Risk Management: Pro-active Principles for Project Success

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What is a Risk

According to the Defense Acquisition University:

"Risk is a measure of the <u>potential</u> inability to achieve overall program objectives within defined cost, schedule and technical constraints"

ISO Defines Risk as the:

- "***combination of the probability of an event and its consequence"***

What is a Risk

In other words:

- Risk is anything that ***could*** cause a negative cost, schedule, or performance impact
  - Must have a probability of ***less than* 100%;** anything with a probability of 100% isn't a risk, it's an issue or a problem.

Identifying Risks provides an opportunity to avoid negative impacts

Risk Vocabulary

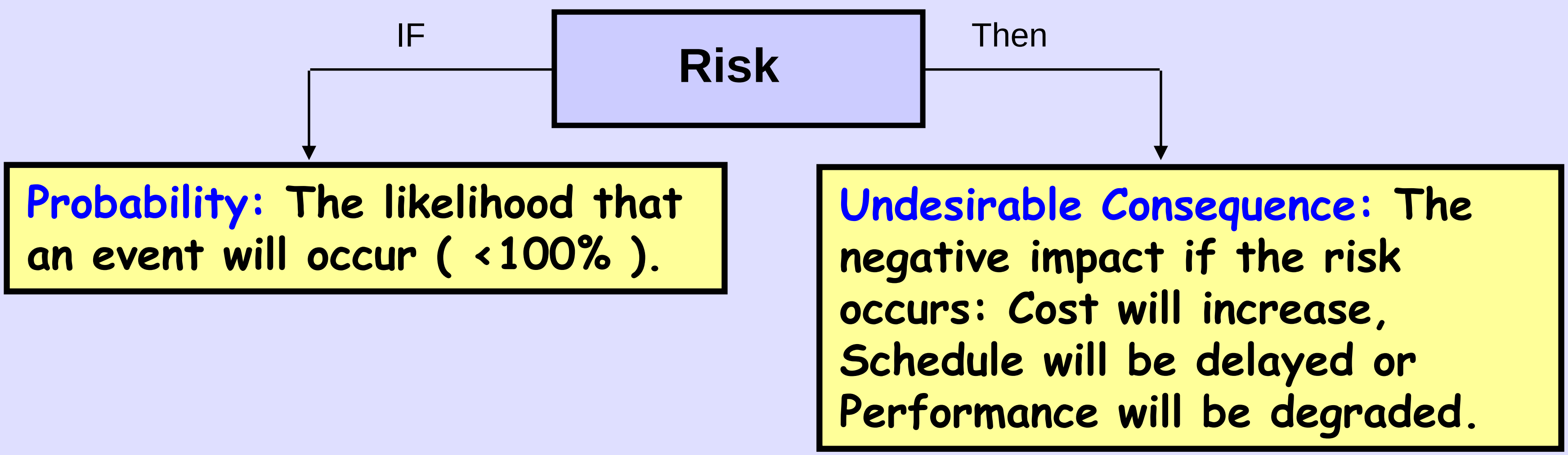
- Risks
- Problems
- Worries

Risk Vocabulary

Risk is …the *Possibility* Of Suffering A *Loss,* the uncertainty of attaining a future goal – it hasn't happened yet.

Every Risk has Two Elements

- **Probability:** the chance that an event will occur. If it's a sure thing, then it's a problem (not a risk)
- **Consequence:** A negative impact on Cost, Schedule, Performance or a combination of all three…"then"



What RISK is NOT…

- A **Problem** is a negative consequence with a certain, or almost certain probability of occurrence. It is not a risk
  - Problems need to be dealt with via corrective action but not as part of Risk Management.
    - They can not be Mitigated or Avoided
- **Worries** are small scale, routine, day-to-day uncertainties that your normal processes should account for (e.g.; equipment calibration and maintenance cycles or System upgrades)
  - Worries are Not considered risks
  - ‘Standard operating procedure’ usually handles

Risks can be avoided – Problems can’t

What is Risk Management?

