



Successful Application of Integrated (Cost-Schedule-Risk) Analysis in Technology Development Projects

**Risk-Informed Cost & Schedule (RICS)
Project Management Strategy
&
Schedule Reserve Allocation Method (SRAM) Implementation**

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Outline



- **Context: The Environmentally Responsible Aviation (ERA) Project**
 - NASA Aeronautics and Integrated Systems Research Program
 - ERA Project Phase 2 Integrated Technology Demonstrations (ITDs)
 - Risk-Informed Project Management Strategy
- **Risk-Informed Cost & Schedule (RICS) Methodology**
 - Implementation
 - Reporting
 - Challenges & Rewards
- **Schedule Reserve Allocation Methodology (SRAM)**
 - Implementation
 - Test Case Results
 - Path Forward
- **Summary**



NASA Aeronautics Programs

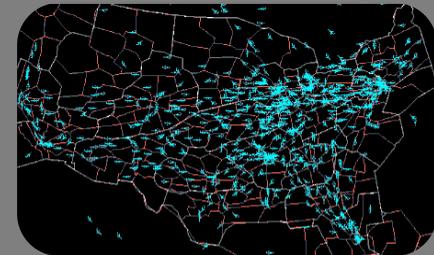


Fundamental Aeronautics Program

Conducts fundamental research to generate innovative concepts, tools, technologies and knowledge to enable revolutionary advances for a wide range of air vehicles.

Integrated Systems Research Program

Conducts research at an integrated system-level on promising concepts and technologies and explore, assess and demonstrates the benefits in a relevant environment.



Airspace Systems Program

Directly addresses the fundamental air traffic management research needs for NextGen by developing revolutionary concepts, capabilities, and technologies that will enable significant increases in the capacity, efficiency and flexibility of the NAS.



Aviation Safety Program

Conducts cutting-edge research to produce innovative concepts, tools, and technologies to improve the intrinsic safety attributes of current and future aircraft and air traffic management systems.



SVS HUD

Aeronautics Test Program

Preserves and promotes the testing capabilities of one of the United States' largest, most versatile and comprehensive set of flight and ground-based research facilities.





Integrated Systems Research Program Overview

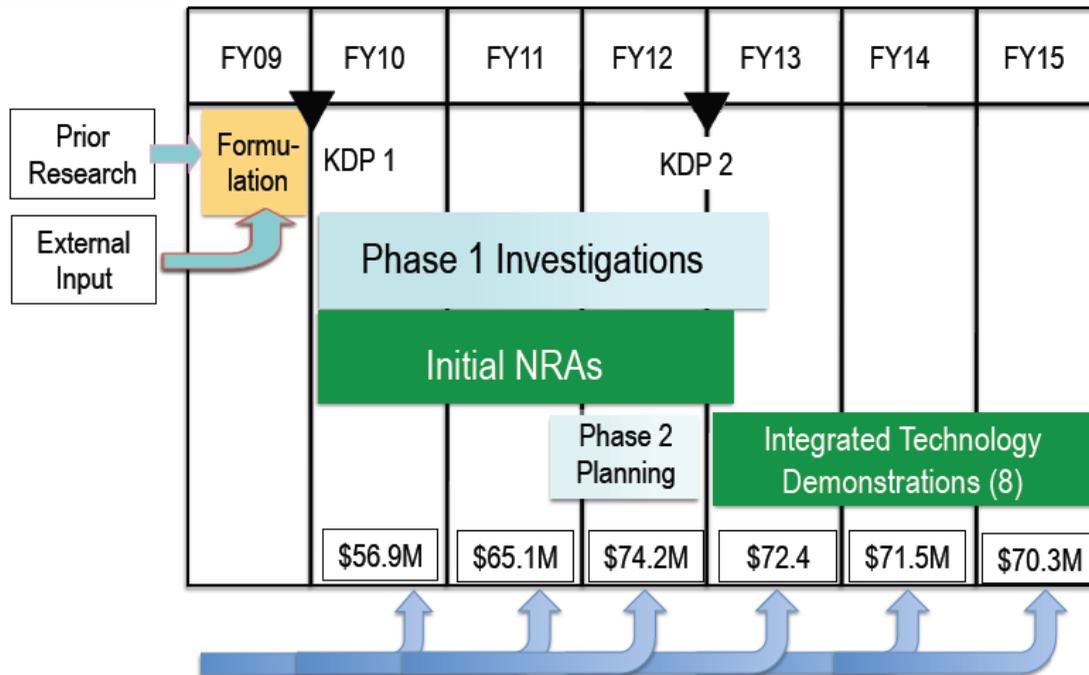


Program Goal:

Pursue innovative solutions to high priority aeronautical needs and accelerate implementation by the aviation community through integrated system level research on promising concepts and technologies, demonstrated in a relevant environment.

Environmentally Responsible Aviation (ERA) Project (NPR 7120.8)

Mature technologies and study vehicle concepts that together can simultaneously meet the NASA Subsonic Transport System Level Metrics for noise, emissions and fuel burn in the N+2 timeframe



- **Technologies have already proven their merit at the fundamental research level**
- **Conduct aircraft system-level demonstrations to enable TRL Maturation (5/6)**
- **Accelerate technology insertion potential to future vehicles (EIS 2025)**
- **Inform future fundamental research needs**

Technical input from Fundamental Programs, NRAs, Industry, Academia, Other Gov't Agencies

- ERA FY 10-12 are actual full cost
- ERA FY 13-15 budget from President's FY13 budget



ERA Technical Challenges



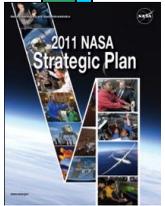
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Strategic Thrusts

Energy Efficiency

Environmental Compatibility



TECHNOLOGY BENEFITS*	TECHNOLOGY GENERATIONS (Technology Readiness Level = 4-6)		
	N+1 (2015)	N+2 (2020**)	N+3 (2025)
Noise (cum margin rel. to Stage 4)	-32 dB	-42 dB	-52 dB
LTO NOx Emissions (rel. to CAEP 6)	-60%	-75%	-80%
Cruise NOx Emissions (rel. to 2005 best in class)	-55%	-70%	-80%
Aircraft Fuel/Energy Consumption ⁺ (rel. to 2005 best in class)	-33%	-50%	-60%

Technical Focus Area

Phase 2 Integrated Technology Demonstrations (ITDs)

Innovative Flow Control for Drag Reduction

- Active Flow Control Enhanced Vertical Tail and Advanced Wing Flight Experiment (TRL 6)

Advanced Composites for Weight Reduction

- Damage Arresting Composite Demonstration (TRL 5)
- Adaptive Compliant Trailing Edge (ACTE) Flight Experiment (TRL 6)

Advanced UHB Engine Designs for Specific Fuel Consumption and Noise Reduction

- Second Generation Ultra-High By-Pass (UHB) Propulsor Integration (TRL 5)
- Highly Loaded Front Block Compressor (TRL 5)

Advanced Combustor Designs for Oxides of Nitrogen Reduction

- Low NOx Fuel Flexible Combustor Integration (TRL 5)

Airframe and Engine Integration Concepts for Community Noise and Fuel Burn Reduction

- UHB Integration for Hybrid Wing Body (TRL 4/5)
- Flap Edge and Landing Gear Noise Reduction Flight Experiment (TRL 6)

