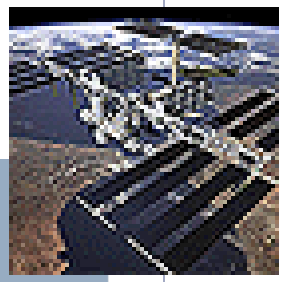
UAHuntsville
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

Systems Engineering at The University of Alabama in Huntsville

Paul J. Componation
Sue O'Brien




Huntsville Alabama

Aviation and Missile Command (AMCOM)

Aviation and Missile Research, Development and Engineering Center

Program Executive Office, Aviation

Program Executive Office, Missiles and Space

Space and Missile Defense Command

Ground – Based Midcourse Defense Joint Project Office

Missile And Space Intelligence Center (MISC)

Army Logistics Support Activity (LOGSA)

US Army Engineering and Support Center

Redstone Technical Test Center

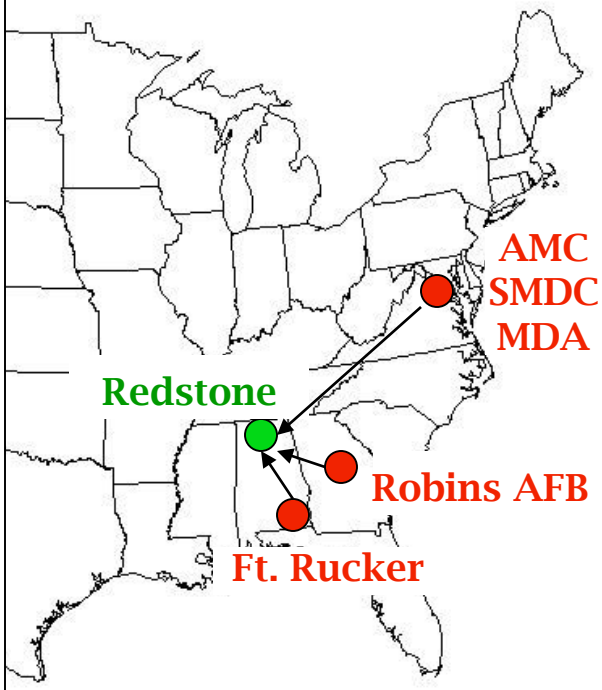
NASA Marshall Space Flight Center

Defense Acquisition University – South

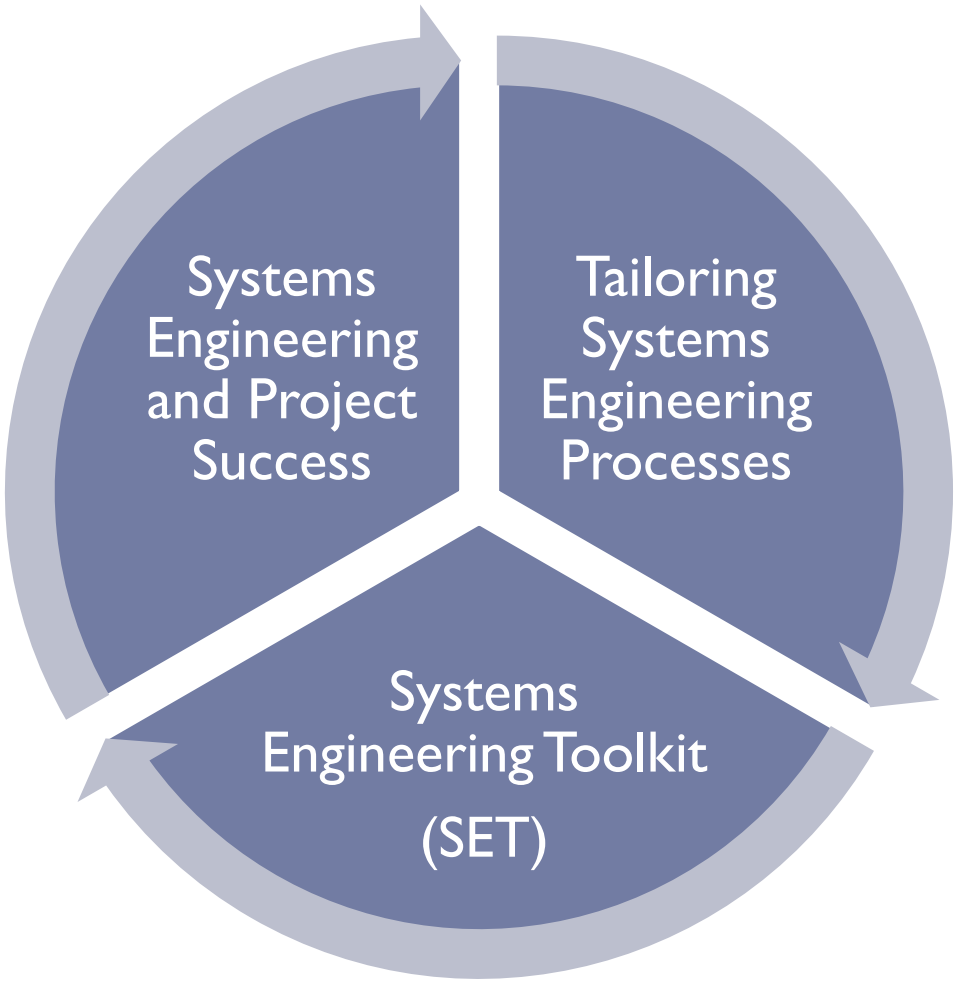
BRAC Decisions

- Relocate HQ Army Materiel Command
- Relocate HQ Security Assistance Command
- Relocate HQ Space and Missile Defense Command
- Relocate Missile Defense Agency (-)
- Relocate Aviation Technical Test Center
- Consolidate Rotary Wing Development, Acquisition, Test and Evaluation

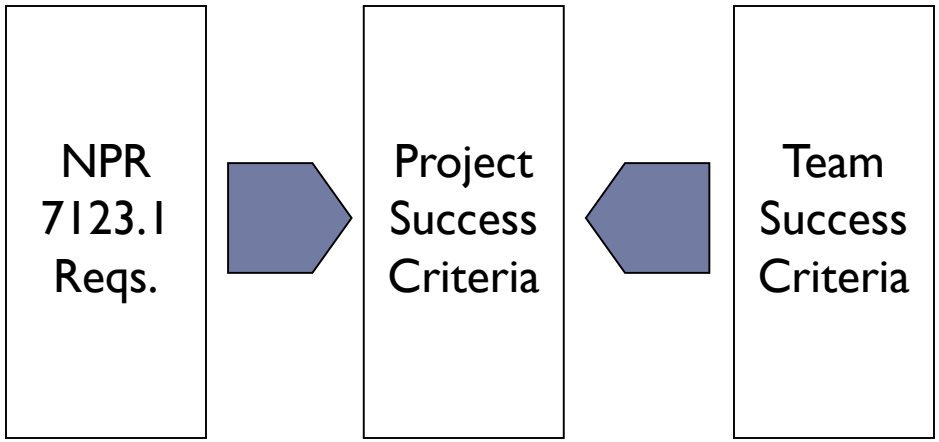
- *Center for Army Acquisition*
- *Center for DoD/Army Space Programs*
- *Center for Army International Programs*
- *Largest Army Contracting Agency*
- *Largest Army Weapon System Concentration*



