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A Framework for Expedited Systems Development
(Work in Progress on a SERC Research Task)

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Agenda

- Challenge
- Research Goals
- Methodology
- Observations
- Framework
- Discussion

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Challenge

- DoD Acquisition is often plagued by cost and schedule growth
- Traditional Acquisition Process is not responsive to warfighter's changing asymmetric threats environment
  - —Some 7000+ Joint Urgent Operational Needs staffed over last few years ($50+billion from 2005-09)
- As a result, over 30 rapid reaction, rapid prototyping, non-traditional acquisition organizations have been created.
  - —Army Prototype Integration Facility (PIF), AFRL Center for Rapid Product Development, Space and Missile Center Rapid Reaction Branch
  - —AF Rapid Acquisition Development Integration
  - —etc

What critical success factors from rapid can be learned and applied to traditional aquisition?

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RT-34 Goals

- Examine expedited systems engineering best practices from rapid organizations
- Develop framework for rapid SE
- Consider ability to be applied to DoD acquisition programs

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Research Phases/ Timeline/ Status

	Description	Research	Status
Phase 1 (Sept – Dec 2011)	Planning and Interviews	Identify organizations practicing expedited systems engineering Visit selected organizations; conduct site interviews Incorporate input from the SERC Research Council	Complete
Phase 2 (Jan – Aug 2012)	Analyze and Develop	Analyze current state of the art in expedited SE Synthesize data Develop framework for expedited SE	Complete
Phase 3 (Mar – Sep 2012)	Pathfinder Plan Development	Prepare plan to validate framework on a DOD acquisition program Develop criteria and questions	Complete
Phase 4 (Funding TBD)	Test Phase	Observe and collect data Validate and iterate Framework	Working to identify funding

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Questions Asked: Process

- Do you use standard/ formal SE processes in your rapid development organizations, if so which ones
- Are SE processes tailored for each program or product. If so, which ones can be highly tailorable and why
- How are SE methods, processes and tools different based on project scale/ scope
- What level of risk is acceptable, how do you determine that, and how do you systemically address it at all levels
- What is the formality of engineering documentation
- How replicable / transferable are your processes from one project or product to another
- How do model-based systems engineering approaches support your rapid development
- Do you integrate a variety of models/ simulations/ prototypes early in the lifecycle, and if so, how
- How would you describe your ability to be innovative in concept refinement
- What are best practices for problem domain understanding
- How do you manage scope and requirements
- What infrastructure (tools, modeling & simulation) allows continuously quickening product delivery cycles
- Decision Analysis Processes
  - Who, and at what level, are most engineering decisions made
  - Who is empowered, how do they know it, how are they supported
  - To what extent are major decisions documented, formalized, communicated
  - How do you prepare for major decisions

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Questions Asked: People

- What types of teams do you use (e.g., domain, functional, IPT, etc.
- What are the primary leadership roles for an expedited project or for the best projects that run the most efficiently (program or project manager, chief engineer, chief architect, etc.)
- How do you select/ design the team
- What are the primary skills you seek for the team
- How do you effectively incorporate/ involve the end user
- How do you effectively and continuously incorporate the user perspective
- How do you manage and network people and teams that are not co-located
- What role does collaboration play… in management, in team building, in problem solving, in SE processes, and in geographically distributed teams
- How do you facilitate improved collaboration (internal, external)
- What collaborative tools or processes do you use
- What types of meetings do you hold, who attends, who makes decisions, and why
- How do you manage urgent project tempos and its personnel effects (stress, work hours, burnout)
- How do you reduce complexity of the SE process

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Questions Asked: Product & Project

- Product (Architectural Design Considerations)
  - How do you translate prototypes to operational use
  - How long is the intended operational lifecycle of the product
  - How many units are you producing/ fielding
  - How does your rapid development schedule drive architectural/ design choices
  - How does reuse, modification of existing systems, or using product lines drive reduced schedules
  - How does the level of complexity effect the product architecture
- Project (size, scope, time)
  - How are answers dependent (scalable) on size of the project (scope, cost, timeline, risk, # people)
- **Not Asked but Came Up**
  - Context of Project
  - Business Case
  - Integration

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Definition: What is Rapid

- The Department of Defense does not have a consistent definition for the term *rapid acquisition*
- General sense that rapid fielding programs deliver capabilities within a 2-year window
  - —Shorter than lead time to simply budget for normal acquisition programs
  - —Time begins when a need emerges in the field and concludes at the initial capability fielding
  - —Transition to a program of record, where appropriate, typically occurs beyond this two year window
- Other definitions referenced
  - —Half the time of traditional ACAT 1 (largest) defense programs
  - —Less than 18-24 months
  - —Less than 3 years for rapid space

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Observations: Organizational Best Practices

- 11 Observations – common practices, whether rapid or not
  - —Principles, habits, heuristics, tenants, practices, behaviors