ERA Project Phase 2 ITD Implementation Roadmap

Detailed Planning
June - September 2012

- ITD WBS, Budget, Schedule, and Risk Definition
- Integrated Cost, Schedule and Risk Analysis
- ITD Uncertainty and Risk Threat Margin Analysis
- ITD Portfolio and PM Reserve Definition

KDP-2 Authority to Proceed
9-26-2012

- ITD Risk-Informed Cost and Schedule
- ITD Level 1 & 2 Milestones
- ITD TCs, NGOs, KPPs Defined
- ITD Driving Requirements Defined

PP&C for Phase 2
Implementation

- Management by Technical Challenge
- Configuration, Schedule & Financial Management
- SE&I Management
- Risk Management
- Decision Gate / Descope Reviews

ITD Implementation Begins
1QFY13

- ITD Kick-off TIM (w/partners)
- ITD Requirements TIMs and Reviews
- ITD IBR: Risk-Informed Budget & Schedule Baselined (Feb-Mar 2013)
- ITD Independent Assessments (Mar-Apr 2013)



ERA Phase 2 Implementation (FY13-15) Risk-Informed Project Management Strategy



- **Implementation Challenge: NPR 7120.8, Technology Development Project**
 - **Finite life:** 3 Years AND **Fixed, Flat Budget Profile:** nominally \$210M, \$70M/FY, 8 ITDs
 - Cost Share with Industry and OGA Partners
 - **Integrated Critical Path:** Co-dependency
 - Phase 1 Lessons Learned
 - mid-TRL technology development projects require **more robust project management controls and enhanced communications**
- **Phase 2 Risk-Informed Project Management Strategy:**
 - **Manage ITDs to the integrated, resource - loaded schedule and budget baselined at their respective IBRs**
 - The ITD grass roots estimate budget **without reserve** is the baseline budget
 - The ITD grass roots schedule **without schedule buffer** is the baseline schedule
 - Hold ITD Reserve and manage Schedule Buffer at the ERA PM Level
 - **Convene Decision Gate Reviews as ITD performance & risk-informed budget and schedule margins deteriorate and/or risks are realized**
 - Descope Options
 - Termination Options
 - **Establish Host Center/Program/Project/Partner interfaces and conduct Integrated Technical, Cost, Schedule and Risk Performance Reviews (Weekly, CMC, EPTR)**



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 - Environmentally Responsible Aviation (ERA)
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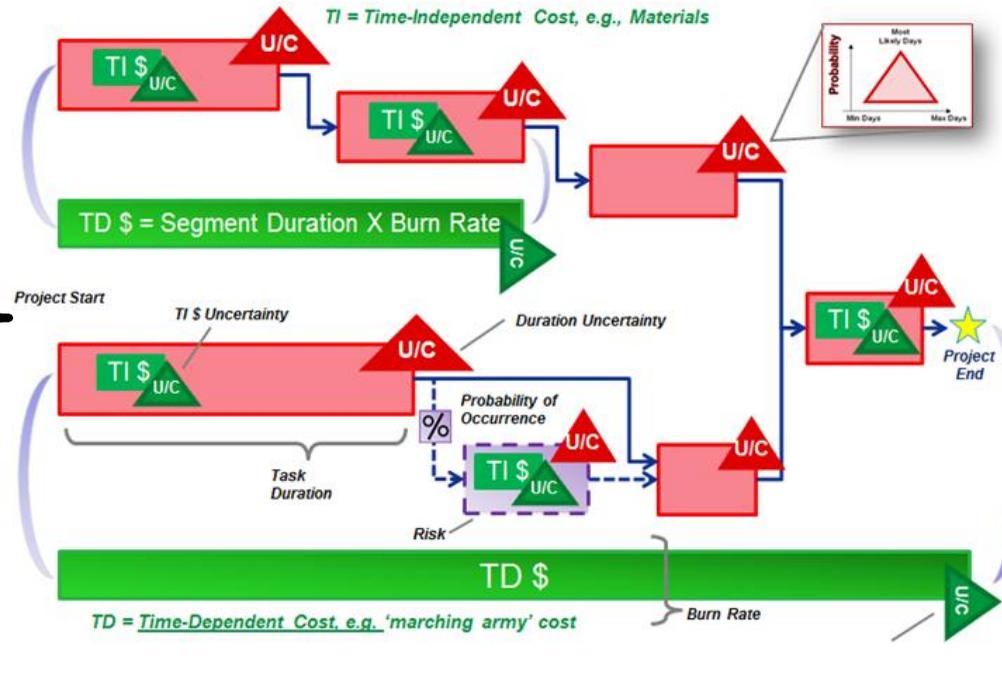
Risk-Informed Cost & Schedule (RICS) Management—ARMD “Pathfinder”