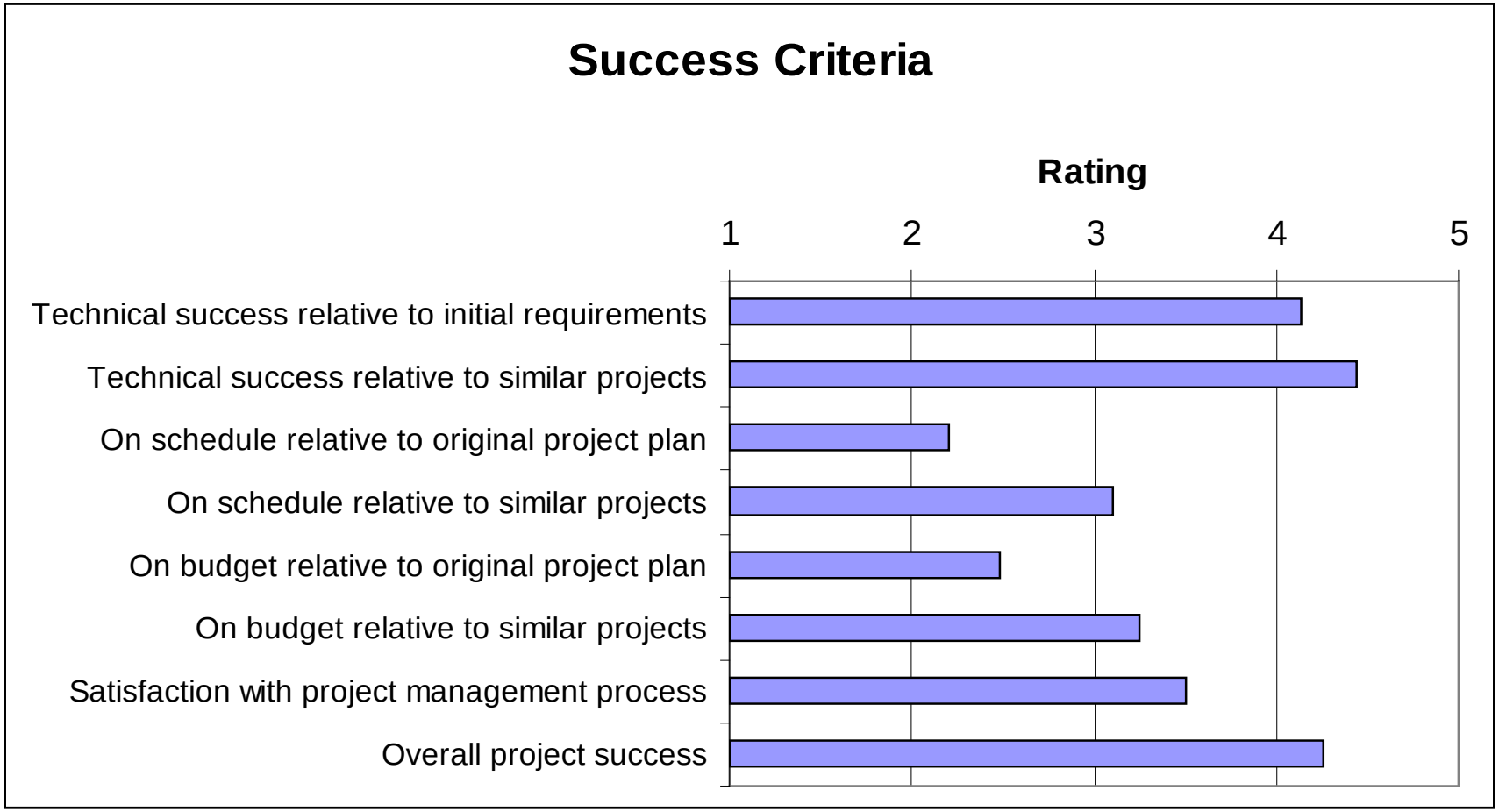
Outline


Systems Engineering and Project Success
Tailoring Systems Engineering Processes
Systems Engineering Toolkit (SET)