- A proactive, customer-focused approach to <u>manage uncertainty</u>
- Risk Management is a continuous, closed loop process that captures new risks as they emerge, tracks the status of already identified risks, retires risks through successful actions, or realizes risks through unsuccessful actions

Risk Management is a systematic process to ID, assess & manage risks

Why Use Risk Management?

Companies can't afford to fail

- **"S*#! happens**": Projects often fail because of unexpected or unmitigated risks….the 'known unknown'
  - The results of an Aberdeen Group study showed that manufacturers without best-in-class risk management procedures were twice as likely to suffer a major impact.
    Industry Week, Blanchard, Feb 2009
- Failure to manage risks usually leads to:
  - Budget Impacts - increased cost,
  - Schedule Impacts - delays,
  - Performance Impacts - defects
  - Career & Business Impacts - unhappy management and customers.
- Risk Management contributes to project success
  - Proactive not Reactive - An ounce of prevention is worth a pound of cure
    - ID what could happen & you can try to avoid rather than 'brace for impact'
    - No one is blindsided

Properly managed, risks can be controlled

Why Use Risk Management ?

Successful businesses spend $ on activities that produce results.

- Risk Management helps optimize resource utilization
  - Identifies what could go wrong
  - Assesses Probability & negative Consequence of it occurring
  - Develops potential mitigation, its cost, and potential to reduce the risk
  - Allows comparison:
    - Mitigation vs. Wait and See
    - Allocating resources to one risk vs. another
- Successful Mitigation plans minimize cost, schedule & performance problems

Risk Management supports knowledge based decision making

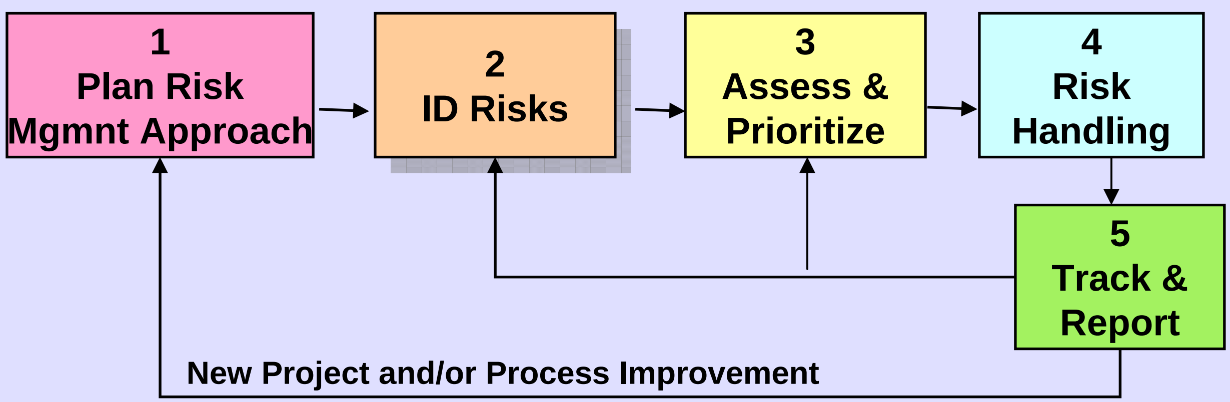
The Risk Management Process

- We’ll go thru the basic approach & concepts and then follow this up with a case study concerning reliability and the application of risk management

The Risk Management Process

- 5 steps - derived from a process developed by the Defense Acquisition University, and other sources such as Carnegie Mellon's Software Engineering Institute and the Open Systems Initiative.