Cost

Schedule

Risk

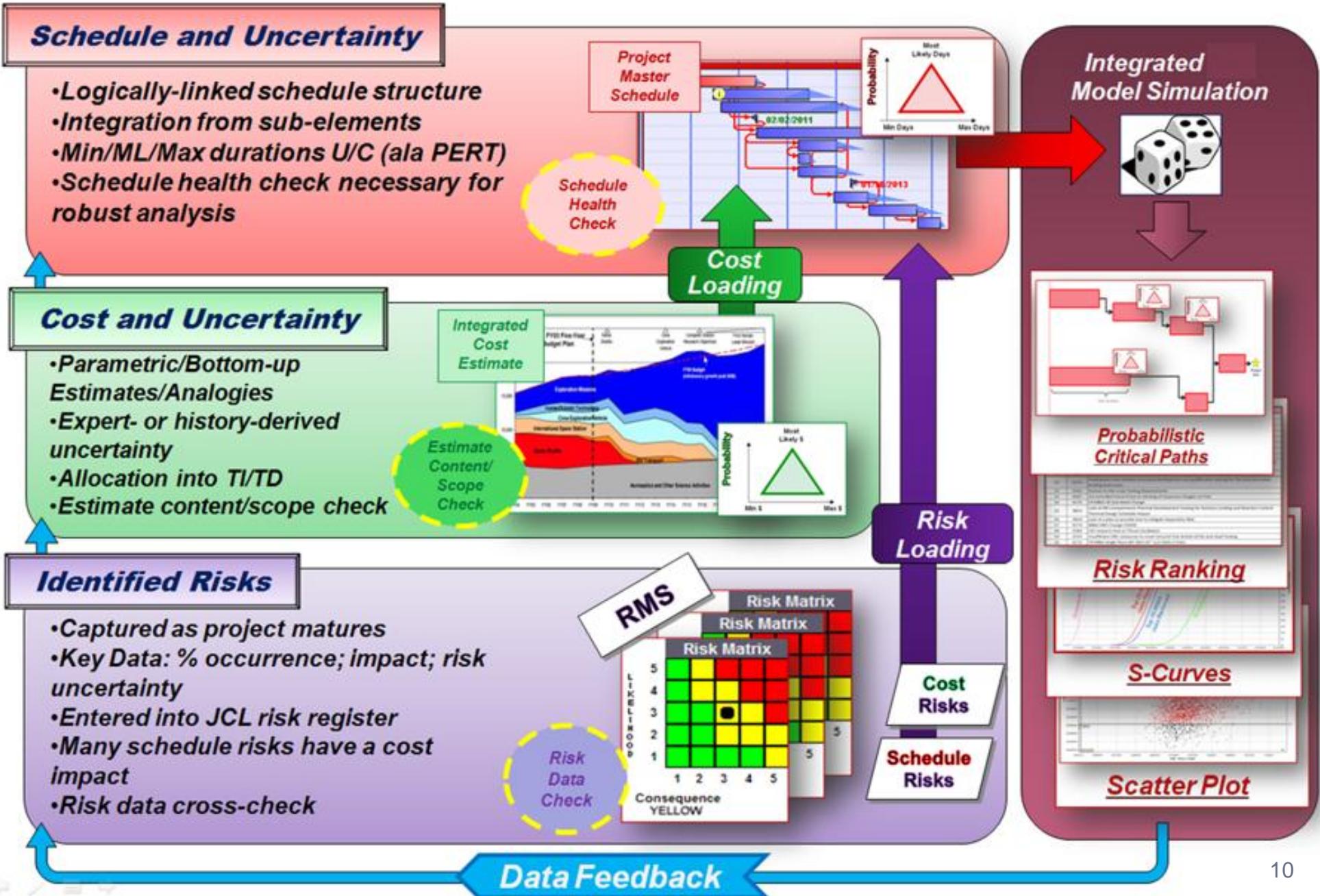


**Management by RICS...
Risk-Informed Cost & Schedule
on all ITDs**

Technical Focus Area	Integrated Technology Demonstrations (ITDs)
Innovative Flow Control for Drag Reduction	<ul style="list-style-type: none"> Active Flow Control Enhanced Vertical Tail and Advanced Wing Flight Experiment
Advanced Composites for Weight Reduction	<ul style="list-style-type: none"> Damage Arresting Composite Demonstration Adaptive Compliant Trailing Edge (ACTE) Flight Experiment
Advanced UHB Engine Designs for Specific Fuel Consumption and Noise Reduction	<ul style="list-style-type: none"> Second Generation Ultra-High By-Pass (UHB) Propulsor Integration Highly Loaded Front Block Compressor
Advanced Combustor Designs for Oxides of Nitrogen Reduction	<ul style="list-style-type: none"> Low NOx Fuel Flexible Combustor Integration
Airframe and Engine Integration Concepts for Community Noise and Fuel Burn Reduction	<ul style="list-style-type: none"> UHB Integration for Hybrid Wing Body Flap Edge and Landing Gear Noise Reduction Flight Experiment



RICS Implementation for ERA Phase 2 ITDs (Feb 2012 to Present)





RICS Reporting



- Development of life cycle cost, identification of risks, and development of schedule for each Integrated Technology Demonstration (ITD)

ITD	Name	Description	Cost Estimate (Point Estimate & 80%)	Schedule Estimate (Point Est & 80%)	Schedule Health	Discrete Risk	Overall Evaluation
12A+	Active Flow Control Enhanced Vertical Tail	Develop and demonstrate the AFC-enhanced vertical tail technology through full-scale wind tunnel testing and flight testing to achieve a 20% side force improvement that will lead to 1 to 2% reduction in drag and fuel burn; advance technology from TRL 4 to TRL 6	PE: \$12,620,752 80%: \$14,040,150 Delta: \$1,419,398	PE: 17 Feb 2015 80%: 10 June 2015	Tasks and Milestones Without Predecessors: 48 (14%) Tasks and Milestones Without Successors: 19 (6%) Constraints (other than ASAP): 78 (23%)	1. Facility/Hardware Interface Incompatibility / 25% / 20 days and \$15K 2. Iterations On Design Delays PDR / 15% / 20 days 3. Critical Skills Within Core Team Not Committed For Duration Of Design, Fab, & Test / 10% / 20 days	Moderate Confidence
21A	Damage Arresting Composites Demonstration	Demonstrate low-weight, damage tolerant stitched composite structural concept and assess its weight and drag reduction benefits; Mature stitched unitized composite structures from TRL 4 to TRL 5	PE: \$19,692,881 80%: \$22,090,609 Delta: \$2,397,728	PE: 1 July 2015 80%: 18 Sep 2015	Tasks and Milestones Without Predecessors: 9 (6%) Tasks and Milestones Without Successors: 4 (3%) Constraints (other than ASAP): 14 (9%)	1. Incorrect fit for loading fixtures / 5% / 12 days impact 2. Unavailability of high pressure air Pristine Structure / 2% / 4 days 3. Unavailability of high pressure air / 2% / 4 days 4. Resealing box after damage / 5% / 2 days 5. Material Shortages / 5% / 2.5 days 6. Part Damage / 5% / 2.5 days 7. Infusion Failure of Lower Section Panels / 10% / 27 days 8. Dimension Accuracy of Panels / 7.5% / 2.5 days	Moderate Confidence

- Define the **risk level** acceptable to management
- Establish a **common standard** by which ITD implementation plans can be assessed
- Protect ERA team from “**surprises**” caused by unacceptable risks
- Engage ERA team members to **dialogue** about the risks being assumed



Challenges & Rewards to RICS Implementation



- **Challenges**

- Unique ITD schedules that were not “quite” aligned for RICS analysis
- Costs categorized into Time Dependent/Independent
- Integrated Discrete Threats into the schedule to assess impacts (direct and indirect)

- **Rewards**

- Overcoming these challenges provided insight into the analysis process
- Implemented standardized ITD Schedules for analysis
 - Facilitated cross-ITD analysis
 - Produced analysis at various points within the schedule (i.e. Test Completions)
- Meaningful dialogue with ITD SMEs led to categorization of costs
 - Time Independent (TI) /Time Dependent split (TD) and uncertainty distributions developed during these meetings
- Mapping of Discrete Risks into schedule provided insight into the true nature of their impacts
 - Total ITD vs. Test Completion Impact
 - Assessment of Criticality of Discrete Risk



What did the RICS Methodology do for us?



- **Increased Stakeholder- ARMD, ISRP, Project and Center Leadership- overall confidence level in the ITD Implementation Plans**
 - Improved project planning by systematically integrating cost, schedule, and risk
 - Facilitated transparency with stakeholders on expectations and probabilities of meeting those expectations
 - Provided a cohesive and holistic picture of the Project's ability to achieve cost and schedule goals and to help the determination of reserves
- **Answered fundamental project management questions that led to robust ITD project management controls**
 - Does the ITD have enough funds?
 - Can the ITD meet the schedule? What are the schedule drivers?
 - What are areas of risk jeopardizing successful execution of the ITD?
 - What risk mitigation strategies provide the best ITD benefit?
 - What are ITD fiscal year phasing needs?
 - What should be held as PM Reserve?



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Schedule Reserve Allocation Methodology (SRAM)