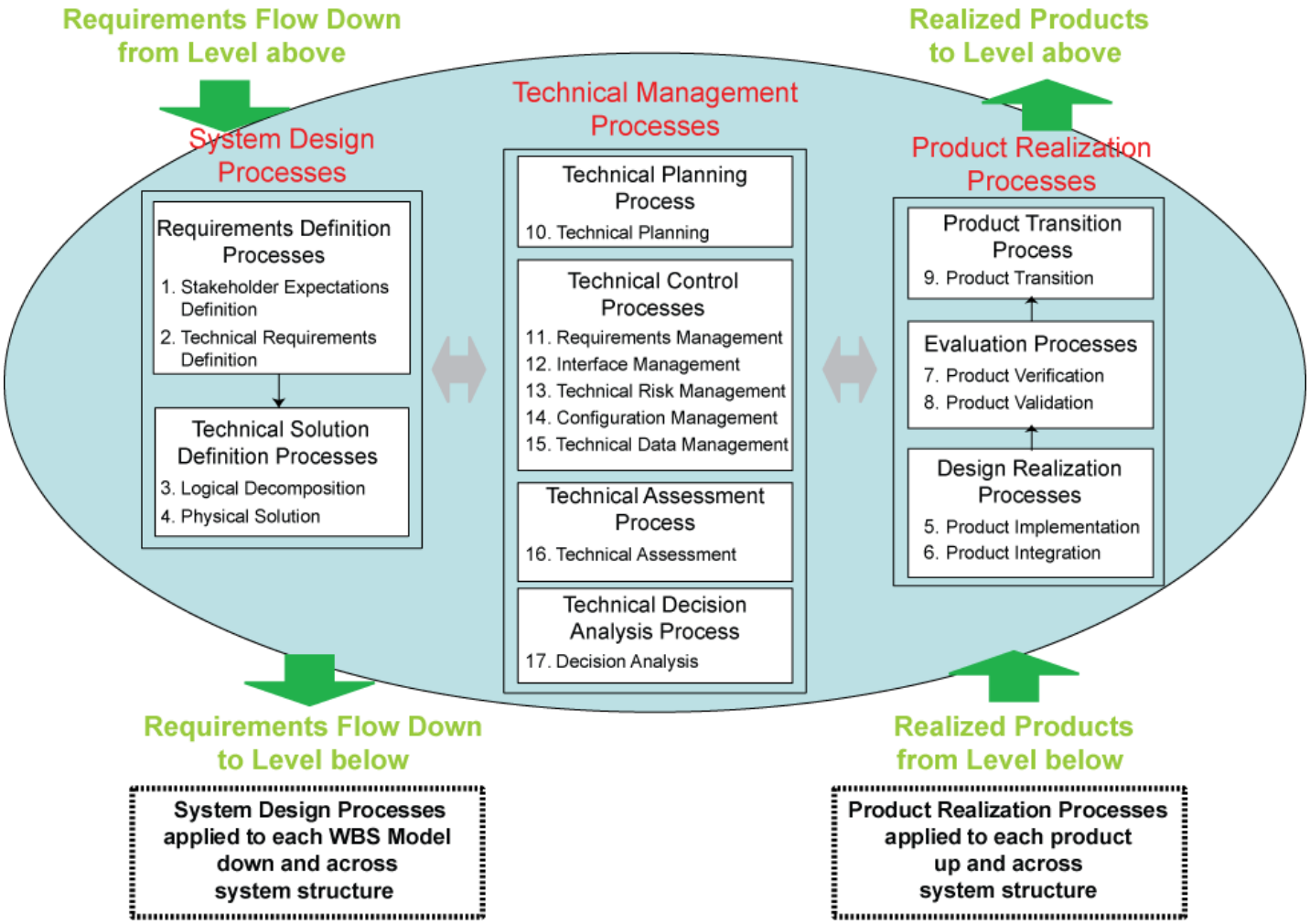
Systems Engineering and Project Success



- International Space Welding Experiment (ISWE)
- Chandra
- Solid Rocket Booster (SRB)
- Reusable Solid Rocket Motor (RSRM)
- X37
- Express Rack
- Gravity Probe B (GP-B)
- ECLSS
- External Tank
- SME Advanced Health Monitoring System
- AXAF
- Saturn Booster
- IML


Success Criteria
Rating
1
2
3
4
5
Technical success relative to initial requirements
Technical success relative to similar projects
On schedule relative to original project plan
On schedule relative to similar projects
On budget relative to original project plan
On budget relative to similar projects
Satisfaction with project management process
Overall project success

System Engineering Processes NPR 7123.1



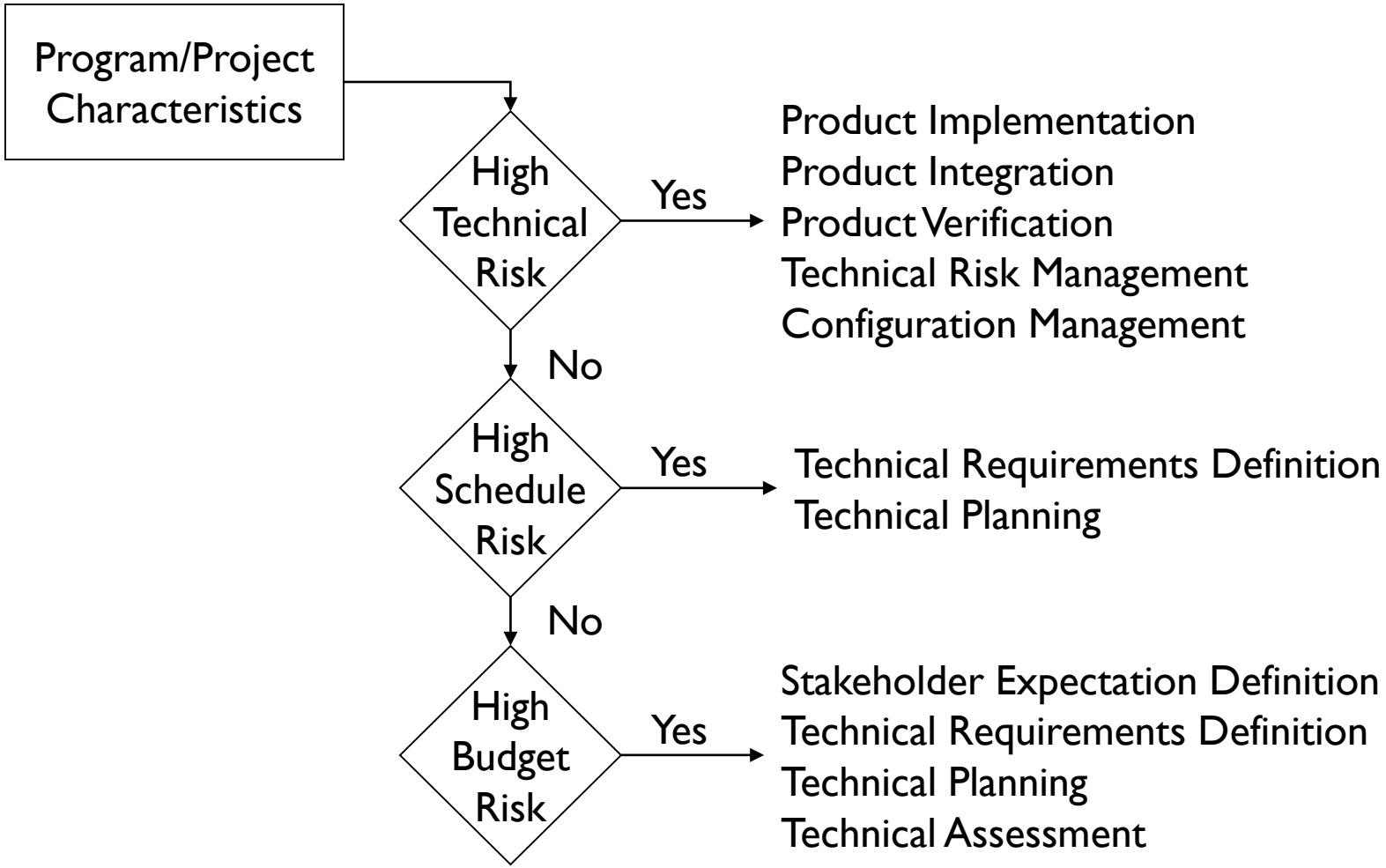
Presence of the SE Process supports Project Success (Motivators)

Project Success and System Engineering Processes Observed Data	1. Stakeholder Expectations Definition	2. Technical Requirements Definition	3. Logical Decomposition	4. Design Solution	5. Product Implementation	6. Product Integration	7. Product Verification	8. Product Validation	9. Product Transition	10. Technical Planning	11. Requirements Management	12. Interface Management	13. Technical Risk Management	14. Configuration Management	15. Technical Data Management	16. Technical Assessment	17. Decision Analysis
Technical success relative to initial req.					√	√	√						√	√			
Technical success relative to similar projects					√	√	√						√	√			
On schedule relative to original project plan																	
On schedule relative to similar projects		√								√							
On budget relative to original project plan																	
On budget relative to similar projects	√	√								√						√	
Satisfaction with project management process																	
Overall project success					√	√	√						√	√		√	

Absence of the SE Process hinders Project Success (Hygiene Factors)

Project Success and System Engineering Processes Observed Data	1. Stakeholder Expectations Definition	2. Technical Requirements Definition	3. Logical Decomposition	4. Design Solution	5. Product Implementation	6. Product Integration	7. Product Verification	8. Product Validation	9. Product Transition	10. Technical Planning	11. Requirements Management	12. Interface Management	13. Technical Risk Management	14. Configuration Management	15. Technical Data Management	16. Technical Assessment	17. Decision Analysis
Technical success relative to initial req.																	
Technical success relative to similar projects																	
On schedule relative to original project plan			√				√		√								√
On schedule relative to similar projects																	
On budget relative to original project plan			√				√		√								√
On budget relative to similar projects																	
Satisfaction with project management process																	
Overall project success																	

