Systems Engineering: Risk Management Part II

CSULA – ECST Department

EE 4130

Prof. Joel K. Harris

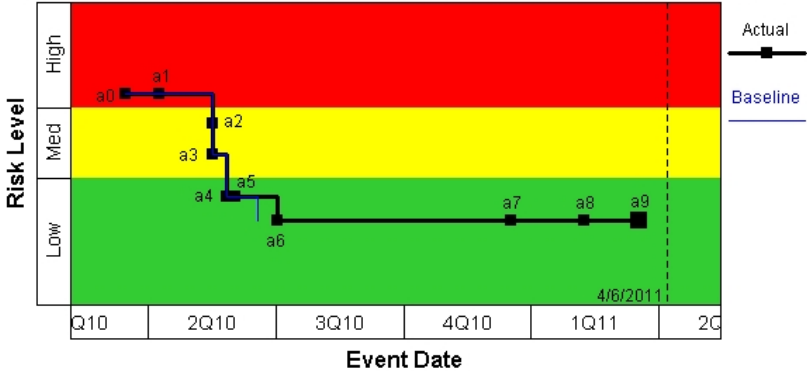2 April 2018

Reviewing From Last Lecture

An *issue* has already occurred - a *risk* <u>may</u> occur in the future….

Risk Management Steps - ∅ Three: Risk Handling/Planning (2 of 2)

Risk 67: Retrofit of Thrust Frame Spherical Bearings on 3-Flight (HUG NROL-15) Engines

Risk Burndown Chart (aka "Waterfall Chart")

#	Event Title	Event Owner	Date	Risk
0	Risk Identified	Fabry, John M	3/15/2010	H 5-3
1	1 GPS IIF-1 loads determination/comparison to SWP bearing rating	Fabry, John M	4/9/2010	H 5-3
2	NROL-32/ NROL-49 Heavy vehicles - loads determination/comparison to SWP rating	Fabry, John M	5/17/2010	M 4-3
3	Estimated NROL-15 flight strut loads (based on Up-Scale of NROL-32/NROL-49 CML runs)	Fabry, John M	5/17/2010	M 3-3
4	GPS IIF-1 Flight Strain Data on Two Struts	Fabry, John M	5/27/2010	L 2-3
5	Structural test of NHBB bearing	Fabry, John M	6/2/2010	L 2-3
6	NROL-15 Strut Loads From ULA	Fabry, John M	7/2/2010	L 1-3
7	NROL-15 Cyclic Loads From ULA	Fabry, John M	12/17/2010	L 1-3
8	NROL-15 PWR HCF Analysis	Fabry, John M	2/8/2011	L 1-3
9	NROL-15 loads waiver	Fabry, John M	3/17/2011	L 1-3

Risk Mitigation Event Table

Source: PWR IPPD *Control* tool, EPP Risk*Control* database

3

Risk Management Steps - ∅ Four: Risk Control/Monitoring (1 of 2)

- Risk monitoring is <u>continuous</u>, <u>consistent</u>, and <u>progressive</u>
- Each risk mitigation event is tracked until its closure
- Wherever possible, objective evidence of event closure is provided
- The overall project/program risk profile is provided to our customer on a regular basis by means of a risk report (see next chart)

Risk 67 - Event 9

General Event Information					
Event #	9		Planned	True	Fallback	False
Event Title	NROL-15 loads waiver				
Event Description	Generate Waiver to SCD				
Event Owner		IMP/IMS			
Event Status	Waiver to include extracted strut loads from ULA and associated peak load safety factors, and cyclic loads from ULA and associated fatigue safety factors				
Closure Criteria	USE-AS-IS waiver disposition with associated rationale.				
RS-68A Event Unique ID					
IPT or Program Level Risk?					
Mitigation Strategy to be Used					
Closed By	Harris, Joel K	Date Closed	3/18/2011		
Closure Justification	Waiver has been signed by the customer for NROL - 15.				

Risk Assessment	
	Actual Assessment
Actual Date	3/17/2011
Likelihood	1
Consequences	
Technical	3
Schedule	3
Cost	3
Risk Level	L 1-3

Risk Management Steps - ∅ Four: Risk Control/Monitoring (2 of 2)

Pratt & Whitney Rocketdyne, Inc.