Product

- The what
- Defines conceptual use of technology used to meet the operational needs of warfighters. Architecture/ Design and Deployment aspects of solution

Process

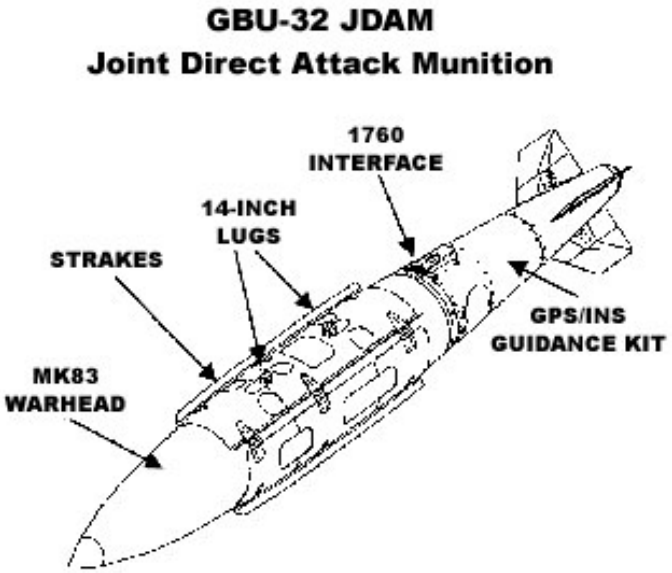
- The how and where
- Describes key programmatic and system engineering strategies used to successfully execute rapid product development. People characteristics. Organization.

People

- The who
- The characteristics, knowledge, education, and behaviors of the personnel in these organizations. Governance / oversight surrounding the acquisition

Product: Faster Architecture?

- System Simplification
- Reuse/ Leverage Legacy architecture/components
  - —Focus on Integration of mature technologies
- Separation of concerns (coupling/interfaces/parallel effort)
- More use of prototyping



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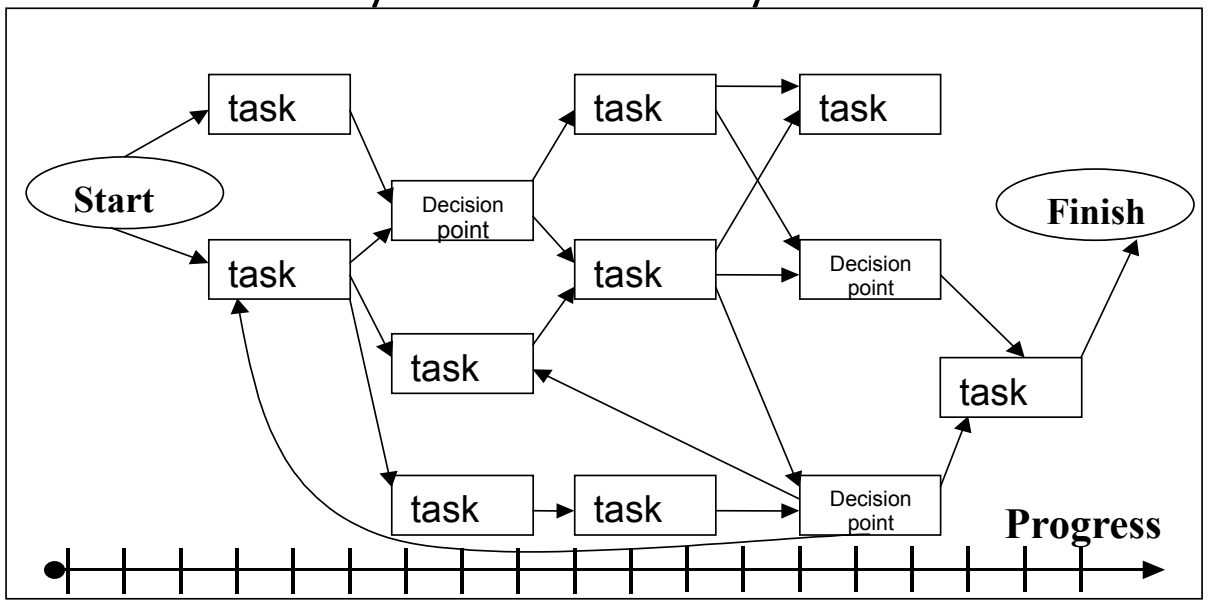
Process: Is Rapid just about Faster Tasks?