Support for Future Projects



Team Characteristics for Successful Projects

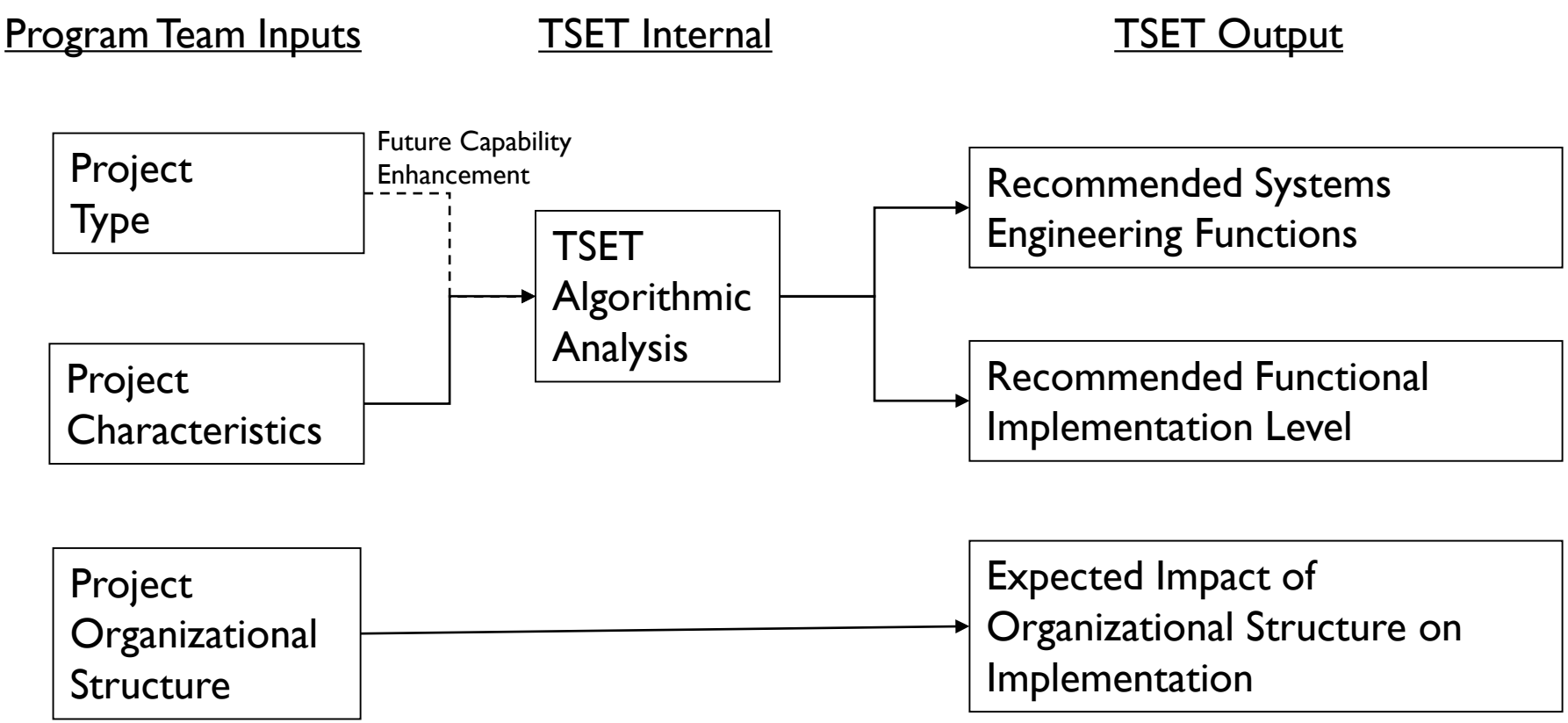
Common

- Team members assigned 100% on the project
- Integration responsibility was either with contractor or shared jointly
- Teams met at least weekly, several daily
- Agendas and action item lists were used
- Teams consisted of good skill mix
- Unified commitment was shared among team members
- Project celebrated successes

Not Common

- Co-location of team members
- Common vision and common values not consistent
- Scope creep or number of changes were not consistent
- Reward structure not consistent
- Project size not consistent
- Leadership style not consistent
- Working approach not consistent

Tailoring Systems Engineering Processes



Project Characteristics* Input (Sample)

General Characteristics

Schedule Risk

Cost Risk

Other Personnel and Material Resources available to project

Experience of R&D Project Management

Organizations Involved: those participating in the project as stakeholders

Project planning

Impact of Project Results Outside of the Project Organization:

*All characteristics have three levels of assessment and importance (low, medium, high)

Project Characterization/Systems Engineering Map

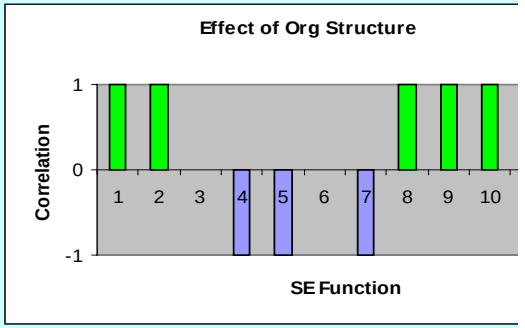
Preliminary SE-PC Mapping (This version is controlled by SE Functions Team. Contact Paul Gradl or SE Team member for latest version.) Rev B (10/17/04) **Project Characteristics**	SE Functions	Quality Management	Reliability Management	Systems Requirements Development Management	Risk Management	Concept Alternatives Management	Test Planning and Evaluation (T&E)	Human Systems Integration (HSI)	Systems Operations Support	Systems Safety Management	Systems Management	Subsystem Integration Management	Systems Integration Management
Time to Deliver		1	1	1	1	0	0	0	0	0	1	1	0
Budget/Cost		1	1	1	0	0	0	0	0	0	1	0	0
Other Personnel and Material Resources		0	0	0	1	0	0	0	1	0	1	1	0
Experience of R&D Project Management		0	0	1	1	0	0	0	0	0	1	0	1
Organizations Involved		0	1	1	1	0	0	0	1	0	0	0	1
Project planning		1	1	1	1	0	1	1	1	1	1	1	1
Impact of Project Results Outside of the Project Organization		0	1	1	0	0	0	0	1	0	1	0	0
Uniqueness of Requirements		0	1	1	1	1	1	1	1	1	1	1	1
Design/Requirements stability		1	1	1	1	0	0	1	1	1	1	1	1
Scope of Requirements		0	1	1	1	1	0	1	1	1	1	1	1
Consistency standards		1	1	1	1	0	1	1	1	1	1	1	1
Project baseline control/flexibility		1	1	1	1	0	1	1	0	1	1	1	1
Constraints or the project or project organization		1	1	1	1	1	1	1	1	1	1	1	1
Degree of Anticipated Technical Task Outsourcing		0	1	1	1	0	0	1	1	1	1	1	1
Degree of Project/System Concept Dependence on New Technology		1	1	1	1	1	1	1	1	1	1	1	1
Project Design Organization's Technological Maturity/Risk		1	1	1	1	1	1	1	1	1	1	1	1
Number of Technology Design Disciplines Involved in the Design Effort		1	1	1	1	1	1	1	1	1	1	1	1
Diversity of New Technology Required		1	1	1	1	1	1	1	1	1	1	1	1
Degree of System Complexity		1	1	1	1	1	1	1	1	1	1	1	1
Degree of System Coupling		1	1	1	1	1	1	1	1	1	1	1	1
External or Environmental Interface Dependence		1	1	1	1	1	1	1	1	1	1	1	1

