on the job.

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Experience Accelerator Goals

To build insights and "wisdom" and hone decision making skills by:

- Creating a "safe", but realistic environment for decision making
- Exposing the participants to the "right" scenarios and problems
- Providing rapid feedback by accelerating time and experiencing the downstream consequences of the decisions made

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Research Activities

- **Identify critical SE competencies and maturation points**
- Create appropriate learning experiences
- Define open architecture & technologies
- Develop & evaluate prototype

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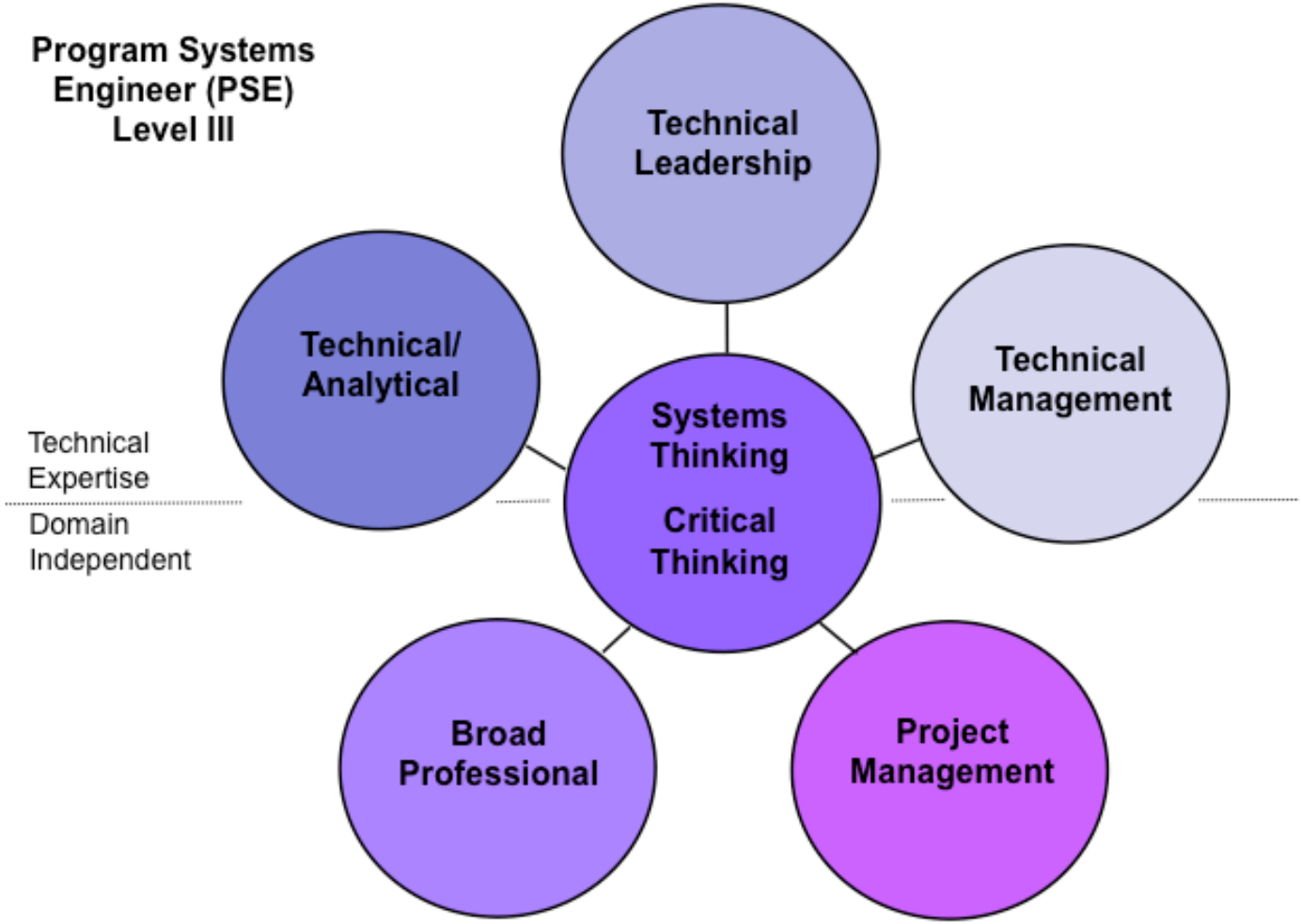
Taxonomy of SE Competencies



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Recommended Approach*

Situation Complexity	Proficiency Level				
	None or Aware only	Apply with guidance	Apply	Manage or Lead	Advance state of art
Exceptionally complex					
Considerably Complex					
Complex					
Somewhat complex					
Simple					

*The user can progress - over time - to increasingly more complex situations (by level) in the simulation and from beginning to advanced stages of capability and understanding in each situational context (level).

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Targeted Learning

Competencies:

- BP8 – Problem Solving and Recovery Approach
- TM11 – Product Integration

Aha's:

- 2.3 – Cutting corners to make short term milestones rather than focusing on end date

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Research Activities

- Identify critical SE competencies and maturation points
- **Create appropriate learning experiences**
- Define open architecture & technologies
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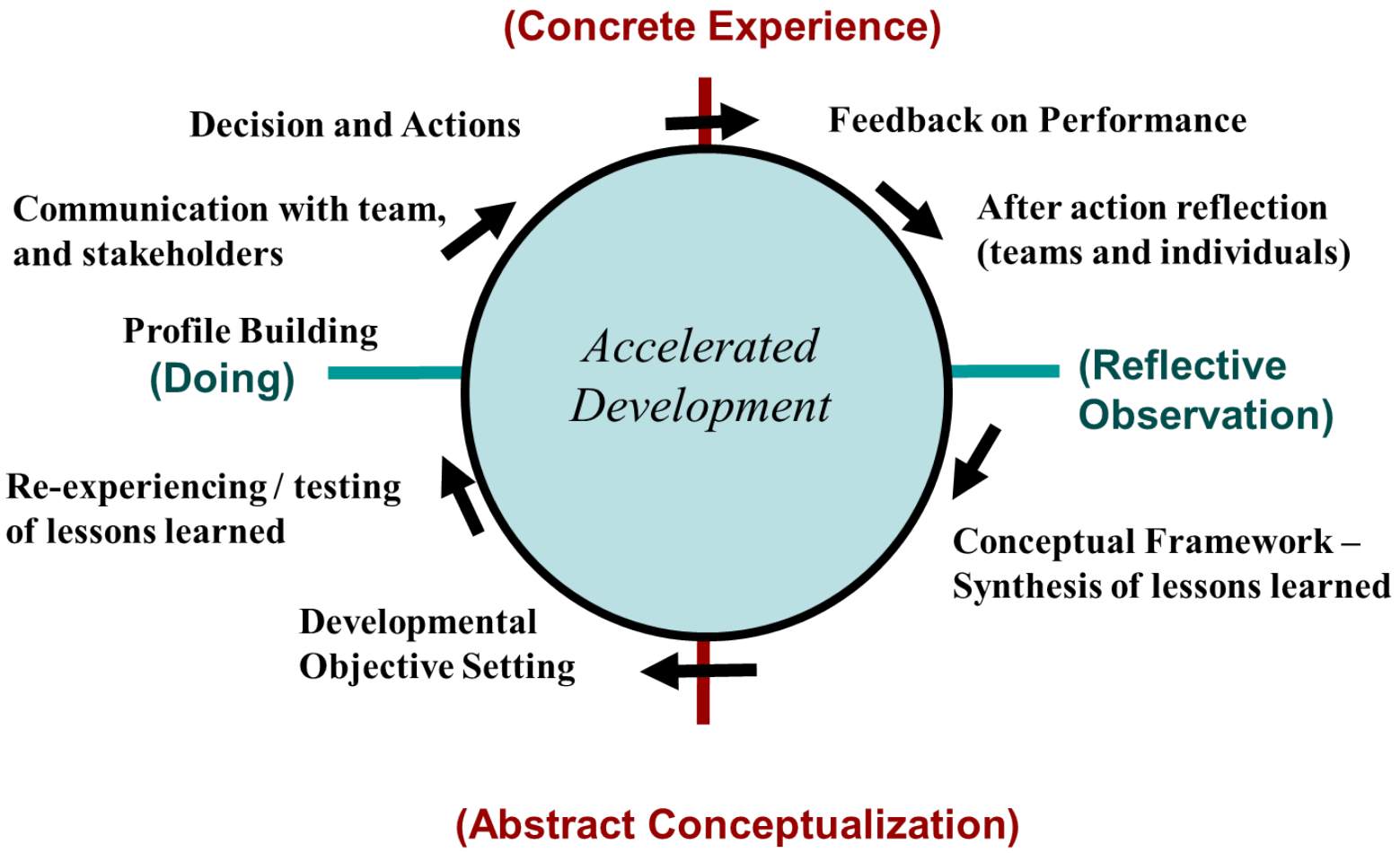
Learning Process