- INCOSE/ ISO 15288 / DAU Systems Engineering Processes
  - —Requirements, Architecture/ Design , V&V, Integration, Decision Analysis, Tech Planning, Trade Studies, Config/ Data/ Interface Management, etc
- Do the SE processes (tasks and activities) better
  - —More efficient, Faster (time), Tailored
  - —If skipped, what steps incur Technical Debt?
  - —Spending *more* time on certain tasks may reduce overall cycle
  - —Task Network
- Consider Technical Debt along the way



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Process: Importance of Up Front Concept Design & Requirements

- Create and evaluate conceptual designs in synergistic, concurrent, collaborative manner, with design engineers and customers
- Simultaneous requirements development and design engineering with real-time tradeoffs and "what if" analyses

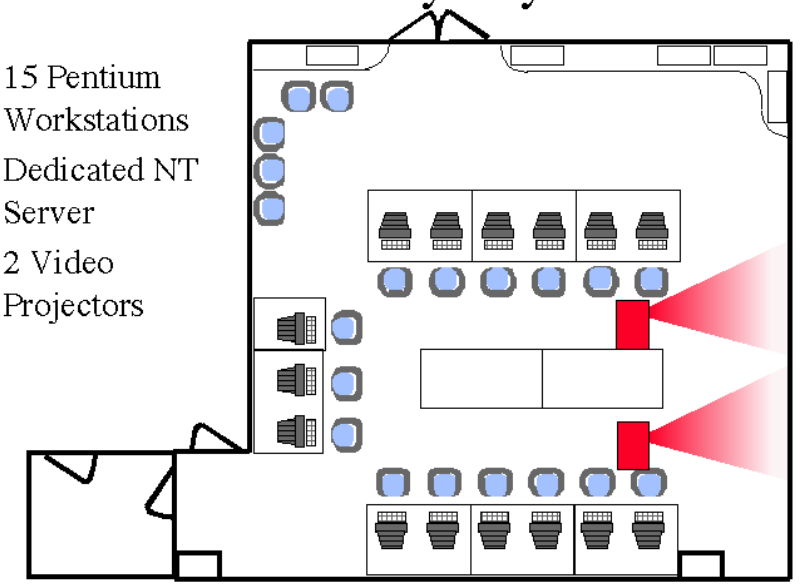
Georgia Tech Research Institute

The Collaborative Visualization Environment allows decision-makers to see solutions in their entirety and see the answers to "what if" questions in real-time

THE AEROSPACE CORPORATION

CDC Facility Layout

- 15 Pentium Workstations
- Dedicated NT Server
- 2 Video Projectors



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People: Implement the Process to make the Product

- Co-located
  - —Though some efforts to collaborate virtually
- Small, handpicked Teams
  - —"A" versus "B" Team
- Experience (previous skills, mentoring, training, hands-on)
- Parallelization of work
- Empowered teams with Improved Decision Making (no stall time) and top-level leadership support
- Hands-on experiences important to grow engineers

Overwhelming response on the importance of "Designing the Design team"

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"Go Fast" Cultural Best Practices

Signified by a shift in energy, commitment, and knowledge

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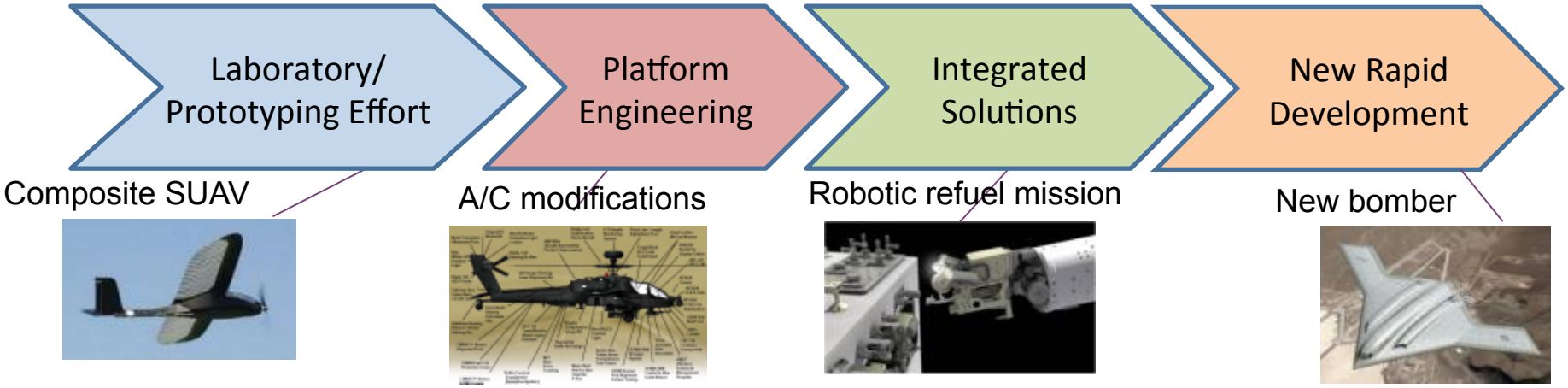
"Rapid World" Best Practices

- **Not a Single Rapid, But Many Different Flexible Rapids**
- **Can be interpreted as "lanes of acquisition")**



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Discussion

- Does the Framework resonate with you?
- Is anything missing?
- What are the most important attributes and principles?
- Where do you see your organization?
- Are there traditional organizations that are using the same principles that allow them to “go faster”

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