Quality Management

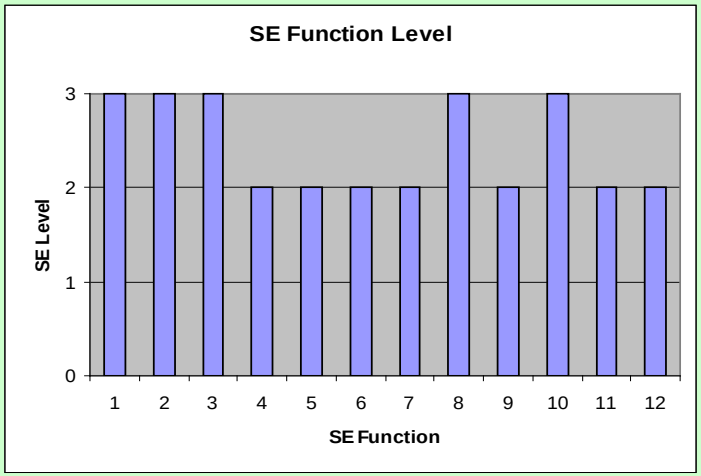
- Level 1 - Establish basic processes for inspection and verification of product conformance to specifications. Monitor variation in production units to identify product improvements.
- Level 2 - Establish efficient production methods for the Apply continuous improvement process methodology to identify performance issues and improvements. Determine root causes or production problems.
- Level 3 - Develop performance metrics and apply statistical methods to ensure product meets requirements. Establish processes to ensure customer feedback is collected and acted on. Evaluate supplier quality plans and suggest improvements where needed.

New Technology Project Output
Electronic Device Development

Recommended System Engineering Functions (SEF)	SEF #	SEF Level	Org Structure Effect on SE Function
Quality Management	1	3	1
Reliability Management	2	3	1
Systems Requirements Development Management	3	3	0
Risk Management	4	2	-1
Concept Alternatives Evaluation	5	2	-1
Test and Evaluation (T&E)	6	2	0
Human Systems Integration (HIS)	7	2	-1
System Operational Support	8	3	1
Systems Safety Management	9	2	1
Systems Management	10	3	1
Subsystem Integration Management	11	2	-1
Systems Integration Management	12	2	0



1 Your organizational structure facilitates this SE Function.
0 There is neither a positive or negative relationship betw een this Function and the organizational structure.
-1 Due to your organizational structure additional coordination w ill be required to ensure that this SE function



This page contains your primary output:

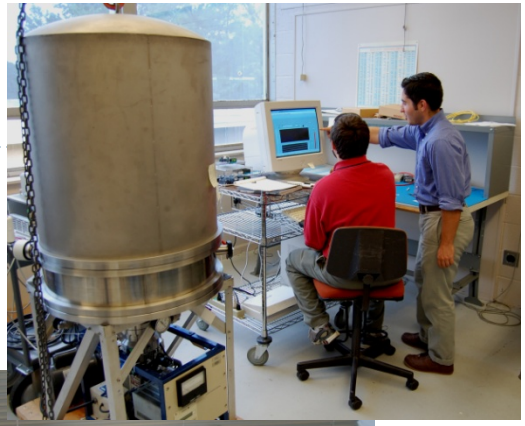
1 - Prioritized SE Functions by importance to your project. Higher SE Level indicates higher p
2 - Your SE Functions recommended levels of rigor. Push button below for details.
3 - The affect of your organization structure to accomplishing these SE Functions

Push to Review SE Function & Rigor Level Definitions

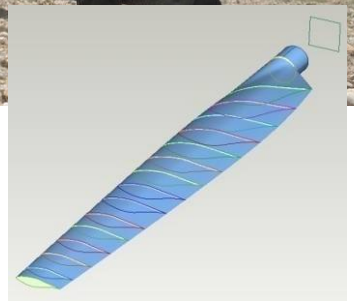
Start Over

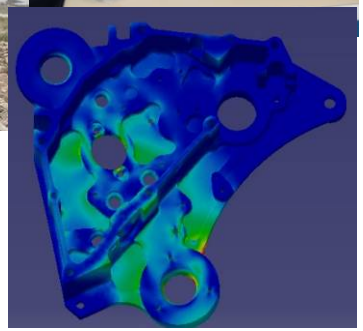
Engineering Labs

- System Engineering Labs w/ full SE Software
- Electrical and Mechanical Design
- Manufacturing Labs
- Research Machine Shop
- Multiple System Design/Fabrication Labs
- Flight Simulation Labs
- Flight Test Research
- NDE/NDT