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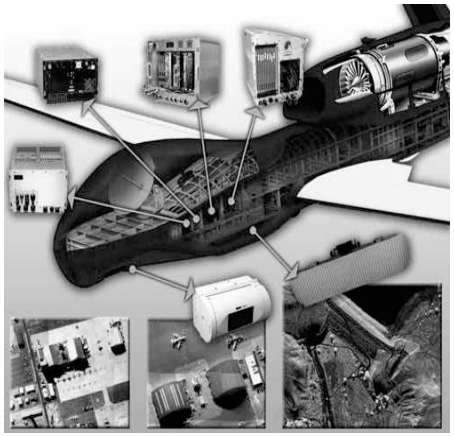
The Experience: A Day in the Life of a PSE

UAV System:

- Airframe and Propulsion
- Command and Control
- Ground Support



UAV KPMs:

- Schedule
- Quality
- Range
- Cost
- Sensing*
- Crew size*

* Potential Phase 2 work

Phases:

- EA Introduction
  - Phase 0: New Employee Orientation
- Experience Introduction
  - Phase 1: New Assignment Orientation
- Experience Body
  - Phase 2: Pre-integration system development -> CDR
  - Phase 3: Integration -> FRR
  - Phase 4: System Field Test -> PRR
  - Phase 5: Limited Production and Deployment -> ISR
  - Phase 6: Experience End
- Experience Conclusion
  - Phase 6: Reflection
- Each session = 1 day

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Challenge/Landmines & Linkages

System	Challenge	Phase	Evidence	Situation	Desired Actions	Inputs to Simulation
S2	range too short	P2	MRG	weight during development is too high	RRE - focus resources on weight reduction	Change assignment of labor within sub-system development
					ASP - reallocate weight from S2 to S1	Change weights
					FEC - reduce expectations for range	Change range target
S1	range too short	P3	MRG	drag is higher than expected in wind tunnel testing	RRE - focus resources on drag reduction	Change assignment of labor in S1
S1, S2	schedule	P2	MSC	productivity lower than expected	RAD - hire additional labor	Hire new personnel
S2	schedule	P3	MSC	more changes had to be made than anticipated	SCC	Change schedule target
S0	schedule	P3	MSC	unexpected integration issues	RAD - hire additional labor and purchase additional test articles/ equipment	
					RRE - focus on integration, get help from other areas	
S0	schedule	P4	MSC	range assets are not available	Renegotiate range priorities (contact customer)	
S2	quality	P2, P3	MQS	software defect rate is too high	RRE - focus resources on design/ code reviews	Change labor assignment

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Research Activities

- Identify critical SE competencies and maturation points
- Create appropriate learning experiences
- **Define open architecture & technologies**
- Develop & evaluate prototype

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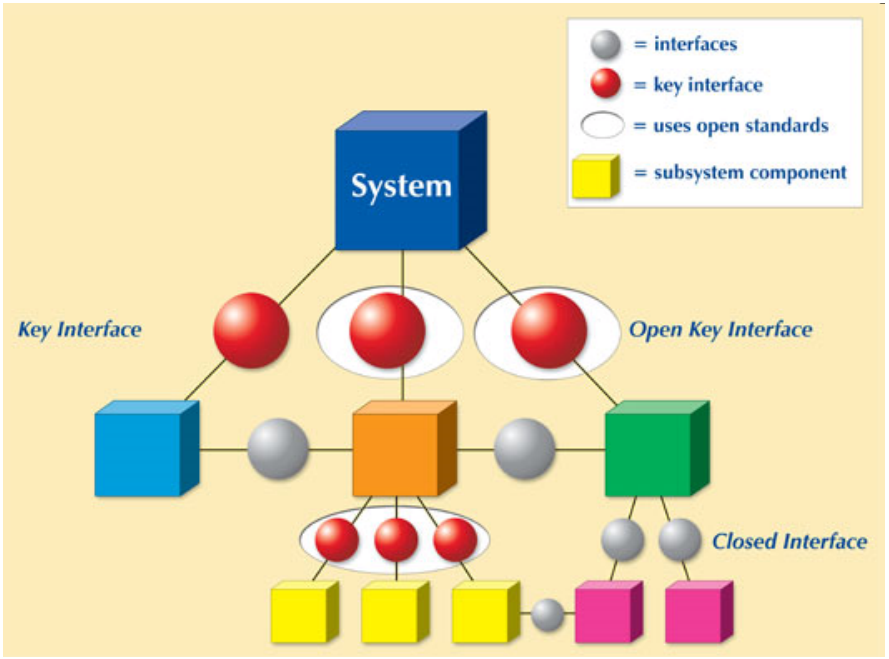
Emphasis on Open System Architecture



Principles:

1. Establish an Enabling Environment
2. Employ Modular Design Principles
3. Designate Key interfaces
4. Use Open Standards
5. Certify Conformance

Benefits:

- Reduced development time and overall life-cycle cost
- Ability to technology as it evolves
- Commonality and reuse of components
- Increased ability to leverage commercial investment

The Experience Accelerator's emphasis on Open System Architecture is coupled with strong preference for use Open Source Software products for implementation wherever appropriate