- Process Steps
  1. Plan
  2. Identify Risks
  3. Assess and Prioritize Risks
  4. Develop and Implement Risk Handling Approaches
  5. Track and Report



Risk Management is an ongoing process, not an event

Step 1 – The Risk Management Plan

The ‘blueprint’

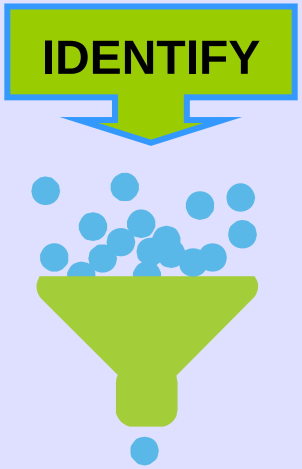
- Defines the structured, disciplined process: the who, what, how and when that is required to identify and manage risk
    - Responsibilities and Stakeholders
    - Oversight and Reporting requirements
    - Selected Tools
    - Parameters for risk categorization
    - Thresholds that trigger mitigation activity
- Standardized scales for Probability & Consequence assessment
    - May tailor for Projects
    - Consistently apply across entire project for the duration
- Does **<u>not</u>** identify the risks

Plan Provides the Framework. NOT the risks

Step 2: Risk Identification

What are all the risks to the project or program

- Cost? Schedule? Requirements? Suppliers? etc
- Techniques for Risk ID can include:
  - Brainstorming
  - Expert interviews, Lessons Learned
  - Failure Modes and Effects Analyses (FMEAs)
  - Staffing Evaluations
  - Review Requirements
    - Are there any TBDs?
    - Are any requirements inadequately defined?
    - Are any requirements very difficult to meet?



- Filter out the Problems and the Noise

- Assign a Risk Owner
  - Ownership is based on who can most likely effect a positive outcome, not by who is most affected by the consequences

Make Risk ID an ongoing practice, not an event

Step 2: Risk Identification

Develop a Risk Statement for each

- **A Good Statement…**
  - Is **concise** and **quantitative**
  - Captures the **consequence** in the statement
  - Uses an **if…then** format
    - IF (conditional probability)
    - THEN (consequence)

Step 3 - Risk Assessment and Prioritization

Assess each risk:
What's the Probability (P_f) & Consequence (C_f) of each?

- Standardize Measure of Probability (P_f) & Consequence (C_f):
  - Should be defined in the Risk Management Plan
  - Specific Categories for Pf and Cf
  - Ensures Risks are normalized (a high risk is a high risk is a high risk)

- P_f and Cf can be Qualitative (Hi/Med/Low) or Quantitative
  - Quantifying Consequence is preferable
    - Puts ceiling on mitigation spending
    - Generates more proactive response to risk

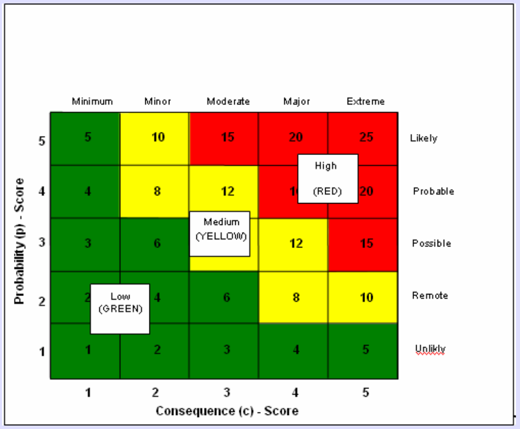
Step 3 - Risk Assessment and Prioritization

Prioritize: Which pose the greatest threat to the project?

- The Risk Factor (R_f) is an evaluation of a Risk's probability of occurring and the severity of consequence to determine its overall seriousness

$$(P_f \times C_f) = R_f$$

- Prioritizing = Ranking all risks by Risk Factor
- Get consensus of assessment from all stakeholders
  - Apply reality check
- Reassess periodically or when conditions change
  - Are your actions producing the expected results?