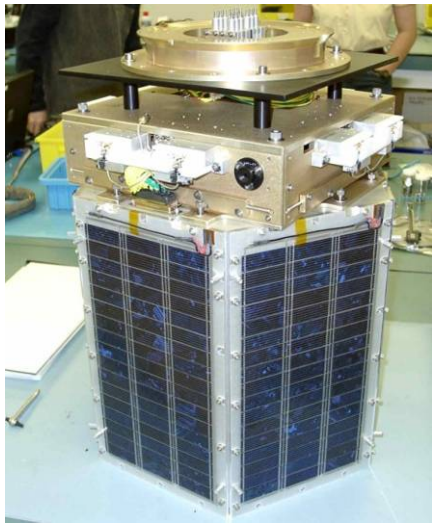
Engineering Design and Analysis

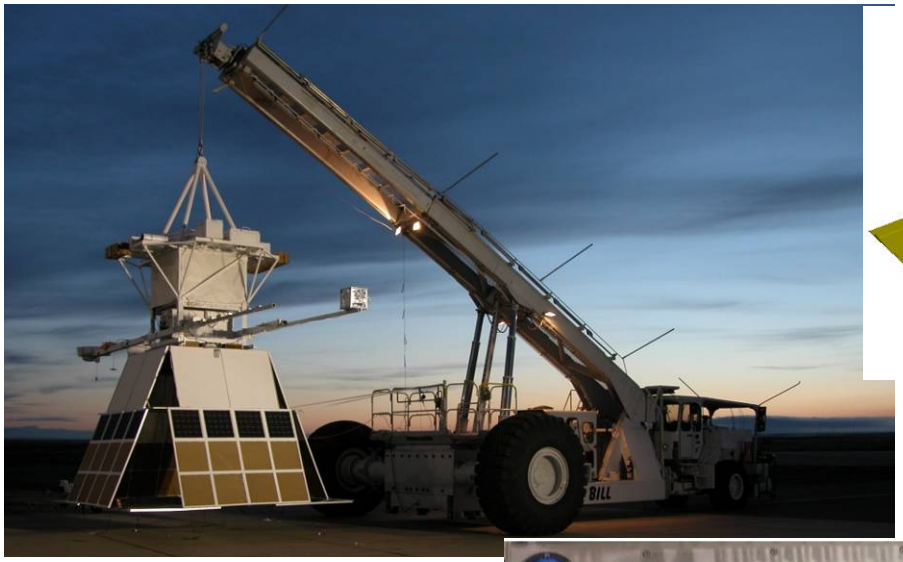


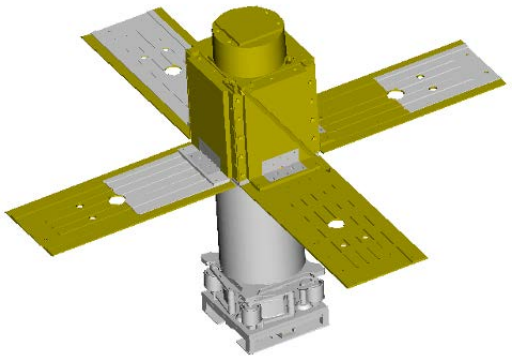


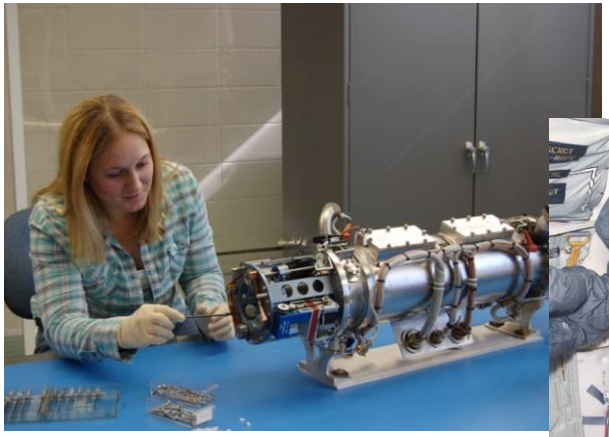
- **Design and Development**
- **Structural Analysis**
- **Testing**
- **Independent Analysis, Modeling and Simulation**

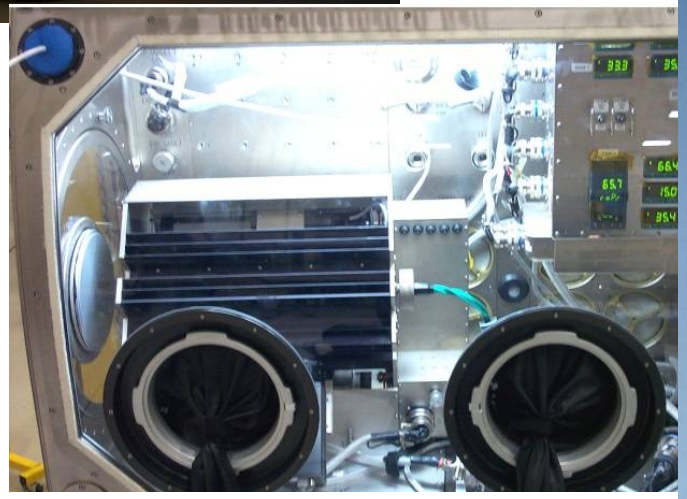
Design, Analysis, Development, Fabrication, and Test





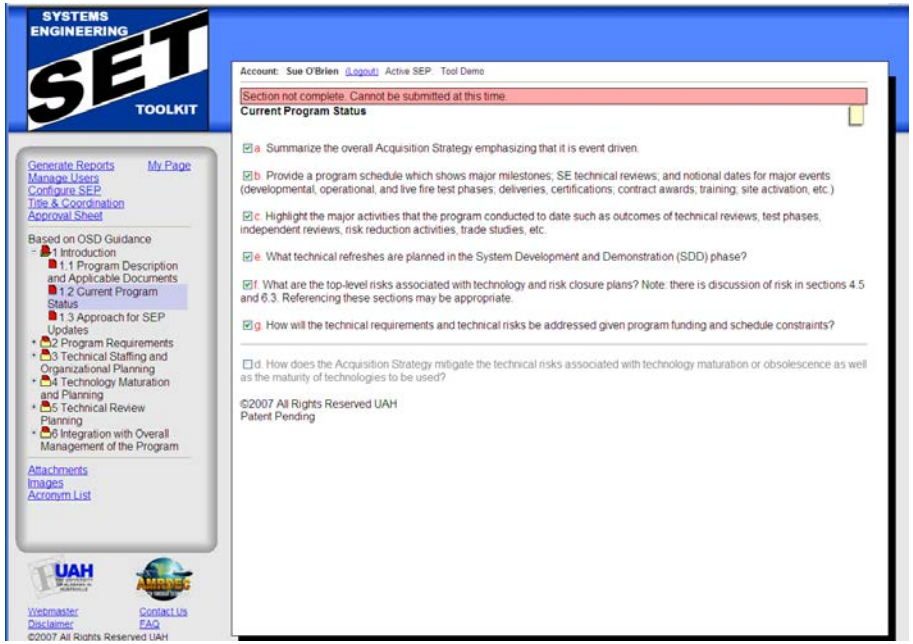






All of these Projects Involve Systems Engineering at Different Levels

Systems Engineering Lab



	KEY PERFORMANCE PARAMETERS [GO / NO GO CRITERIA]	COMPANY 1			
		9780-0095/0129		9780-0073 / -0074	
K.P.P. 1	AC: 400Hz, 3 Phase, 115/200V, 47kVA Cont., 69kVA Peak	-	-	-	-
	DC: 28V, 210A Cont., 500A Peak	-	-	-	-
	HYD.: 12gpm @ 3350psig (start), 15gpm @ 3000psig (service)	GO	-	GO	-
	PNEU.: 30lb/min @ 30-50 psig	-	-	-	-

	KEY SYSTEM ATTRIBUTES	Yes/No	COMMENTS
K.S.A. 1	Simultaneous Operations	YES	A/C, DC, Hydraulic and Pneumatic
K.S.A. 2	Mobility	?	Trailer
K.S.A. 3	Transportability	YES	L X W X H = 13' X 6.9' X 6.9' Weight = 7,700 lbs (wet)
K.S.A. 4	Reliability	?	