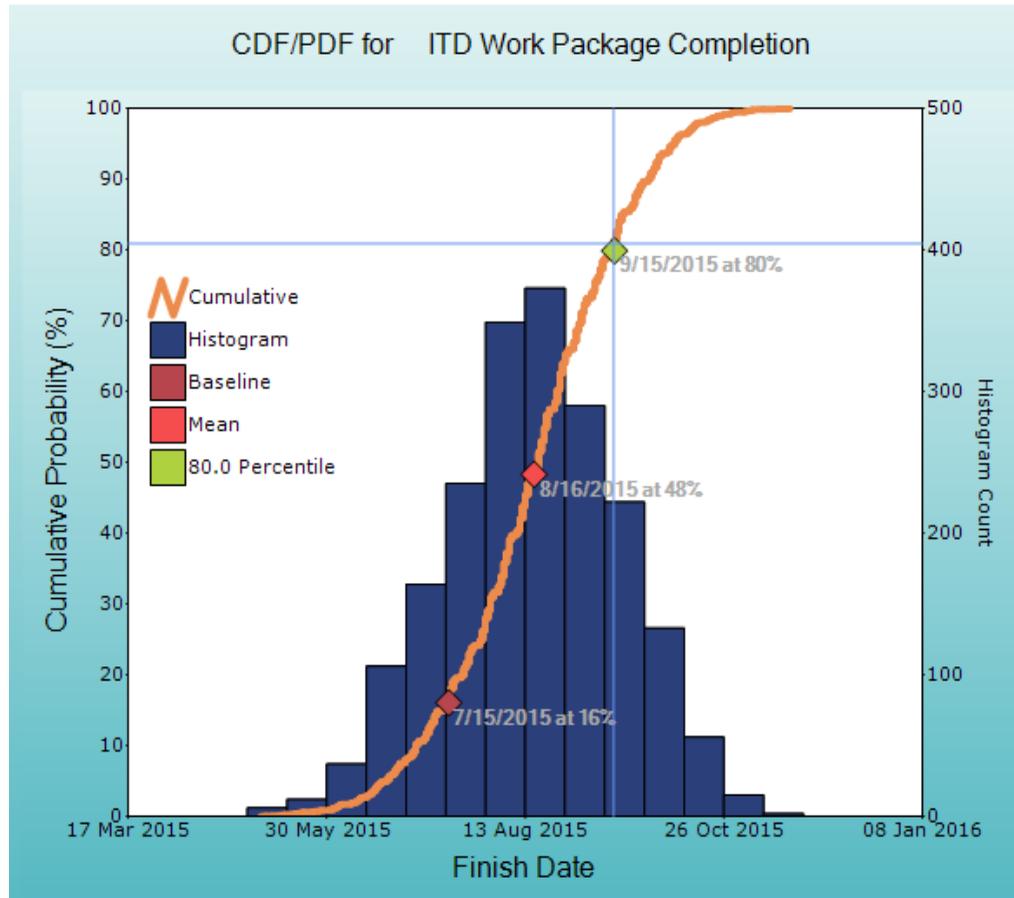
- **Critical schedule management gap identified by the ERA Project upon executing ITD Implementation Plans in 2Q of FY13:**
 - The need for tracking and assessing the use/ or burn down of schedule buffer as:
 - ITD Level 1 and 2 Milestones are completed or slipAnd/or
 - Discrete risks are realized
- **Currently tracking consumed reserve and comparing to a straight risk burn-down plan from ITD Baseline Completion Date to ERA Project Termination Date of September 30, 2015**
- **NASA HQ study to build “Data-Driven / Risk-Informed Plans”**
 - Quantitative-based algorithm using mathematical principles
 - ERA Project ITD “XX” used as a test case
 - ITD Test Case of SRAM demonstrated:
 - Understanding of risk posture over the duration of the ITD
 - Identification of “riskiest” overall path for the ITD
 - Enabled alignment of schedule to cost reserves
 - Pressing forward with implementation of SRAM on all ITDs



ERA ITD Test Case “SRAM” Results



- ITD Baseline Schedule Completion Date of 7/15/2015
- 80% schedule confidence level Completion Date of 9/15/2015
- **44** work-days of reserve between 7/15/2015 and 9/15/2015
- Absolute threshold date for completion is 9/30/2015, **55** work-days of reserve