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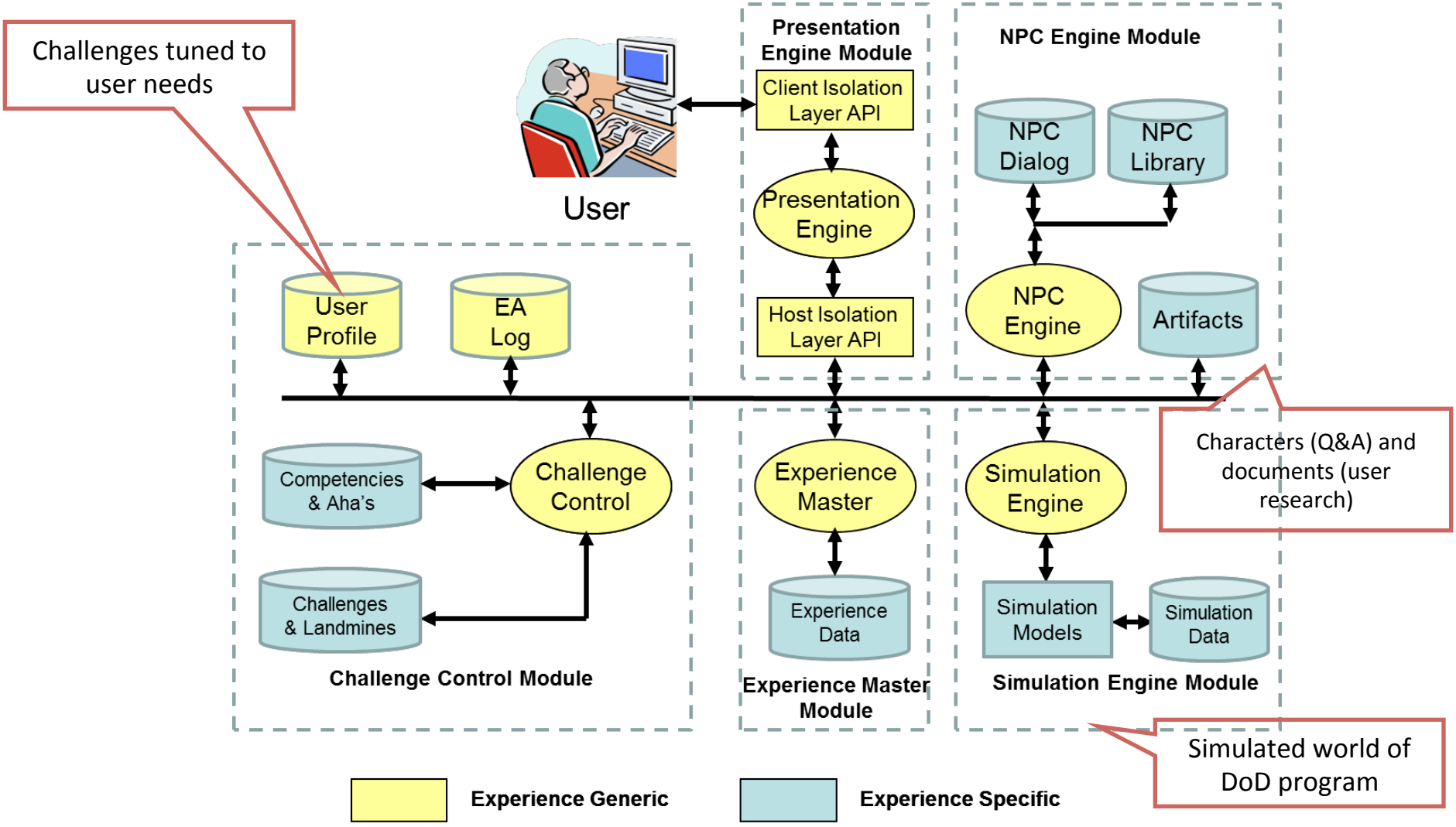
The Prototype

Experience Accelerator Block Diagram



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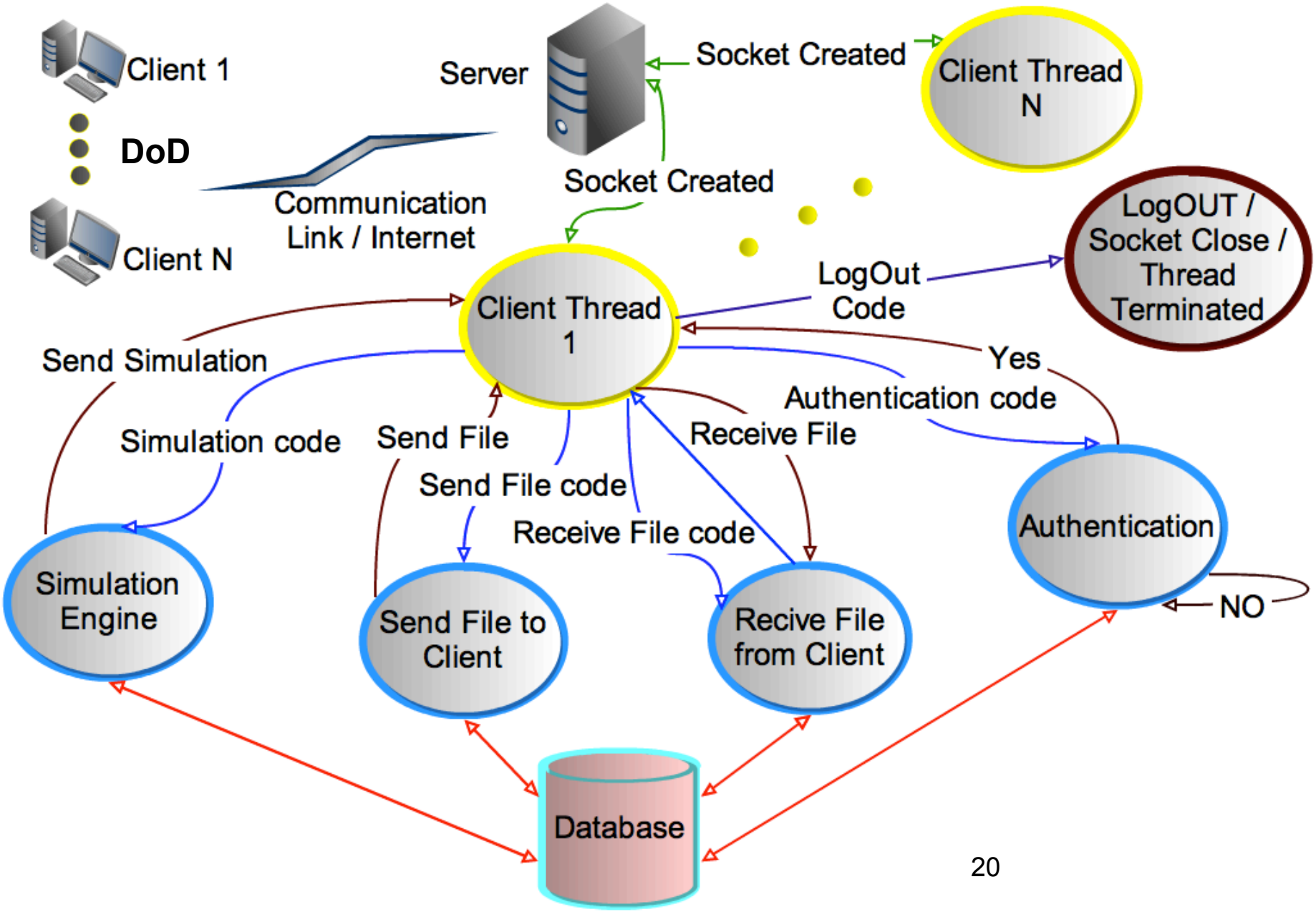
Multi-Threaded Java Server Architecture



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Research Activities

- Identify critical SE competencies and maturation points
- Create appropriate learning experiences
- Define open architecture & technologies
- **Develop & evaluate prototype**

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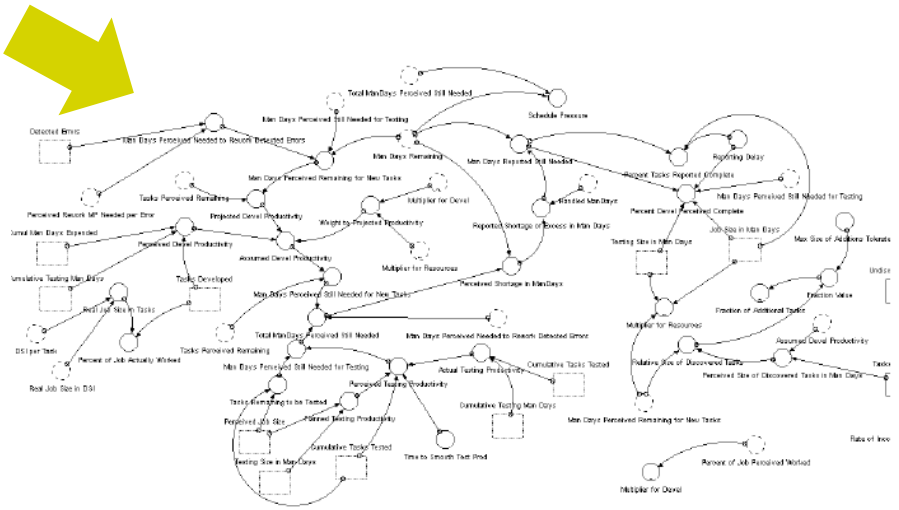
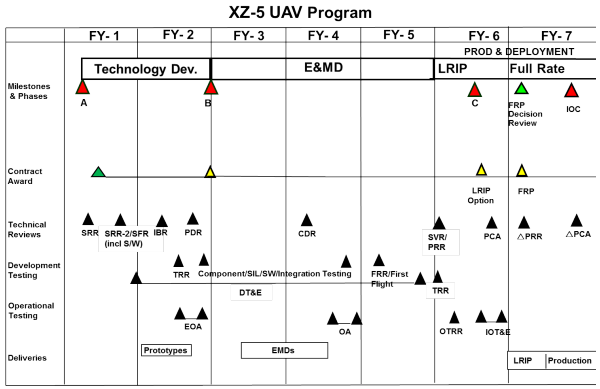
Prototype Feedback Loop