Fully Integrated SE Lab

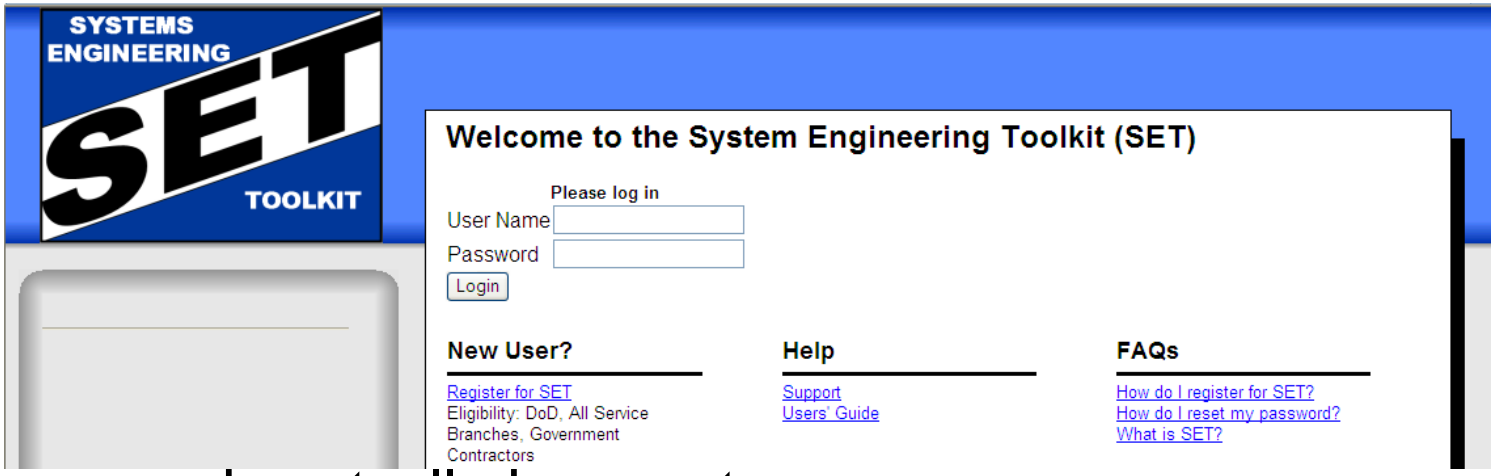
Analysis and System Engineering Software

Integrated with CAD Lab, Computer Cluster, Rapid Prototyping Machines

Systems Engineering Toolkit (SET)

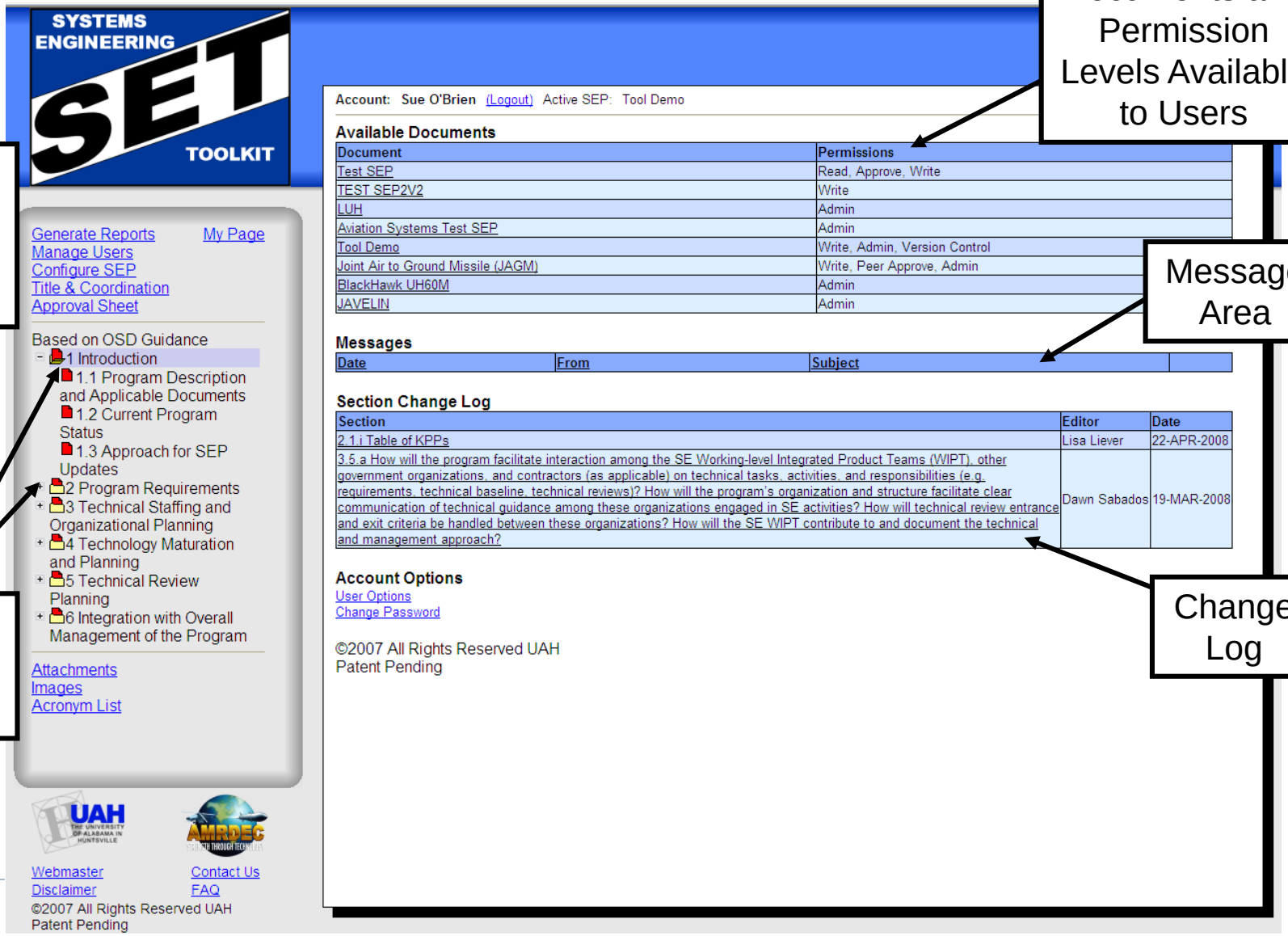
- The tool is
  - Configuration Controlled with Global Access
  - Web based for generating Plans and Technical Documents
  - Modular/adaptable system to many different documents, applications, and phases
  - Allows team based planning development
- The Systems Engineering Toolkit presently assists in creating SEPs.
- It is anticipated that future versions will be composed of several systems engineering tools.

Systems Engineering Planning Tool



- Secure and controlled access to programs
- Foundation for metrics and statistical analysis
- Enhanced communications
- Global access to most up-to-date information
- Built in mapping of information
- Ability to strengthen planning process
- Tailoring for Phase, ACAT, project complexity and processes