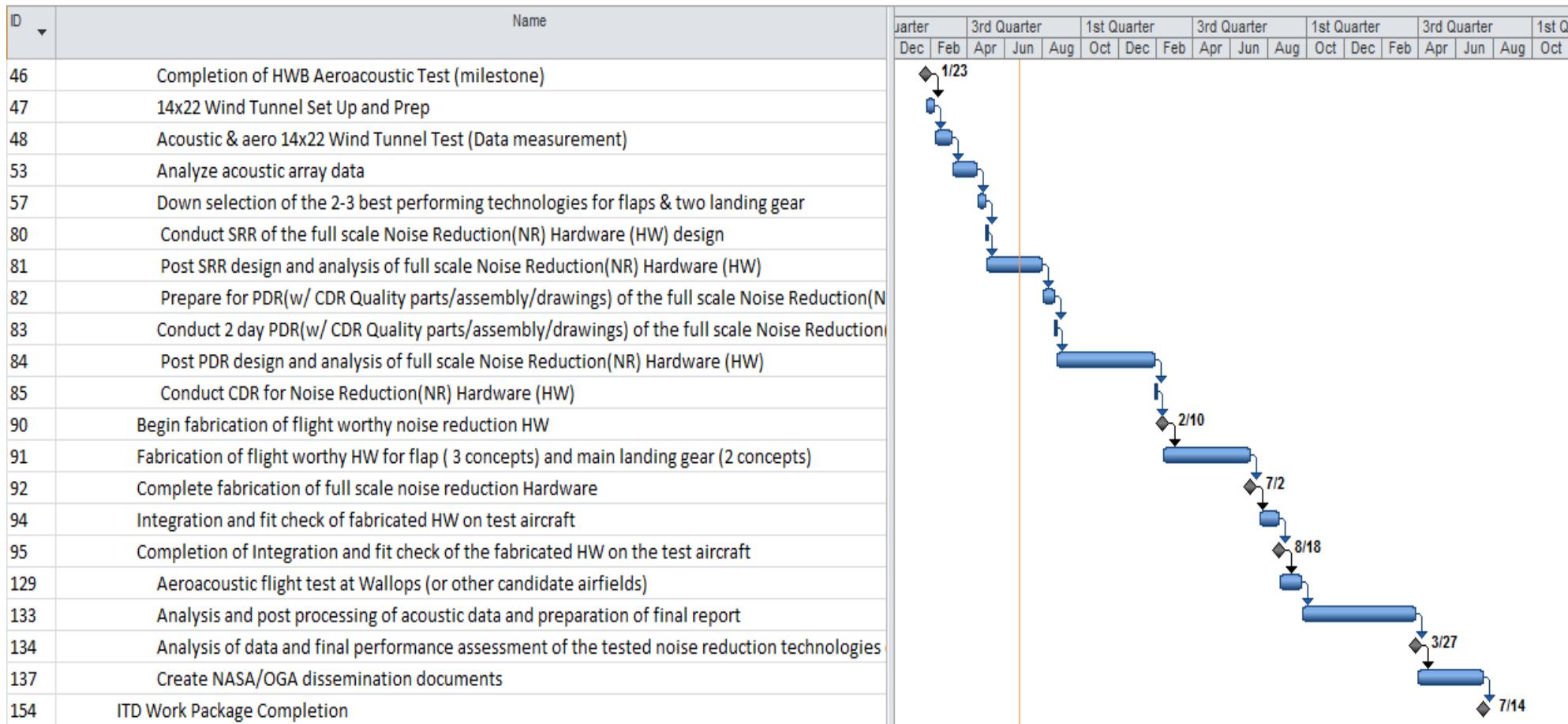




SRAM



Highlighted the Most Frequent Critical Path

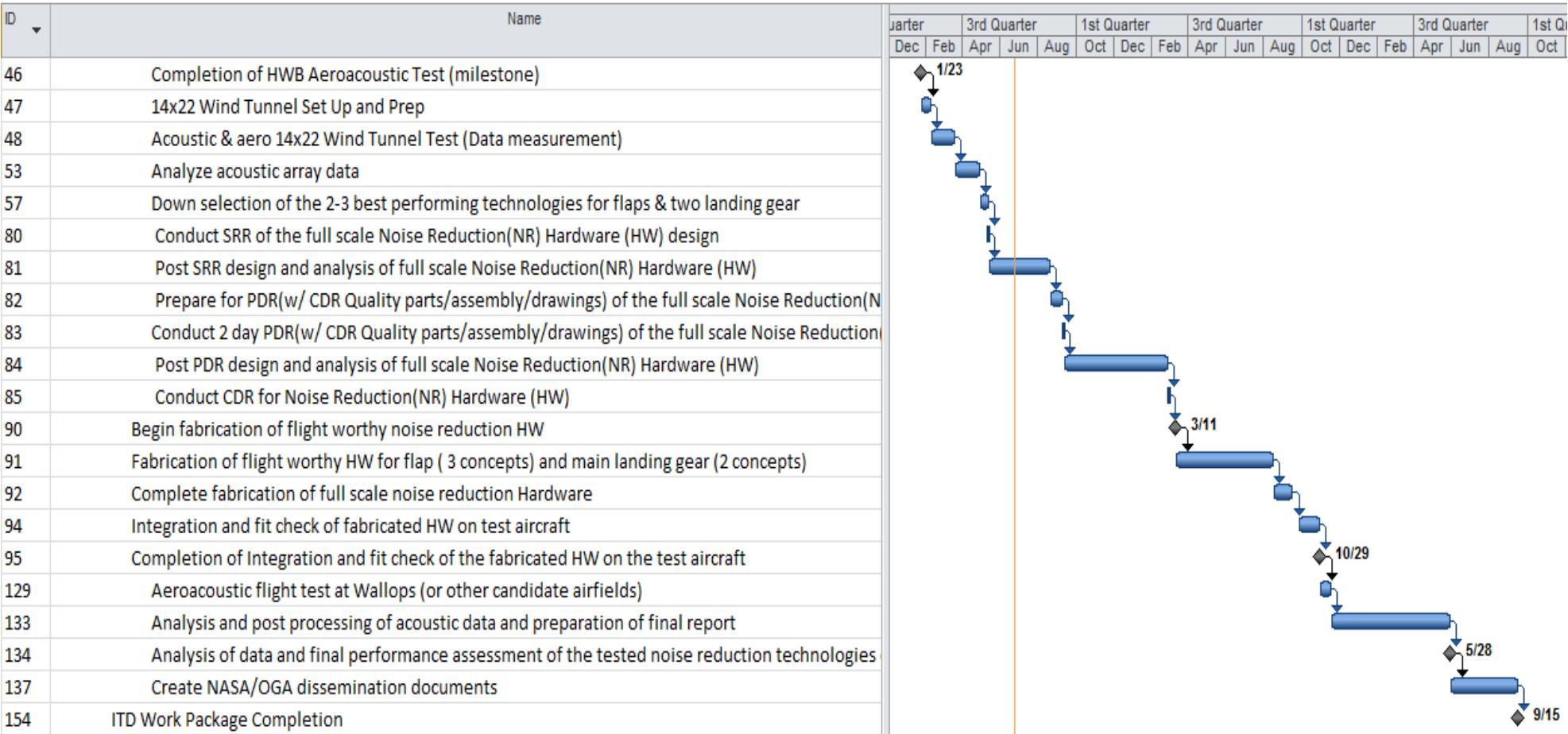


Algorithm Allocated the Total Reserve along the Most Frequent Critical Path



SRAM Calculation

Risk-Adjusted Dates to Meet Target Confidence Level



Reserves are Captured in the Correct Place in Time



Results



“SRAM” ITD Test Case Reserve Burn Down Plan

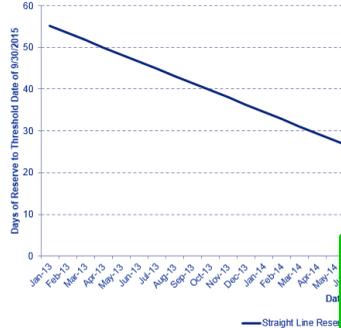
Reserve Burn Down – Based on Heuristics

From “Straight-Line...”

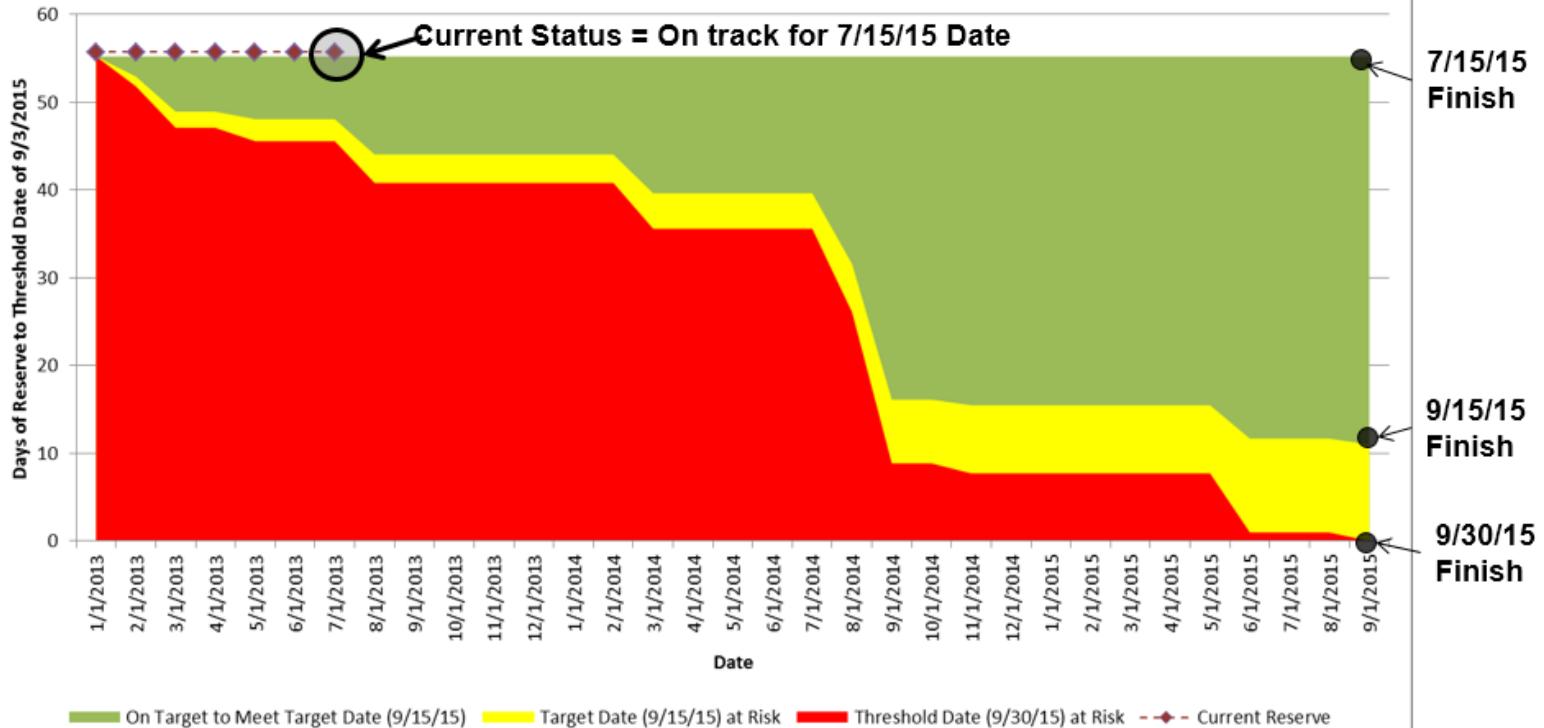


To data-driven schedule reserve allocation

ITD 50A Risk-Based Margin Burndown



Risk-Based Margin Burndown





Additional Insight Provided at ITD Task Level



Milestone Level	Task Name	Baseline Finish	Target CL Finish	Threshold Finish	Margin for Target CL	Margin for Threshold Date	Current Finish	Remaining Margin to Target CL	% Change in Target Margin	Status	% Complete
1	Complete down select	4/30/2013	5/13/2013	5/16/2013	10	13	4/24/2013	14	40.00%		100%
1	Completion of Integration of the fabricated HW	8/19/2014	10/09/2014	11/19/2014	53	51	8/13/2014	57	-7.55%		0%
1	Aeroacoustic flight										
1	Final validation of acoustic predictions										