6633 Canoga Avenue
P.O. Box 7922
Canoga Park, CA 91309-7922

Pratt & Whitney
A United Technologies Company

March 10, 2011
In reply refer to 2011RC00603

United Launch Alliance, LLC
Attn: Delta Supplier Data Management, M/S F1998
12257 S. Wadsworth Blvd.
Littleton, CO 80125

Subject: P.C. 7EC2533, RS-68A UPGRADES PHASE III and IV
            SDRL A001

Dear Sir or Madam:

We are transmitting the enclosure in accordance with the subject contract for your
information and retention.

Sincerely,

Theresa Solis

Theresa Solis
Configuration and Data Management

Encl: RD08-117-37 – Risk Reduction Effort Monthly Report, February 2011

RD08-117-37

Pratt & Whitney
A United Technologies Company

Rocketdyne Propulsion & Power
6633 Canoga Avenue - PO Box 7922
Canoga Park, CA 91309-7922

RS-68A Engine Risk Reduction Effort
Monthly Report for February 2011

Delta IV Heavy RS-68A Upgrade – Phase III and IV
Contract No. NRO-000-07-C-290
PWR 7EC2533
SDRL A001

PREPARED BY
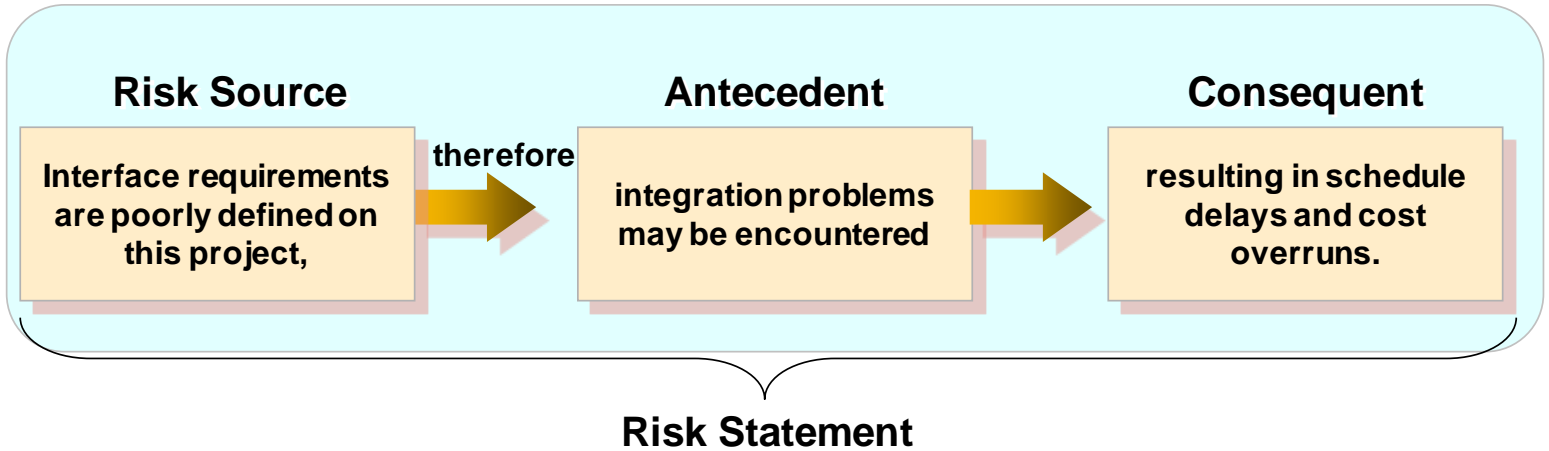
Joel K. Harris
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Program Manager
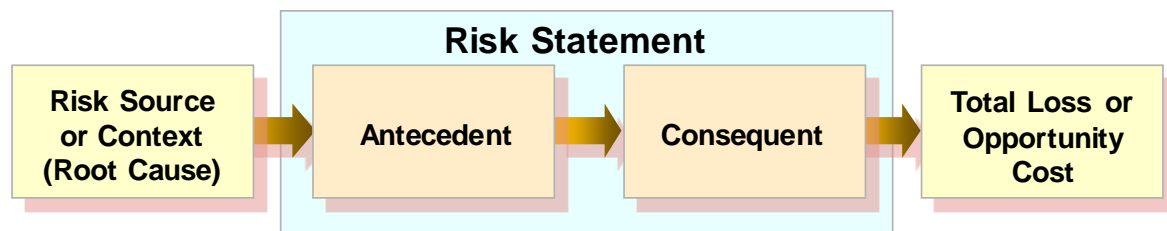
Submitted: March 10, 2011

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Risk Statement Characteristics

A risk must be clearly stated before it can be effectively managed

Risk Source

Interface requirements are poorly defined on this project,

therefore

Antecedent

integration problems may be encountered

Consequent

resulting in schedule delays and cost overruns.