Systems Engineering Tool



Navigation Tree Based Guidance TOC

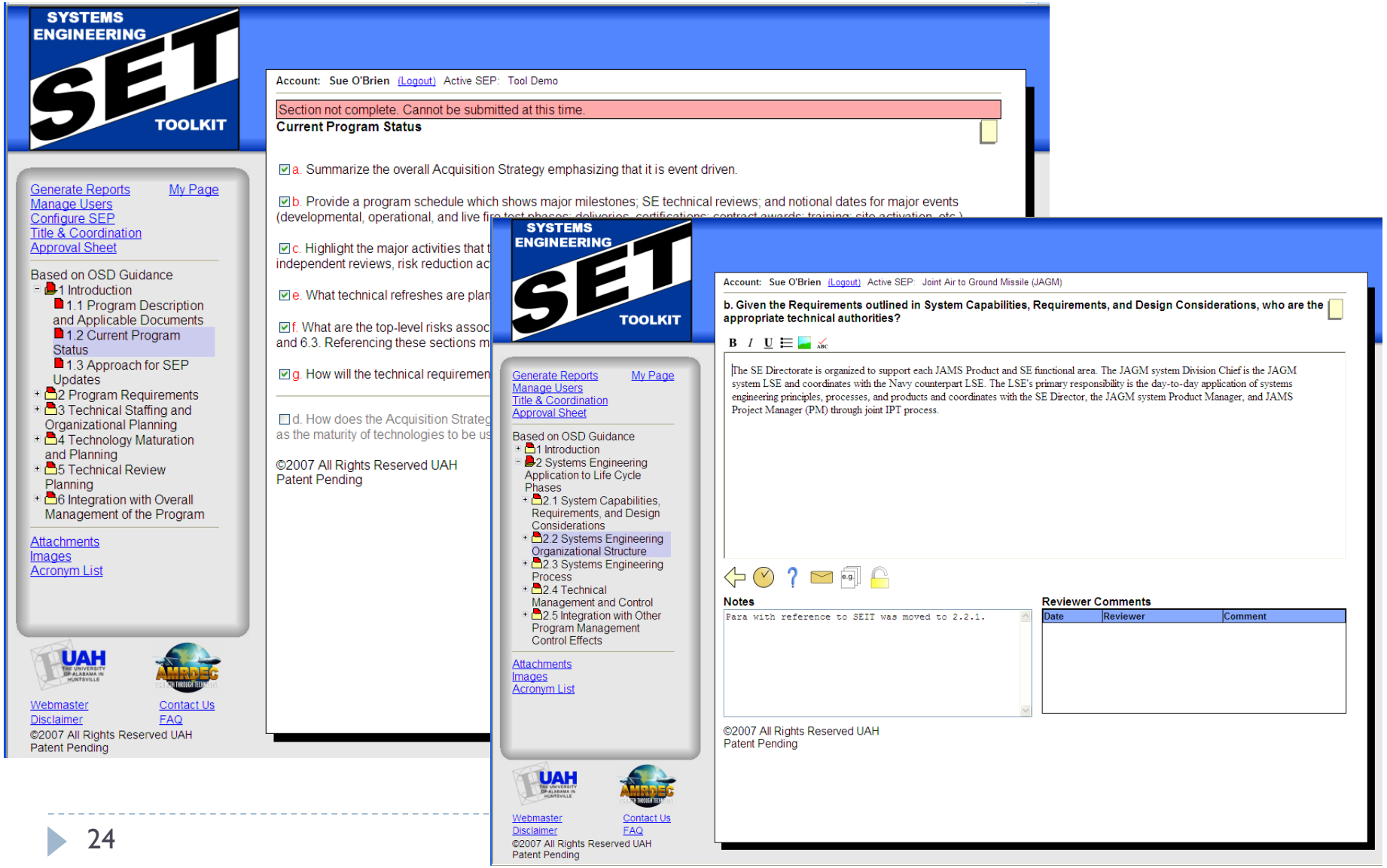
Colored Status Indicators

Multiple Documents and Permission Levels Available to Users

Message Area

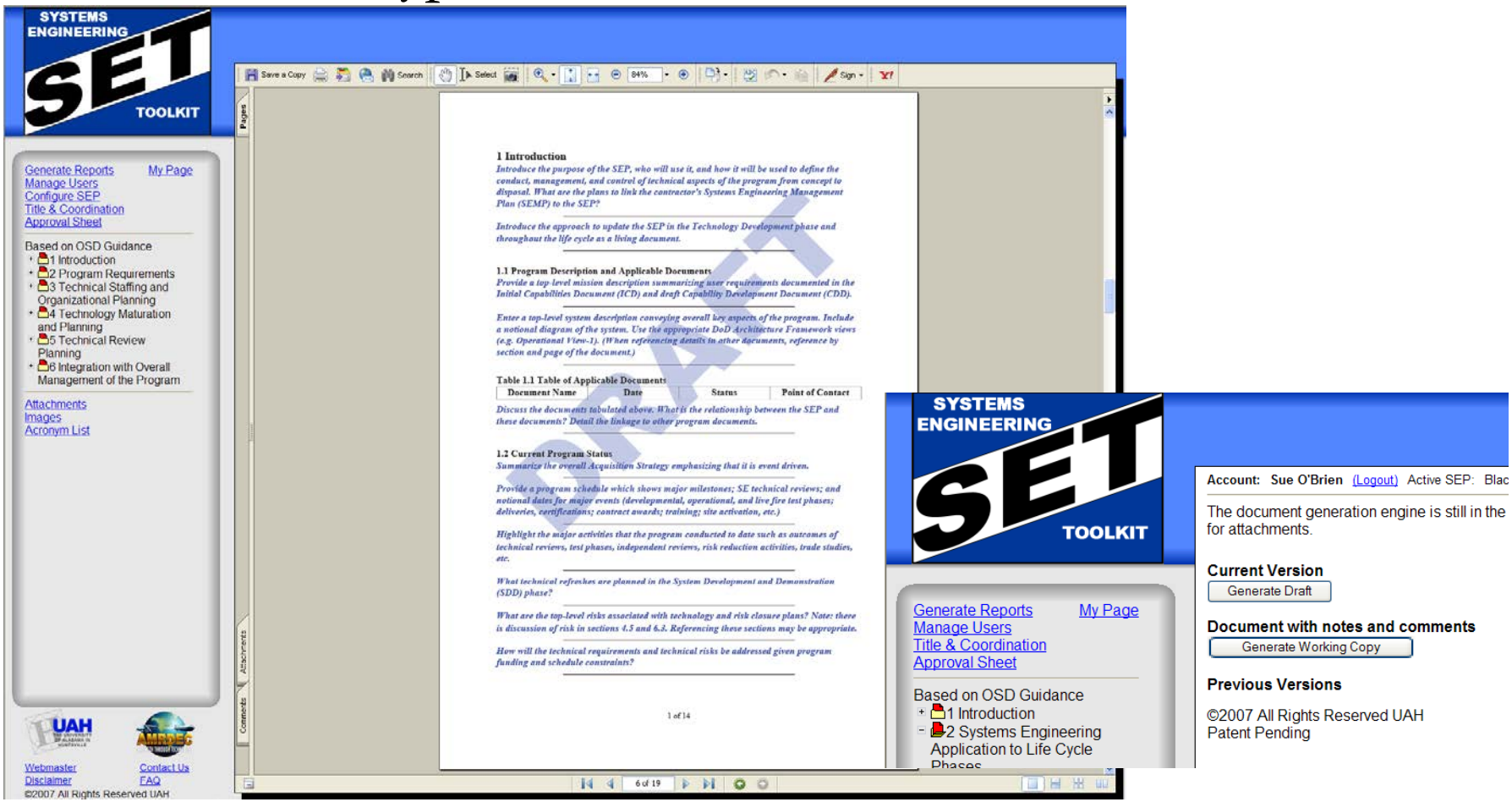
Change Log

Systems Engineering Tool



Document Generation

- Configuration controlled with automatic change logs
- Creates two types of PDF documents



Systems Engineering Toolkit

- Benefits
  - Most up-to-date information
  - Increased communications
  - Ability to leverage strengths of other projects/programs
  - Disciplined/ Known Process
  - Decrease Approval Timeline
  - Team-Based SEP Generation = Consistent Execution of a Multi-Disciplined Plan
  - Minimize "Shelf-Ware"
  - Means to collect metrics and best applied practices including statistics on users and level of experience
  - Hands-on real time training