	Overall System
Schedule:	
Confidence Level to Achieve Program Schedule Goals	<H,M,L>
Actions to address issues:	
Nothing Required	◯
Call in external audit team	◯
Add senior/junior design staff	Sr◯/Jr◯
Add development equipment	◯
Add facilities	◯
Reduce capabilities	◯
Anticipate schedule extension by xx months	<xx>

Learner Recommendations

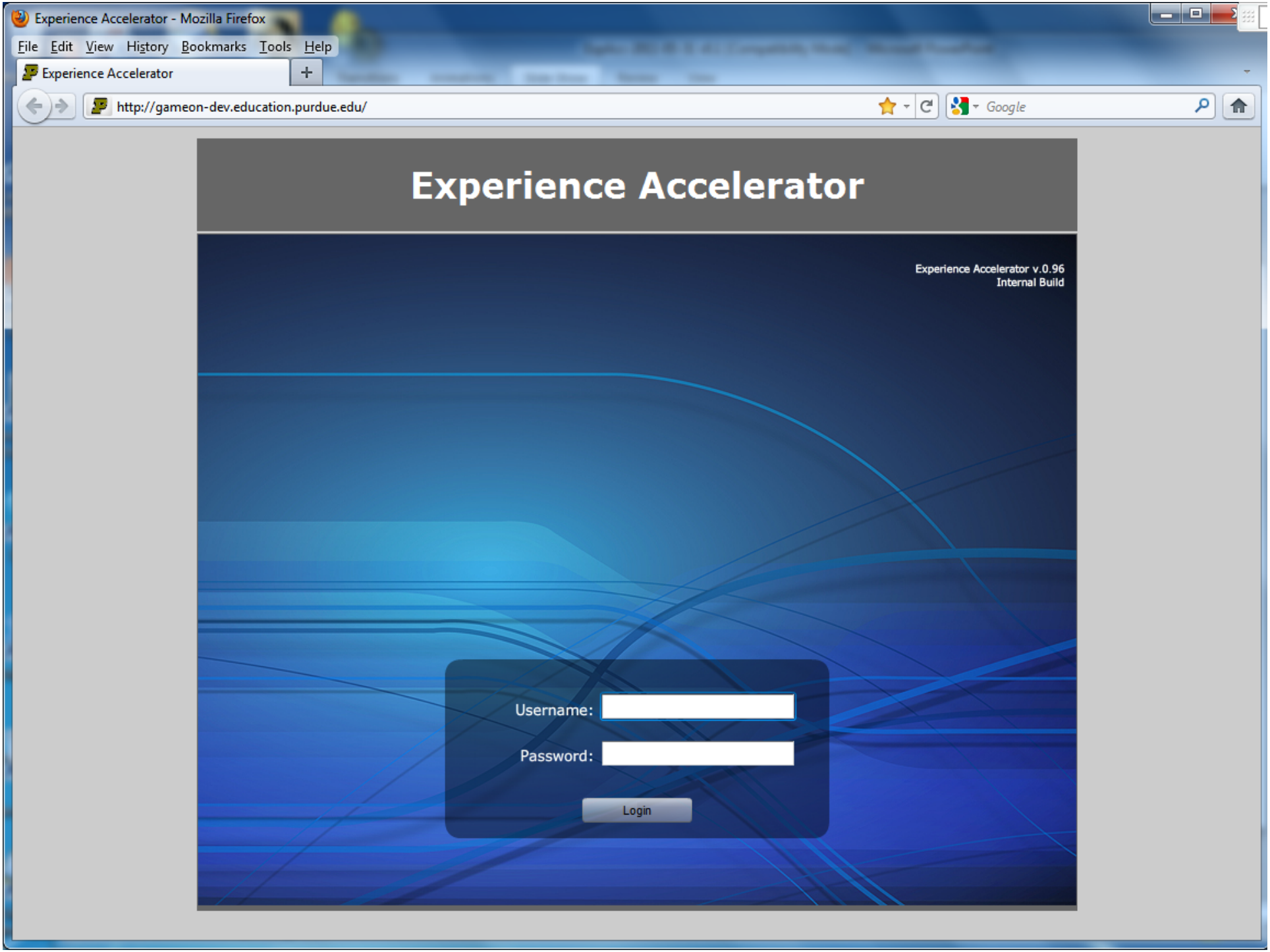


Systems Dynamics Simulations



Project Impact

NPC Dialog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Experience Accelerator v.0.96
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Password:
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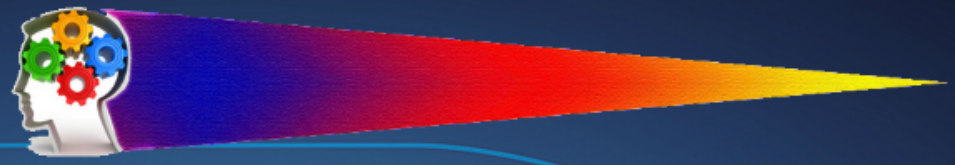


Experience Accelerator

Welcome Jon Wade

Your Experience Awaits You!