Risk Statement

- A good risk statement <u>usually has only one antecedent</u>, but may have <u>one or more consequents</u>

Risk Statement

| Risk Source or Context (Root Cause) | Antecedent | Consequent | Total Loss or Opportunity Cost |

- **<u>Antecedent</u>**: a single phrase briefly <u>describing a current key circumstance or situation</u> that is causing concern, doubt, anxiety, or uncertainty

- **<u>Consequent:</u>** a single phrase or sentence that describes the key, <u>undesirable outcome</u> or outcomes of the current condition

- **<u>Risk Source or Context:</u>** provides additional information about the risk, such as contributing factors and related issues beyond the risk condition

- **<u>Total Loss or Opportunity Cost:</u>** the ultimate loss or the opportunity cost resulting from the risk consequence

Questions to Ask to Validate Attributes and Clarity of Risk Statements

- Is the risk statement clear and concise?

- Will most project members understand it?

- Is there a clear condition or source of concern?

- Is there a clearly stated consequent?

- Is there only one condition followed by one (or more) consequents?

Are these *good* or *bad* Risk Statements?

❌ 1. "The hardware test failed"

❌ 2. "There is a hardware test risk"

❌ 3. "The current hardware test plan is not defined"

✅ 4. "*Given that* there is a lack of a thorough hardware test plan, *there is a possibility that* untested environmental conditions may result in mission failure."

Risk Statement Example 1

- What Makes Up a Risk Statement?
  - ➢ Must be a **FACT** or perceived to be FACT
  - ➢ Must be **REALITY BASED**
  - ➢ Can have NO ambiguity attached
- Example:
- *"Given that the Main Injector redesign will reduce outer row mixture ratio and increase fuel injector resistance, there is a possibility that the fuel repress temperature may be below minimum, and the pressure at EPL may be above maximum requirements of the SCD."*
- (condition) - (consequent)
- Risk context or supporting information can be provided in another area

*A good risk statement must be **ACTIONABLE** and have **ONE** condition and **ONE or More** consequences per statement*

Risk Statement Example 2

- What Makes Up a Risk Statement?
  - ➢ Must be a **FACT** or perceived to be FACT
  - ➢ Must be **REALITY BASED**
  - ➢ Can have NO ambiguity attached
- Example:
  - ➢ *"Given that there is uncertainty in Howmet's ability to support RS-68A casting development and delivery requirements, there is a possibility that the hardware will not be available when needed."*
- (antecedent) - (consequent)
- Risk context or supporting information can be provided in another area

*A good risk statement must be **ACTIONABLE** and have **ONE** condition and **ONE or More** consequents per statement*

In Class Risk Statement Individual Exercise

- Create a risk statement for the following threat to a system being developed:
  - ....

The Risk Management Plan

- <u>Risk Management Plan</u>
- Program Management (PM) should establish the basic approach and working structure it will use, and document that approach in a Risk Management Plan (RMP)
- An example RMP format summary may include:

  - ➢ Introduction
  - ➢ Program Summary
  - ➢ Risk Management Strategy and Process
  - ➢ Responsible/Executing Organization
  - ➢ Risk Management Process and Procedures
  - ➢ Risk Identification
  - ➢ Risk Assessment
  - ➢ Risk Handling Methodologies
  - ➢ Risk Planning/Mitigation Process
  - ➢ Risk Control/Monitoring Method

RD08-152

Pratt & Whitney
A United Technologies Company

RS-68

RS-68A Three Flight Engine Program Risk Management Plan

June 23, 2008

Prepared By:

_____
J. Harris, Systems Engineer
RS-68A Three Flight Engine SEIT

Approved By:

S. Bennett, RS-68A Three Flight Engine   J. Tibble, RS-68A Three Flight Engine
SEIT IPT Lead   Project Manager

R. Berenson, RS-68A Three Flight Engine   R. Brazier – RS68A Three Flight Engine
Chief Engineer   Production Manager

Schedule Risks: A Challenging Dimension of Risk Management

- Of the 3 dimensions of any risk item's consequences (technical, cost, or schedule), schedule-leading risks are by far THE most vexing/difficult to manage…

- Why is this??
  - ➢ Perception that schedule risks <u>cannot be controlled</u>
  - ➢ There is <u>no risk mitigation plan</u> that will reduce them
  - ➢ Schedule risks are <u>unpredictable/unstable</u> and as such, are nearly impossible to analyze