Step 4 - Risk Handling

Five Approaches

- **Avoidance:** Adopt a baseline that doesn't allow the risk to occur.
  - Ex: Changing requirements while still meeting end product needs.
- **Transfer:** Require a 3rd party, (supplier, subcontractor, etc) to share the consequence if the risk is realized.
  - Ex: Reallocating requirements to a party that has more control over the risk area
  - May be implemented via contract penalties/incentives, insurance policies, etc
- **Assumption:** Risk is acknowledged and accepted, but no actions are taken.
  - E.g.; Cost to mitigate > impact value; have no control over the risk, strategy for a low risk.
  - Resources may be set aside in reserve to absorb the impact of the risk should it occur
- **Contingency Planning*:*** Identify activities to invoke if the risk is realized. ID Contingencies when there's insufficient confidence in the mitigation activities, or when there are no viable activities that could reduce or control a risk
- **Mitigation:** Define & Implement actions to control/minimize risk.
  - The most proactive means of handling risks

Step 4 - Risk Handling

Elements of a good mitigation plan :

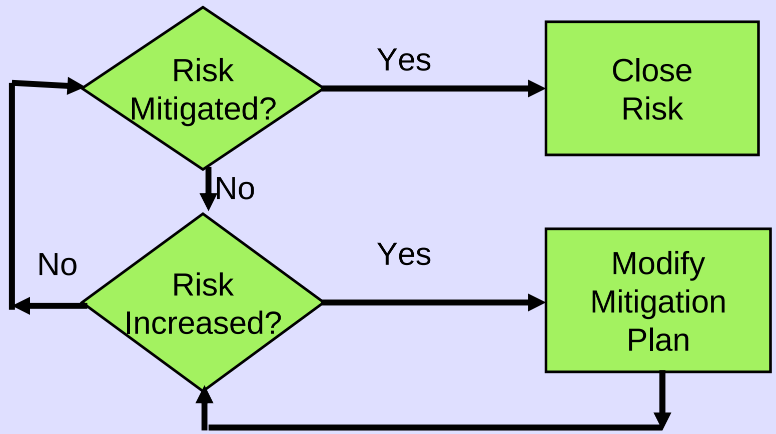
- **Action oriented**
  - Mitigation steps address the root cause & reduce the R_f
  - "Monitor' is <u>not</u> Mitigation
- **Cost Benefit from mitigation > cost to mitigate**
- **Has Start and End dates for each step**
- **Ownership & Resources**
- **Success criteria (How much is 'enough')**
  - Defines the expected outcome for <u>successful</u> completion of the step
  - Not always required to mitigate risk probability to zero

Preventive not Corrective

Step 5 – Track and Report

- Risks and mitigation should be tracked & reported regularly
  - Make it a habit not an event
  - Enforce Accountability and Visibility
    - Regular reviews of risks with key stakeholders
    - Risks periodically reviewed by management

- How are planned actions proceeding
  - Was the Risk Mitigated ?
  - Has the Risk Increased?
    - Time to re-evaluate the plan of attack?
  - Any new risks ?



Case Study:

The XYZ Communications Module Upgrade

Case Study: The XYZ Communications Module Upgrade

- The XYZ company designs and manufactures a communication system consisting of a power supply, transmit and receive module, and a controller card. They typically build and then perform a formal acceptance test for their customer, which they have to pass in order to be able to sell off the lot. They update the design due to tech refreshes and obsolescence every few years.
- The design//build/test cycle was 18 months for the original design. The next two iterations had minor capability upgrades. The first took 15 months, the second 12 months.