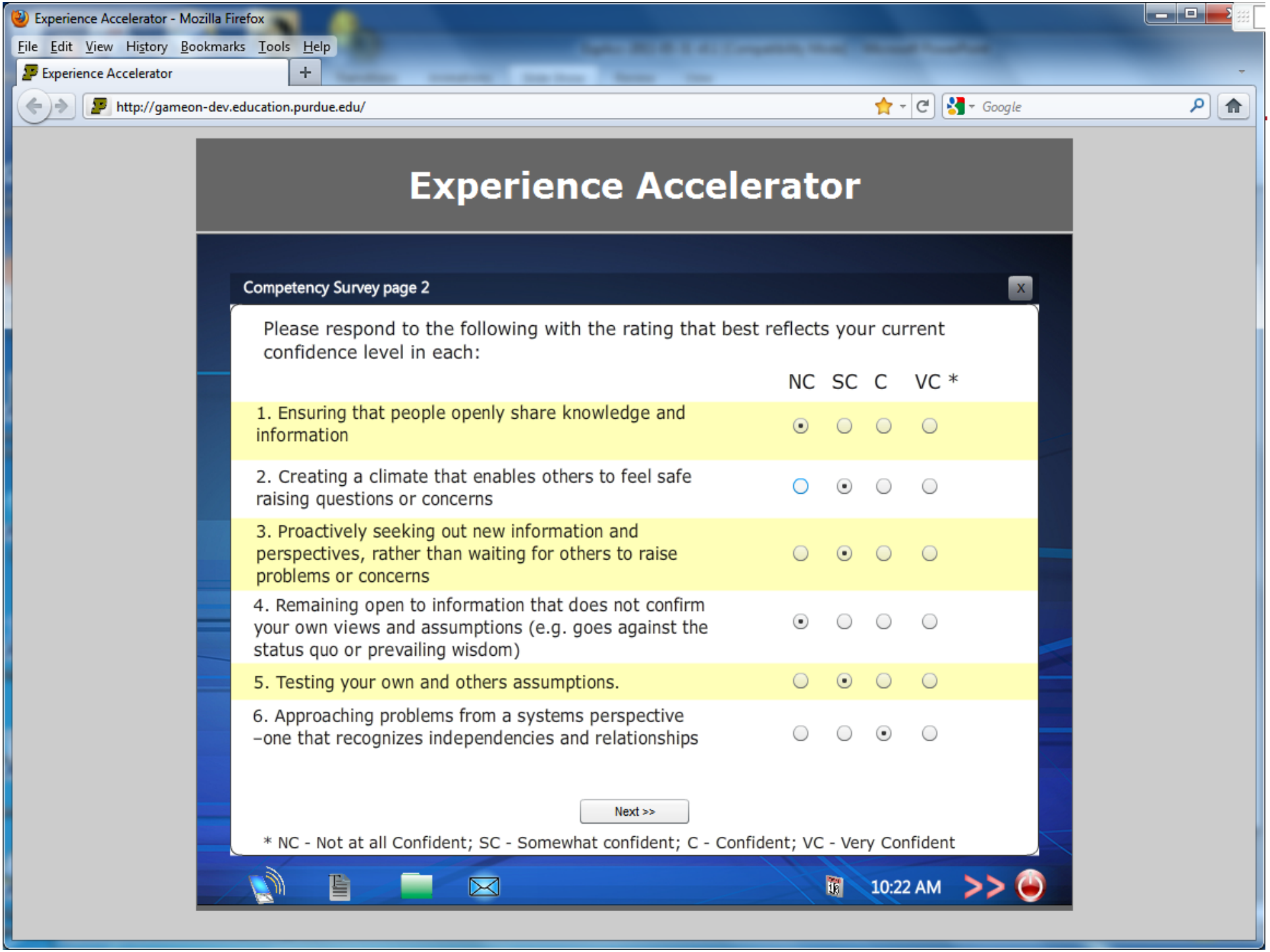
Option Menu:

- UAV Experience
- Profile Update
- Logout

UAV Experience Status

New Employee Orientation----------	In progress
New Assignment Orientation----------	Incomplete
Pre-Integration System Development---	Incomplete
System Integration----------	Incomplete
System Field Test----------	Incomplete
Limited Production and Development--	Incomplete
Experience End----------	Incomplete
Reflection----------	Incomplete

- Abort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Competency Survey page 2
X
Please respond to the following with the rating that best reflects your current confidence level in each:
NC SC C VC *
1. Ensuring that people openly share knowledge and information
2. Creating a climate that enables others to feel safe raising questions or concerns
3. Proactively seeking out new information and perspectives, rather than waiting for others to raise problems or concerns
4. Remaining open to information that does not confirm your own views and assumptions (e.g. goes against the status quo or prevailing wisdom)
5. Testing your own and others assumptions.
6. Approaching problems from a systems perspective –one that recognizes independencies and relationships
Next >>
* NC - Not at all Confident; SC - Somewhat confident; C - Confident; VC - Very Confident
10:22 AM

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UAV Background

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autonomy to perform a wider variety of missions. And these activities are the most challenging. Figure 1 provides on example for Global Hawk showing the tight "packaging" that must take place involving sensor systems, avionics, airframe structure, etc. Electronic interference as well as thermal issues must be accounted when arranging these systems. More broadly, the requirements and constraints of these sub-systems must be managed by the UAV systems engineer to ensure that hard-to-solve interferences and constraint violations between sub-systems do not occur. The managing of the overall requirements for the UAV must also be done carefully—if the requirements grow, so do the requirements of the sub-systems, and interactions that were never envisioned may develop.

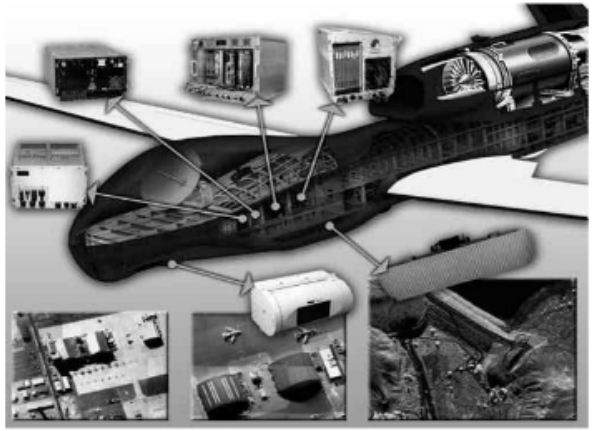

Fig. 1: Cutaway of Global Hawk Showing Integrated Sensor Suite Locations[1]

In addition, in almost all cases, UAVs must interact with other battlefield systems in order to

Return to Options Screen

10:06 AM

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Post-PDR Status

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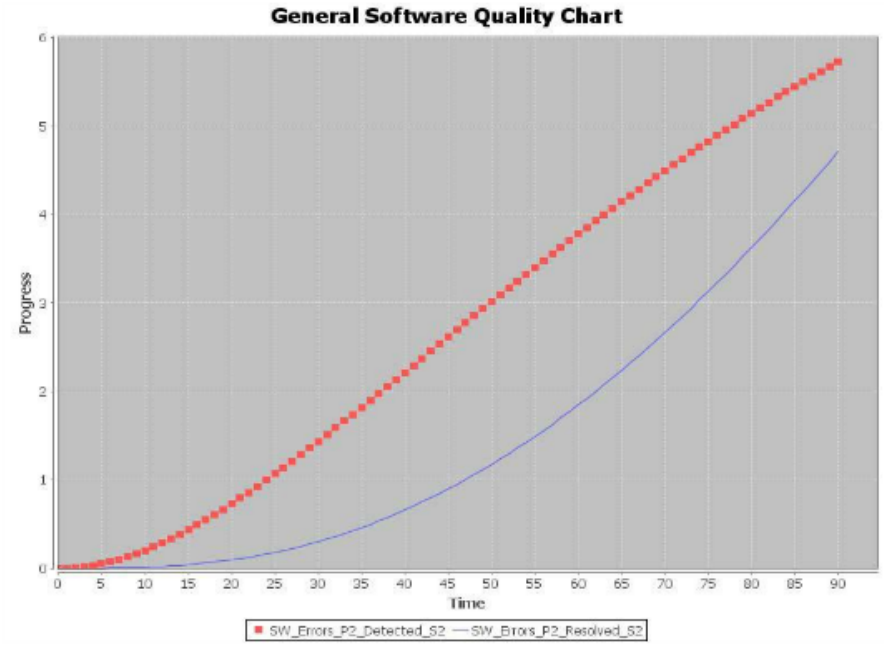