as of: 3-Jul-13

Milestone Level	Task Name	Baseline Finish	Target CL Finish	Threshold Finish	Margin for Target CL	Margin for Threshold Date	Current Finish	Remaining Margin to Target CL	% Change in Target Margin	Status	% Complete
2	Deliverable: Completion of complete full aeroacoustic predictions(14x22 wind tunnel test) (Baseline & Quietest configuration)	1/13/2014	3/13/2014	3/27/2014	44	54	1/31/2014	30	-31.82%		0%
2	Completion of HWB Aeroacoustic Test (milestone)	1/23/2013	1/23/2013	1/23/2013	1	1	1/22/2013	2	100.00%		100%
2	Acoustic & aero 14x22 Wind Tunnel Test (PIV/LDV measurements) in 14x22 Wind Tunnel Complete	4/9/2013	5/3/2013	5/9/2013	19	23	4/26/2013	6	-68.42%		100%

as of: 3-Jul-13

Milestone Level	Task Name	Baseline Finish	Current Finish	Remaining Margin to Target CL	% Change in Target Margin	Status	% Complete
2	Deliverable: Completion of complete full aeroacoustic predictions(14x22 wind tunnel test) (Baseline & Quietest configuration)	1/13/2014	1/31/2014	30	-31.82%		0%
2	Completion of HWB Aeroacoustic Test (milestone)	1/23/2013	1/22/2013	2	100.00%		100%
2	Acoustic & aero 14x22 Wind Tunnel Test (PIV/LDV measurements) in 14x22 Wind Tunnel	4/9/2013	4/26/2013	6	-68.42%		100%
2	Post Processing and Comparison Aerodynamic Flight Test Data to Wind Tunnel Test Data Complete		4/18/2013				100%
2	Conduct 2 day PDR(w/ CDR Quality parts/assembly/drawings) of the full scale Noise Reduction(NR) Hardware (HW) design	8/21/2013	8/15/2013	20	25.00%		0%
2	Conduct CDR for Noise Reduction(NR) Hardware (HW)	1/30/2014	1/24/2014	26	18.18%		0%
2	Conduct CDR for Noise Reduction(NR) Hardware (HW) Complete		1/24/2014				0%
2	Deliverable: Completion of Full-Scale aircraft aeroacoustic predictions (baseline)	5/19/2014	5/13/2014	37	12.12%		0%
2	Conduct full-up test of mic array (Risk reduction Plan) Complete	5/2/2014	5/2/2014	25	0.00%		0%

Still ahead of schedule but losing margin

Loss of margin and finished behind schedule . Question – why no downstream impact?

Activities not present in original schedule



ERA Project ITD Test Case Results



- **Data indicates:**
 - ITD Test Case appears to be healthy with respect to the 80% schedule confidence level ITD Completion Date given the current planned dates; however,
- **Some evidence of “soft” optimism in current planned dates**
 - Activities downstream of a 20 day risk with 50% probability show no potential impact from the risk; warrants revisit of risk
 - Details of certain tests are unclear - possibly finished over a month late with no apparent effect on the overall finish date
- **Relatively large effect of key risk element**
 - Responsible for almost half the total margin to be allocated
 - Project to revisit risk assumptions:
 - Still a risk?
 - New information?
 - Is the risk impact and probability of occurrence appropriately allocated within the ITD schedule?



SRAM Path Forward



- **Monthly Assessments provide**
 - Trip-wire indicator to re-run an integrated cost/schedule risk analysis (if risk realization is higher than assessed risk)
 - Simple communication if remaining buffer is adequate to meet project commitments
- **Deep-Dive Analysis of Drift and Compression provide**
 - Insight into pin-pointing problems
 - Insight into amount of drift from plan
 - Analysis of duration compression/expansion, where is it occurring
- **Risk Mitigation benefits**
 - Comparison of target date confidence levels
 - Revised reserve burn-down plan



Summary



- **Pathfinder Efforts—recognized by NASA HQ and across ARMD**
 - ARMD Program and Mission Support Award to Mr. Antonio Rippe
- **RICS and SRAM methodologies are tailorable to NPR 7120.8, mid-TRL Technology Development Projects**
 - Has set a precedent in the application of “risk-informed” assessment tools to aid future ARMD projects from planning through implementation.
 - Held as an example of Project Management Best Practices within NASA
- **The ERA Project is pursuing the application of the Schedule Reserve Allocation Methodology (SRAM) with the remaining ITDs**
 - ITD Test Case success has increased project insight to potential schedule challenges and led to a re-assessment of the risk threats identified
- **The ERA Project Team is stronger, more agile and responsive to unknown/unplanned challenges due to the implementation of RICS and SRAM.**
 - The integrated cost, schedule and risk analysis products are integral to ERA’s Phase 2 project management controls and decision making framework



Back-Up



- ITD Objectives
- ERA Project Details on Phase 2 ITD Implementation PP&C
 - Development of ITD Risk-informed Cost and Schedule Flow Chart
 - ITD Risk-Informed Cost Basis of Estimate
 - ITD Risk-Informed Schedule Basis of Estimate
 - ITD Risk Categories and Dispositions
 - ITD Reserve Determination
 - ITD De-scope and Termination Processes
 - ERA Project Planning and Control Processes for Phase 2
 - IBR Compliance Matrix-Project and ITD Controlled Documentation

Innovative Flow Control Concepts

Active Flow Control Enhanced Vertical Tail (Lead) and Advanced Wing (Support) Flight Experiment

Develop/demonstrate AFC-enhanced vertical tail technology; achieve a 20% side force improvement that will lead to 1 to 2% **reduction in drag and fuel burn**; **TRL 4 to TRL 6****Advanced Composites**

Damage Arresting Composite Demonstration

Demonstrate low-weight, damage tolerant stitched composite structural concept and assess its **weight and drag reduction** benefits; mature stitched unitized composite structures from **TRL 4 to TRL 5**; demonstrate multi-bay box handles FAA-required pressure load and supports design ultimate load

Adaptive Compliant Trailing Edge (ACTE) Flight Experiment

Demonstrate the ACTE technology in the flight environment; compliant flap technology from **TRL 5 to TRL 6**; design tools match flight data strains to within 10%; demonstrate ACTE deflections for cruise flap application & gust load alleviation application**Advanced Engine Design**

Second Generation Ultra-High By-Pass (UHB) Propulsor Integration

Demonstrate **fuel burn** (9% thrust specific fuel consumption-TSFC) and noise potential (15 effective perceived noise decibel reduction-EPNdB); advance and measure **noise reduction** for Over-The-Rotor / Soft-Vane (OTR/SV) noise treatments from **TRL 3 to TRL 5**; demonstrate integrated GTF propulsor design at TRL 5; and other reduction requirements.