Case Study (continued)

- Because XYZ had been consistently cutting down their cycle time, they agreed to a 12 month schedule for the newest iteration of the design, same as the last build. But there were some differences this time around.
  - New transistor technology in the transmit/receive circuitry to handle higher power requirements
  - Power Supply will stay the same, but will now be stressed at a higher level due to the increased power requirements
  - New vendor for the controller card, who claims that the controller firmware will interface with the Power Supply and Transmit/Receive Module, but this has not been tested

Case Study (continued)

- **Although warning signs were present that this was an aggressive schedule, no risks were formally identified and no plan was put in place to handle them. As it turned out:**
  - The new transistor technology was unable to meet specifications without extensive additional testing and modifications from the supplier
  - The power supply handled the increased power load, but the extra heat it dissipated resulted in changes in the mechanical layout of the system
  - The new Controller Card firmware had to be modified to work with the existing power supply and transmit/receive module
- All of these factors caused XYZ to enter the acceptance test over budget, behind schedule, and with a reduced degree of confidence they would pass the test
- **What could XYZ have done differently? And how could a robust Risk Management Program have helped them to avoid these problems?**

Step 2: Risk Identification

- Example from Case Study: New vendor for the controller card claims that the controller firmware will interface with the Power Supply and Transmit/Receive Module, but this has not been tested
- Example of a good risk statement: IF the firmware in the new controller card is unable to communicate with the Transmit/Receive Module and Power Supply, THEN modifications to the firmware or selecting new hardware will be required, causing an increase in budget and jeopardizing the current schedule.

***SPECIFIC* concern**

***SPECIFIC* consequence**

Step 3 - Risk Assessment and Prioritization

Example from case study: Perform a quantitative assessment of the risk that the firmware in the new controller card will communicate with the Transmit/Receive Module and Power Supply.

Step 3 - Risk Assessment and Prioritization

Probability of Occurrence (P_f)

Rating	Software	Testing	Technology	Hardware	Producibility
0.9	Theoretical S/W concepts beyond known practice. Development of new approach &/or language.	Theoretical technology, design or concepts beyond known testing processes, methods or practices.	Maximum theoretical technology; max or beyond known capability	Theoretical desi[illegible] research. Requi[illegible] breakthrough.	[illegible] ogy to
0.8	New complex S/W, new approach, new language. new unproven apps. Extremely large scale integration.	Theoretical technology, design or concepts requiring significant research in test methods, processes or practices.	Theoretical Technology requiring significant research.	New Theoretical [illegible] leading edge co[illegible] research require[illegible]	[illegible] cepts [illegible] cant R&D
0.7	All new S/W development; beyond experience base. Large integration of new or existing SW.	Technology approach has identified conceptual test methods but not verified or validated.	Newer technology; feasible by analogy; Concept untested or not verified.	All new complex [illegible] stringent rqmts [illegible] many new HW e[illegible]	[illegible] cesses [illegible] nt to [illegible]
0.6	Extensive changes in S/W development approach & application. Moderate integration of new or existing SW.	Technology approach has limited concept testing. Limited or no in house experience.	Newer technology; feasible by analogy, studies and/or concept verification.	New design to moderately improved existing design &/or major integration of many HW elements.	New manufacturing process to industry. Major investment to establish capability & develop experience.
0.5	Major modification of approach, conversion from similar SW, expanded to new application. Some Int Exp	New technology or similar designs have initial testing. Limited or no in house experience	New &/or adapted technology with feasibility studies and initial testing.	Major design[illegible] modification[illegible] of HW eleme[illegible]	[illegible] ing
0.4	Moderate modification & tailoring of existing SW but team was design agent with integration experience.	Similar designs & technology have been tested by other design agencies. Limited in house experience.	Proven technology and approach. Concept analysis and testing complete.	Redesign, m[illegible] Integration is[illegible] functional el[illegible]	[illegible] no
0.3	Slightly modified SW &/or combining of existing functions with minor integration. Team was design & Int. agent.	Limited testing done on new or existing components but experienced in test methods.	Proven technology and approach; previously validated.	Existing prov[illegible] or minor mo[illegible]	[illegible]
0.2	Some modification of existing S/W approach with minimal integration impacts. Team was design & Int. agent.	Sub systems &/or components are tested for current application or validated in similar applications.	Proven technology and approach. Used occasionally by a design agent	Existing prov[illegible] and/or minor usage variation.	[illegible] ed at least twice by design agent.
0.1	Minor revision and checkout of existing software. No impacts to integration tests.	System has been tested & validated in similar applications.	Proven technology and approach with significant design experience.	Functional H/W. Mods in form only. Minor usage variation.	Proven Manufacturing processes used occasionally by design agent.
	Use of existing, checked out SW. No additional test, validation or integration required.	System has been thoroughly tested & validated for current application.	Off-the-shelf hardware proven to operational environments	Functional hardware. Hardware will meet the form, fit, & functional rqmts. of the application	NDI off-the-shelf manufacturing processes which have been used often.