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11:02 AM

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Call

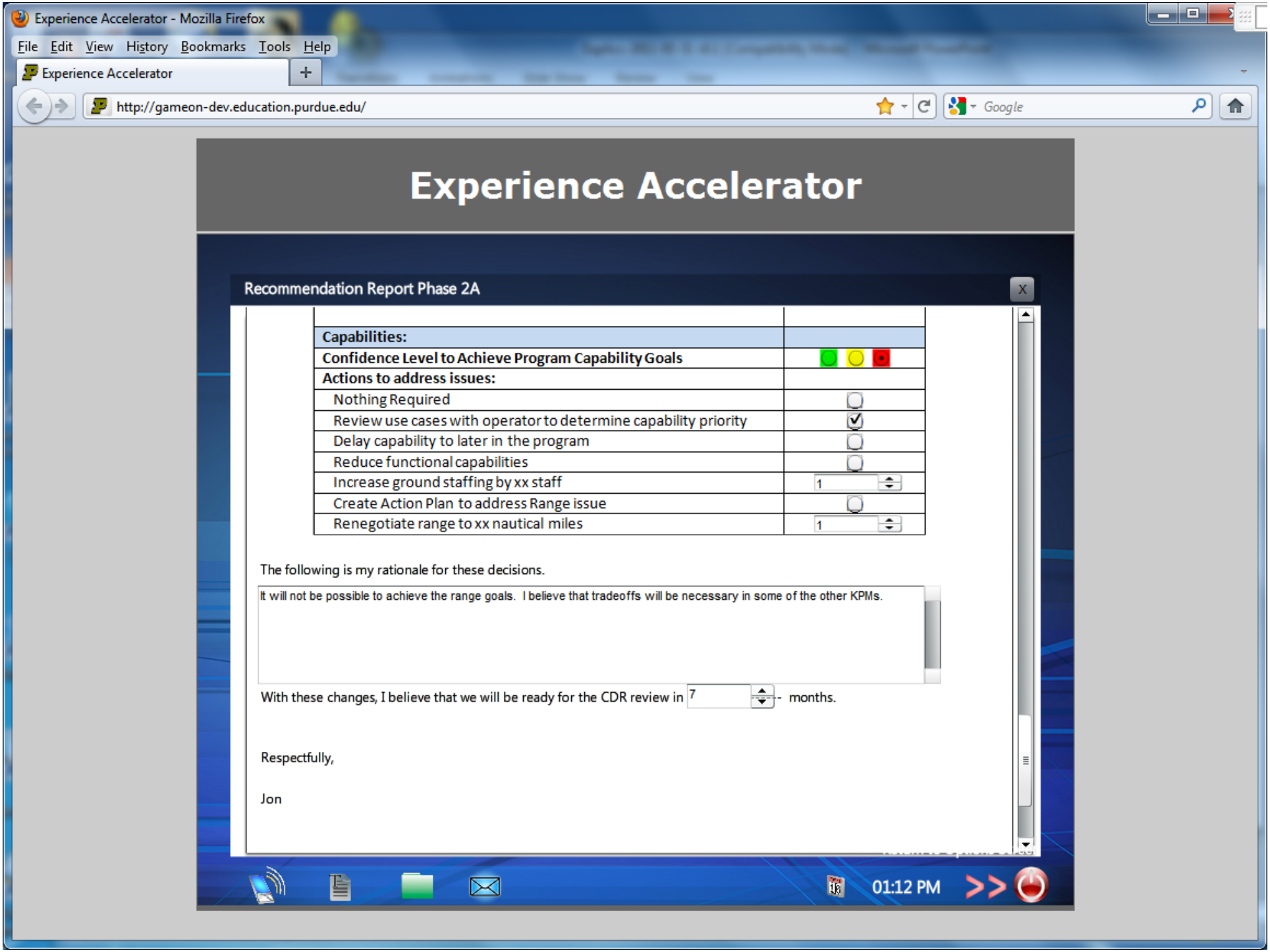
Tom Williams, PSE Prime

Tom Williams: *Okay.*
You: How is the quality looking to you?
Tom Williams: *It's not too bad. Of course we have a few rookie mistakes, but the quality is rapidly improving. It is about what I expect at this stage of the program.*
You: What types of problems are you seeing?
Tom Williams: *Most of the issues that I have seen have been related to poor file management. The young guys can sometimes be a bit careless with uploading their latest designs and this can cause problem downstream. I haven't seen too many analysis or real design errors.*

Schedule
Quality
Capability
Go to another system or exit...