Highly Loaded Front Block Compressor

Demonstrate front block compressor technologies to enable high pressure ratio (28:1) core compressors for a 2-3% **reduction in SFC (specific fuel consumption)**, including other pressure ratio, efficiency, and stall margin requirements; **TRL 4 to TRL 5****Advanced Combustor Designs**

Low NOx Fuel Flexible Combustor Integration

Demonstrate emissions goals 75% Landing-Take-Off (LTO) and 70% cruise Nitrogen-Oxide (Nox) **reduction**, including performance, operability, and durability of fuel flexible combustors; **TRL 3 to TRL 4**; including other hours of operation, inlet temperature, inlet pressure, and flame temperature requirements; advance full annular combustor from **TRL 4 to TRL 5****Airframe and Engine Integration Concepts**

UHB Integration for Hybrid Wing Body (HWB)

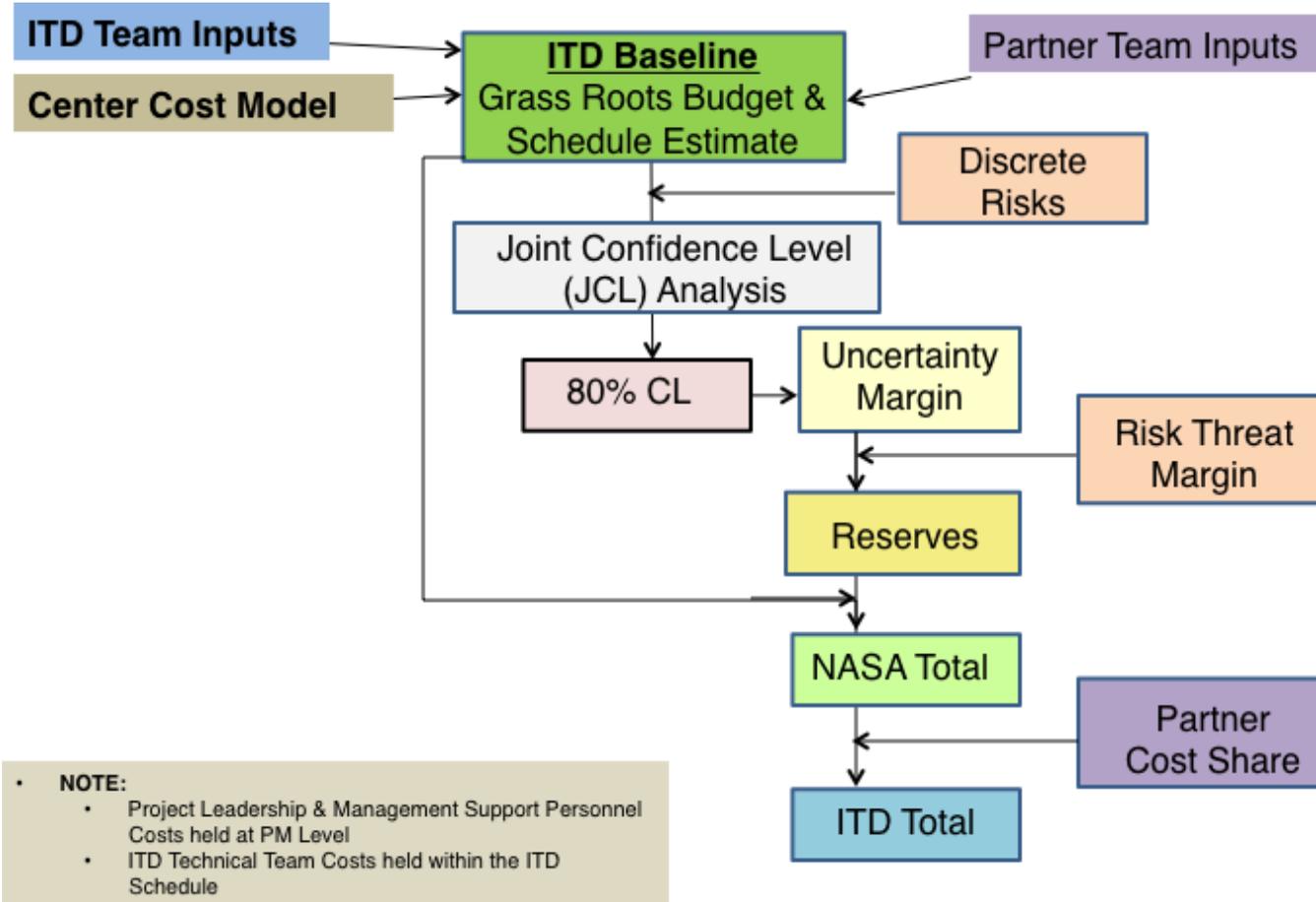
Demonstrate HWB PAI design concept and enable **fuel burn reductions** in excess of 50% (1% drag penalty) and providing noise shielding required to meet ERA noise reduction metrics; **TRL from 2 to 4** for inlet operability; **TRL from 3 to 5** for installed performance; and other inlet operation requirements

Flap Edge and Landing Gear Noise Reduction Flight Experiment

Mitigate radiated airframe noise during aircraft landing applicable to current and future generations of civil transports and advance **TRL 3 to TRL 6**; reduce overhead noise during flyover; and meet other associated weight and fuel penalty



Development of Risk-Informed Cost & Schedule



- Enabled cost-loading of schedule tasks and discrete risk events
- Addressed costs based on time behavior (i.e. marching army)
- Allocated discrete risk impacts, cost and schedule probability distributions in an integrated schedule
- Created a holistic view of the resultant risk analysis
- Guidance to the PM for the determination of ITD Reserves
- Informed the confidence of the grass roots estimate & integrated, risk- & resource- loaded schedule



ITD Risk-Informed Cost Basis of Estimate



- **Grass Roots Estimate (based on Center-based Cost Model Results)**
 - Allocated at major tasks within the ITD Schedule
 - Adjusted for inflation
 - Discretionary procurement include:
 - NASA's 'cost share' procurements to Partner
 - Costs based on Phase 1 contract costs and SME experience/estimate
 - Upon Partner contract award, costs data updated into ITD budget baseline through PP&C CR process
 - Facility/Service Pool and Fabrication estimated pricing reports as appropriate
- **Risk-Informed Cost modeled at the task level**
 - Cost Uncertainty Allocation
 - Uncertainty on Labor Rates entered as +/-10% to account for composite rates and a mix of personnel skill levels
 - Uncertainty on Fixed Costs entered as triangular distribution on Most likely, Best case, Worst Case
 - Discrete Risk Cost Impact Allocation
 - Probability and Cost
- **Project Leadership & Management Support Costs held at PM Level**
- **ITD Technical Team Costs held within the ITD Schedule**



ITD Risk-Informed Schedule Basis of Estimate



- **Detailed Schedule**

- Task Durations allocated for all tasks within the ITD Integrated Schedule
 - Phase 1 Project Experience
 - SME experience
- Upon Space Act Agreement signature and/or Partner contract award, Partner schedule updated in ITD baseline schedule through PP&C CR process
 - Initial Partner schedule inputs based on dialogue/RFI responses