- The major reason for the above beliefs: how we *perceive* and *contend with* program schedules…

14

An Example of a "Mitigated" Schedule Risk (1 of 2)

Closed Risk #47

Risk Summary			
Risk #	47	Reference Code	
Team	Turbomachinery	Current Risk Level	L 2-2
Risk Owner		Risk State	Closed: Mitigated
General Risk Information			
Risk Title	Behind Schedule 30003-5 FTP Shaft Assemblies		
Risk Statement	Given the behind schedule status of 30003-5 FTP Shaft Assemblies, there is a possibility of not completing 30003-5 FTP assemblies on-time which may impact program cost and schedule.		
Context			
Closure Criteria	Completion of 3 Flight Engine FTP Shaft Assemblies		
Closure Justification	The final payback shaft was completed on 6/25/10, thus completing the "payback" portion of this risk reduction plan. The risk has now been successfully mitigated and shall now be closed.		
Category	*General		
IMP/IMS (Int. Schd.)		WBS	
Other Reference			
Requirement	Path: Requirement:		
RS-68A Risk ID			
Comments			

An Example of a "Mitigated" Schedule Risk (2 of 2)

Risk Event Summary			
		Actual	
#	Event Title	Date	Risk
0	Risk Identified	1/18/2009	M 3-4
1	Perform Cost/Benefit Analysis for Expedited Schedule	3/10/2009	M 3-4
2	Request Borrow/Payback from Lot 1 Production	4/15/2009	M 3-4
3	Receive Borrow/Payback Approval	4/30/2009	L 2-2
4	Transfer 30003 Shaft	4/30/2009	L 2-2
5	Transfer 30004 Shaft	4/30/2009	L 2-2
6	Transfer 30005 Shaft	4/30/2009	L 2-2
7	Monthly Update of Weekly Telecon to Ensure Key Milestone is Met	4/30/2009	L 2-2
8	Monthly Update of Weekly Telecon to Ensure Key Milestone is Met	5/30/2009	L 2-2
9	Monthly Update of Weekly Telecon to Ensure Key Milestone is Met	6/30/2009	L 2-2
10	Monthly Update of Weekly Telecon to Ensure Key Milestone is Met	7/30/2009	L 2-2
11	Receive 20040 Payback Shaft	8/5/2009	L 2-2
12	Receive 20041 Payback Shaft	8/5/2009	L 2-2
13	Receive 20042 Payback Shaft	8/5/2009	L 2-2
14	Coordinate w/SFC to Expedite 30003-5 Shafts	8/15/2009	L 2-2
15	Monthly Update of Weekly Telecon to Ensure Key Milestone is Met	8/30/2009	L 2-2
16	Complete 20040 Payback Shaft	2/10/2010	L 2-2
17	Complete 20041 Payback Shaft	3/9/2010	L 2-2
18	Complete 20042 Payback Shaft	8/4/2010	L 2-2

Schedule Risk: An Elementary Example

ID	Name	Duration	Start	Finish	Successors						
						Apr 3, '11			Apr 17, '11			May 1
						W	M	S	T	T	S	F
1	**Fabricate OTP Blisks**	**19.42 days**	**4/4/11**	**4/29/11**								
2	Forge Blisk Blanks	2 days	4/4/11	4/5/11	3							
3	Rough Machine Blisk Vanes	3.43 days	4/8/11	4/13/11	4							
4	Perform Surface Finish on Blisks	2 days	4/14/11	4/15/11	5							
5	Apply Silver Overcoat/Plating on Blisks	6.42 days	4/18/11	4/26/11	6							
6	Remove Blisters/Overplating/Rough Edges on Blisks	2 days	4/26/11	4/28/11	7							
7	**Send Blisks to Pump Assembly Room for Integration into OT**	**1 day**	**4/28/11**	**4/29/11**								
8	Add Blisks to engine kits	1 day	4/28/11	4/29/11								

Risk Reference Sources

- *"Risk Management Guide for DoD Acquisition" – 5th Edition, June 2003 - DAU website (www.acc.dau.mil)*
- *"INCOSE Systems Engineering Handbook" – V 3.1, August 2007*
- *"Program Management Book of Knowledge (PMBoK)" – 3rd Edition – 2004.*
- *"Effective Risk Management: Some Keys to Success", by E. Conrow, 2nd Edition, (AIAA)*
- NASA Risk Management portal/website (*www.hq.nasa.gov/office/codeq/risk/index.htm*)

....Th-th-that's All Folks!!

Questions??