Disconnect

10:33 AM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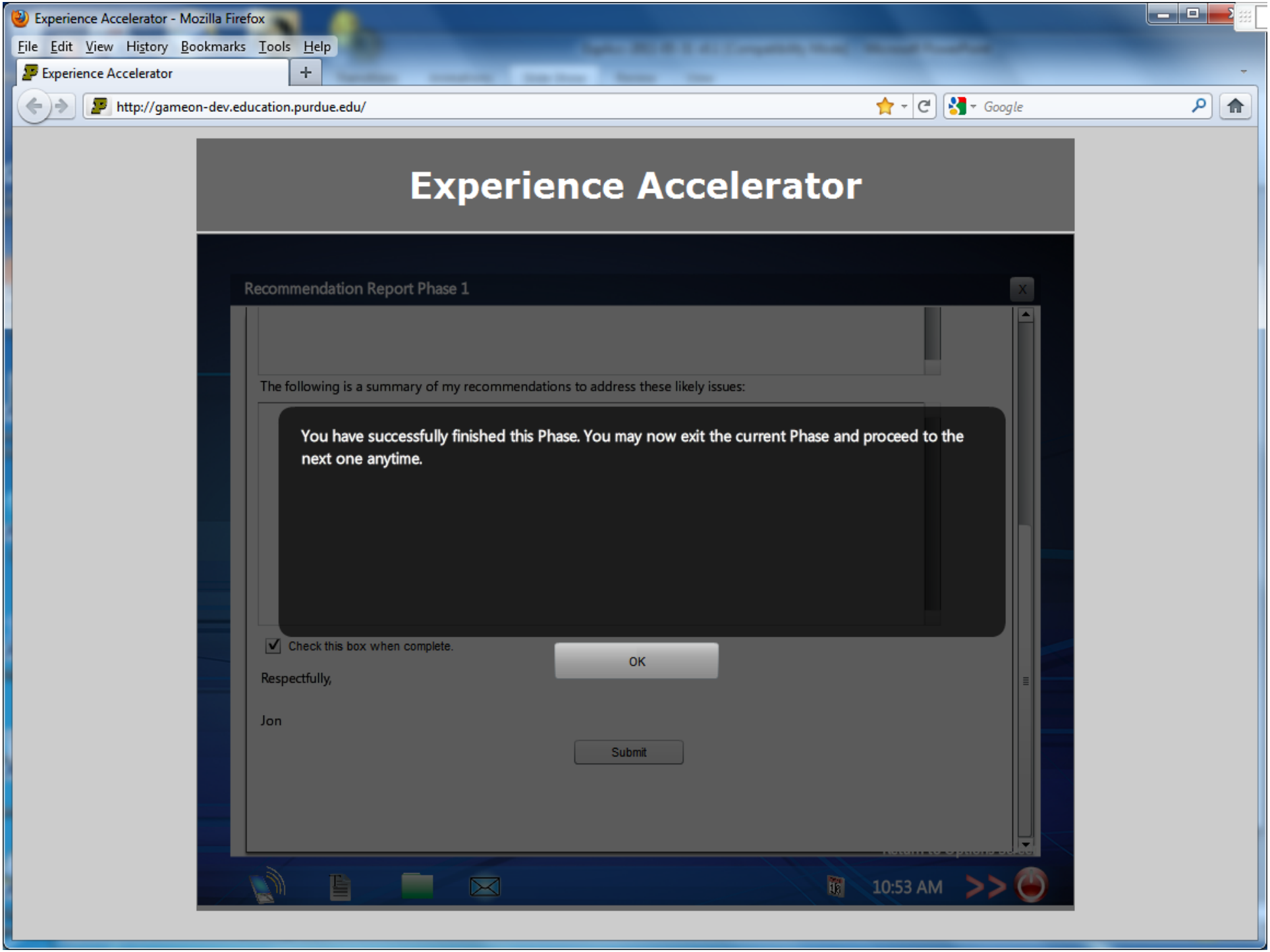
Recommendation Report Phase 2A
X
Capabilities:
Confidence Level to Achieve Program Capability Goals
Actions to address issues:
Nothing Required
Review use cases with operator to determine capability priority
Delay capability to later in the program
Reduce functional capabilities
Increase ground staffing by xx staff
1
Create Action Plan to address Range issue
Renegotiate range to xx nautical miles
1
The following is my rationale for these decisions.
It will not be possible to achieve the range goals. I believe that tradeoffs will be necessary in some of the other KPMs.
With these changes, I believe that we will be ready for the CDR review in 7 months.
Respectfully,
Jon
01:12 PM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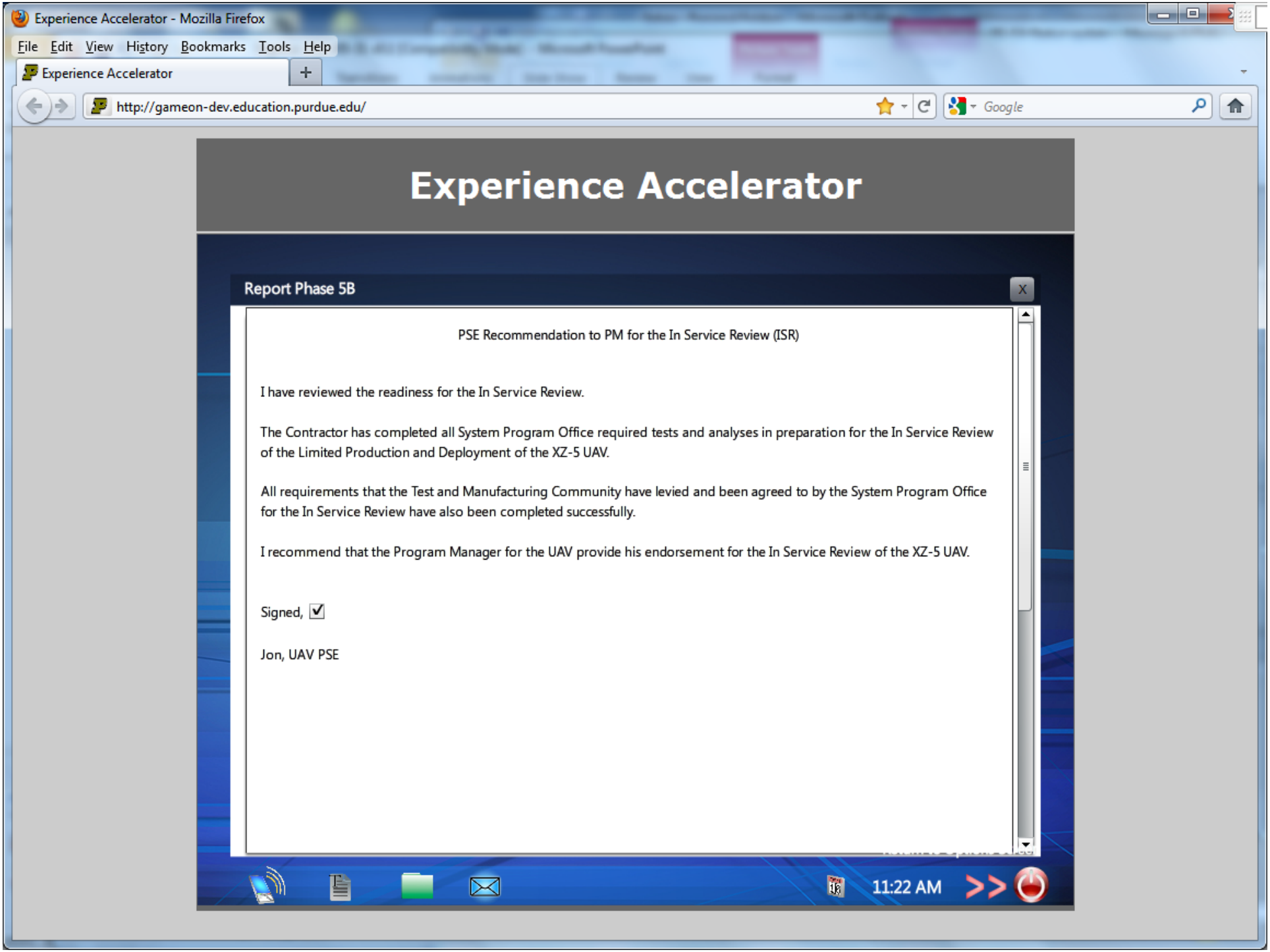
Experience Accelerator
Recommendation Report Phase 1
The following is a summary of my recommendations to address these likely issues:
You have successfully finished this Phase. You may now exit the current Phase and proceed to the next one anytime.
Check this box when complete.
OK
Respectfully,
Jon
Submit
10:53 AM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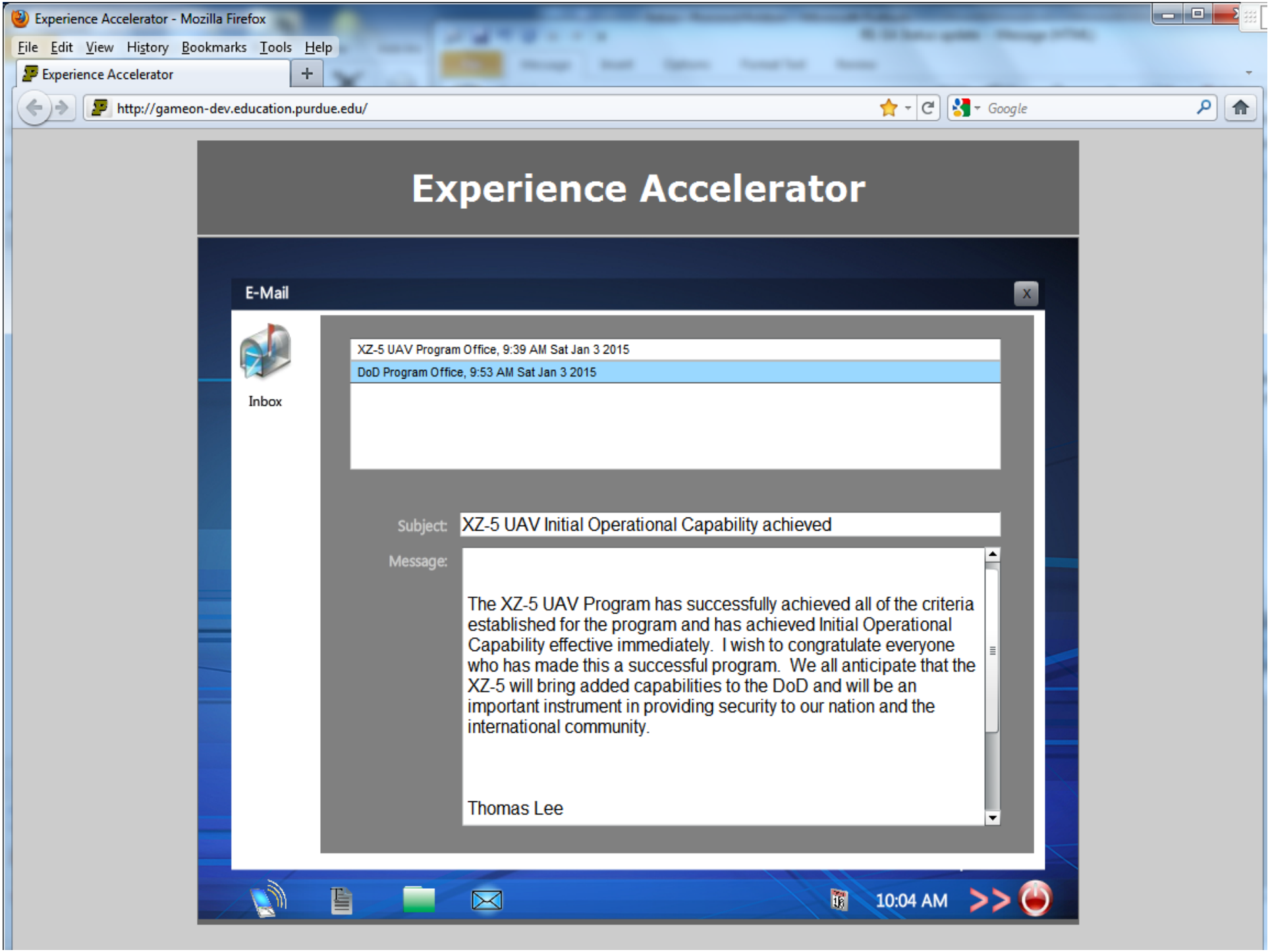
Report Phase 5B
X
PSE Recommendation to PM for the In Service Review (ISR)
I have reviewed the readiness for the In Service Review.
The Contractor has completed all System Program Office required tests and analyses in preparation for the In Service Review of the Limited Production and Deployment of the XZ-5 UAV.
All requirements that the Test and Manufacturing Community have levied and been agreed to by the System Program Office for the In Service Review have also been completed successfully.
I recommend that the Program Manager for the UAV provide his endorsement for the In Service Review of the XZ-5 UAV.
Signed, ☑
Jon, UAV PSE
11:22 AM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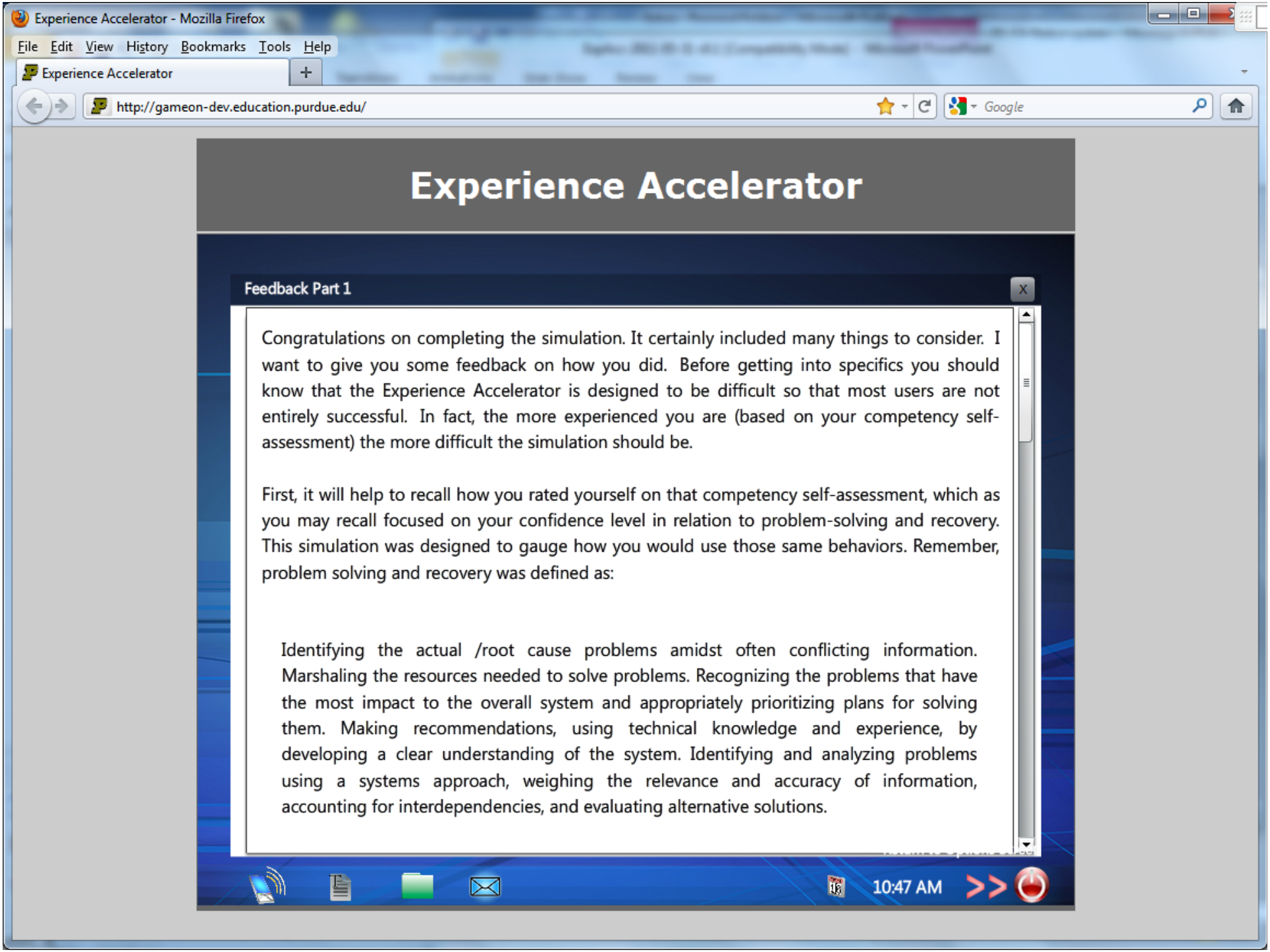
E-Mail
X
Inbox
XZ-5 UAV Program Office, 9:39 AM Sat Jan 3 2015
DoD Program Office, 9:53 AM Sat Jan 3 2015
Subject:
XZ-5 UAV Initial Operational Capability achieved
Message:
The XZ-5 UAV Program has successfully achieved all of the criteria established for the program and has achieved Initial Operational Capability effective immediately. I wish to congratulate everyone who has made this a successful program. We all anticipate that the XZ-5 will bring added capabilities to the DoD and will be an important instrument in providing security to our nation and the international community.
Thomas Lee
10:04 AM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Feedback Part 1
X