- **ITD Risk-Informed Schedule Components**

- Detailed Schedule
 - WBS: Level 3 and 4 Tasks (during detail planning)
 - WBS Refinement of ITD Schedule to at least Level 6 developed prior to ITD IBR
- Risk-Informed Schedule modeled at the task level
 - Schedule Duration Allocation
 - Discrete Risk Schedule Impact Allocation



ITD Risk Categories and Dispositions



Risk Type	ITD Risk Disposition	Action
Discrete	<ul style="list-style-type: none">Managed within the ITD Baseline ScheduleCost impact is the uncertainty margin component of the ITD Reserve held at the PM Level	<ul style="list-style-type: none">Probability and impact is modeled and added to the Task Uncertainty Margin to calculate JCL schedule and budget
		<ul style="list-style-type: none">Potential Impact is already included in the Uncertainty Margin of the affected TaskNo additional action required
Risk Threat	<ul style="list-style-type: none">Managed outside the ITD Baseline ScheduleManaged during EXECUTION as part of ERA Risk Management Process	<ul style="list-style-type: none">Potential schedule and cost impact is mitigated at the ITD levelPotential impact held as a risk threat<ul style="list-style-type: none">Cost impact is the risk threat margin component of the ITD Reserve held at the Project PM level

- All identified risks are included and tracked in the **ERA Project Risk Database**
 - Top 5 ITD risks to be managed at the ERA Project Level
 - Remainder to be managed at the ITD Level



ITD Reserve Determination

Guidance

Uncertainty Margin (Cost and Schedule)

+

Risk Threat Margin (Cost and Schedule)

+

KDP-2 Guideline of 15% of ITD Cost as Reserve

Judgment

PM = ITD
Reserve

- Used as guidance the JCL-derived **risk-informed schedule completion date at 80% CL**
- Assessed risk threat mitigation cost and schedule margins
- **Uncertainty Margin** derived from JCL Analysis of ITD budget and schedule
 - ERA Project selected the 80% JCL ITD schedule completion date to determine the associated ITD cost
 - The delta between the cost at the 80% JCL ITD schedule completion date and the baseline cost determined the ITD uncertainty cost margin.
 - The delta between the 80% JCL ITD schedule completion date and the baseline schedule date determined the ITD schedule margin
- **Risk Threat Margin** based on ITD discrete risks to be managed during execution
- ITD Baseline Budget and Schedule does **NOT** include the ITD Reserve



ITD De-scope and Termination Processes



De-scope Initiating Event

- It is determined that the ITD cannot meet the Full Success Criteria within schedule deadline *and/or* given budget

Next Steps

- Convene Decision Gate Review with Implementing Centers and ISRP
 - Evaluate and execute identified de-scope options that ensure ITD minimum success criteria

Termination Initiating Event

- It is determined that the ITD cannot meet the Minimum Success Criteria within the schedule deadline *and/or* the given budget
 - Example Causes: Poor project/partner performance, plan exceeds budget & margins, facility failure, loss of key people

Next Steps

- Coordinate with Implementing Centers, ISRP, and ARMD to terminate the ITD
 - Terminate existing contracts as appropriate
 - Use remaining FTE commitment to close down the ITD, working toward a logical conclusion where possible
 - Document results
- Deploy remaining funds to reserves, remaining ITDs or system studies
 - Examine non-selected ITDs



ERA PP&C Processes for Phase 2



- **Implementation Timeline (began in Phase 1)**
 - Formal Risk Management: **Jan 2011**, RMB: March/2011- Present (MRB)
 - Configuration and Data Management: **Nov 2010**, CCB: June/2011- Present (MRB)
 - Schedule Management: **Feb 2010**, CCB: June/2010- Present (MRB)
 - Financial Management via Execution Memos (FY10-3QFY11)
 - Management Review Board (MRB): **Jan 2012** – Present
- **ITD Baseline will only change in the event of a de-scope or termination action being implemented.**
- **Slips from the baseline in cost or schedule will be tracked as a revision**
 - If a slip in a Level 1 or Level 2 Milestone Date occurs, reporting will include:
 - Baseline Completion Date and Planned Completion Date
- **Providing evidence that the Level 1/2 exit criteria and deliverables has been met will define the Actual Completion Date.**
- **As part of the Change Request (CR) process to the Host Center, the Project will coordinate and gain consensus with appropriate Implementing Center representative for approved changes.**



IBR Compliance Matrix- Project & ITD Controlled Documentation (1 of 2)



IBR Entrance Criteria		Referenced Document		NX Location	
Organization Breakdown Structure (OBS)		ITD OBS document		Secure NX folder	
Implementation Details	Technical Management and Roadmap	ITD IBR Briefing Package	Management by Technical Challenges Chart	Secure NX folder	
			TRL Maturation Roadmap Chart	Secure NX folder	
	Driving Requirements	ITD IBR Briefing Package	Driving Requirements Chart	Secure NX folder	
			Projects Requirements Database		Document link in Secure NX folder
			ITD Objectives Requirements Document		Document link in Secure NX folder
	Major SOWs and agreements developed	ITD IBR Briefing Package	Acquisition Status Chart	Secure NX folder	
			SAA and Contract SOWs drafts		Secure NX folder
	NASA/Partner Roles and Responsibilities	ITD IBR Briefing Package	Driving Requirements Chart	Secure NX folder	
ITD Space Act Agreements and Contract SOWs			Secure NX folder		
Risk Informed Budget		ITD Project Grass Roots Budget		Document link in Secure NX folder	
		Center-based Cost-Model Budget		Secure NX folder	
		ITD IBR Briefing Package	Risk-Informed Resource-loaded Schedule GANTT Chart	Secure NX folder	
Risk Informed Schedule With Level 2 Milestones (include exit criteria and deliverables)		ITD Project Grass Roots Schedule		Document link in Secure NX folder	
		ITD IBR Briefing Package	ITD Level 1 and 2 Milestones with Exit Criteria and Deliverables Table		Secure NX folder
			Risk-informed Schedule GANTT Chart with Level 1 and 2 Milestones		Secure NX folder



IBR Compliance Matrix-

Project & ITD Controlled Documentation (2 of 2)



IBR Entrance Criteria		Referenced Document		NX Location
Reserve		ITD Programmatic Analysis		Document link in Secure NX folder
		Project Risk Threat Analysis		Document link in Secure NX folder
		ITD IBR Briefing Package	Cost Summary Chart with PM Reserve (Uncertainty + Risk Threat)	Secure NX folder
Risk Management Plan	Risk Identification and Assessments	ITD Risk Registry		Document link in Secure NX folder
		Project Risk Database		Document link in Secure NX folder
		ITD IBR Briefing Package	Top 5 ITD Risk Scorecard Chart	Secure NX folder
	Top 5 ITD Risk Focus Charts		Secure NX folder	
	Descope Options	ITD IBR Briefing Package	Descope Options Chart	Secure NX folder
Termination Plan	IBR Kick-off Presentation	Descope and Termination Process Chart	Secure NX folder	
Work Breakdown Structure (WBS)		ITD SE&I Document Chart		Document link in Secure NX folder
Description of ERA Management Process	Performance Reporting (internal cost/schedule reports)	IBR Kick-off Presentation		Secure NX folder
		Project Schedule Management Plan		Document link in Secure NX folder
		Project Budget Management Plan		Document link in Secure NX folder
		Project Risk Management Plan		Document link in Secure NX folder
	Change Management		Project Data Management Plan	Document link in Secure NX folder
		Project Configuration Management Plan		Document link in Secure NX folder
Project Dictionary		ITD-specific Dictionary Chart		Secure NX folder