Congratulations on completing the simulation. It certainly included many things to consider. I want to give you some feedback on how you did. Before getting into specifics you should know that the Experience Accelerator is designed to be difficult so that most users are not entirely successful. In fact, the more experienced you are (based on your competency self-assessment) the more difficult the simulation should be.
First, it will help to recall how you rated yourself on that competency self-assessment, which as you may recall focused on your confidence level in relation to problem-solving and recovery. This simulation was designed to gauge how you would use those same behaviors. Remember, problem solving and recovery was defined as:
Identifying the actual /root cause problems amidst often conflicting information. Marshaling the resources needed to solve problems. Recognizing the problems that have the most impact to the overall system and appropriately prioritizing plans for solving them. Making recommendations, using technical knowledge and experience, by developing a clear understanding of the system. Identifying and analyzing problems using a systems approach, weighing the relevance and accuracy of information, accounting for interdependencies, and evaluating alternative solutions.
10:47 AM

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Future Work: Capabilities

- Assess and improve first-year prototype to stabilize operation and produce desired learning
- Expand first-year prototype with additional capabilities
  - —Expand set of challenges and landmines
  - —Include cost objectives
  - —Enrich user profile and competencies addressed
  - —Enhance simulated world features and character interaction
  - —Add features to user desktop

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Future Work: Productivity

- Improve content creation and development tools
  - —Dialog authoring
  - —Artifact creation
  - —Event descriptions and triggering
- Make Open Source Ready
  - —Documentation
  - —Source control and defect tracking
  - —Port to open development environment

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Future Work: Evaluate Efficacy

- User Feedback
  - —Develop more detailed feedback linked to competency model
  - —Create competency scores based upon simulation performance
  - —Create a Comprehensive Feedback Report that participants can save/download
- Outcomes assessment
  - —Establish outcomes assessment plan
  - —User reactions
  - —Behavior change / performance improvement measures
- Development Planning
  - —Provide Development goal setting and planning tools
  - —Create a database of development suggestions

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Questions?

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Join the Experience Accelerator Team!

Contact for information:

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or

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