Pf (Software) = 0.4 (Moderate modification of existing SW)

Pf (Testing) = 0.3 (Limited testing done on new or existing components but experienced in test methods)

Step 3 - Risk Assessment and Prioritization

Potential Severity of Consequences (C_f)

Rating	Cost Impact: Program Threat	Cost Impact: Amount *	Schedule Impact: Program Slip	Schedule Impact: Amount *
1	Pro		Major prog. Milestones moved; Prog threate	> 9 months
0.9	Maj con	%	Major i contrac	ns
0.8	Affe Cost goal in jeopardy.	Unit > 8K$ or 20%	Critical Schedule jeopardized.	ns
0.7	Changes require revision w/cust.	NRE > 70K$ or 17.5% Unit > 7K$ or 17.5%	Intermediate milestones require revision w/cust.	> 6 months
0.6	Significant rebudgeting reqd.	NRE > 60K$ or 15% Unit > 6K$ or 15%	Significant program rescheduling required	> 5 months
0.5	Some rebudgeting required.	NRE > 50K$ or 12.5% Unit > 5K$ or 12.5%	Some program changes; critical path affected.	> 4 months
0.4	Changes within mgmt reserve.	NRE > 40K$ or 10% Unit > 4K$ or 10%	Internal milestones chgd. Schd slip w/alternatives	> 3 months
0.3	Minor within budgeted range	NRE > 30K$ or 7.5% Unit > 3K$ or 7.5%	Subsystem slip within IPT Requires workaround.	> 2 months
0.2	Budget reallocated within current plan.	NRE > 20K$ or 5% Unit > 2K$ or 5%	Minor changes to internal IPT milestones	> 1 month
0.1	Negligible cost increase	NRE > 10K$ or 2.5% Unit > 1K$ or 2.5%	Possible minor slip, noncritical path.	< 1 month

Cf (Cost) = 0.5 (Some re-budgeting required, estimate NRE cost at $50K)

Cf (Schedule) = 0.2 (Estimate 1 ½ month schedule impact)

* Values are for example only. Scale to fit individual program or project budget and schedule
NRE : Non-recurring Expense

Step 3 - Risk Assessment and Prioritization

- Example from case study: Perform a quantitative assessment of the risk that the firmware in the new controller card will communicate with the Transmit/Receive Module and Power Supply.
  - $P_f = 0.4$ (Highest of assessed P_f factors)
    - » P_f (Software) = 0.4 (Moderate modification of existing SW)
    - » P_f (Testing) = 0.3 (Limited testing done on new or existing components but experienced in test methods)
  - $C_f = 0.5$ (Highest of assessed C_f factors)
    - » C_f (Cost) = 0.5 (Some re-budgeting required, estimate NRE cost at $50K)
    - » C_f (Schedule) = 0.2 (Estimate 1 ½ month schedule impact)
  - $\mathbf{R_f} = P_f \times C_f = 0.4 \times 0.5 = \mathbf{0.2}$
- Get consensus of assessment from all stakeholders
- Document all rationale and assumptions

Step 4 - Risk Handling

– Example from case study: Options on handling the risk that the firmware in the new controller card will communicate with the Transmit/Receive Module and Power Supply.

Avoidance **Assumption** **Transfer** **Mitigation**

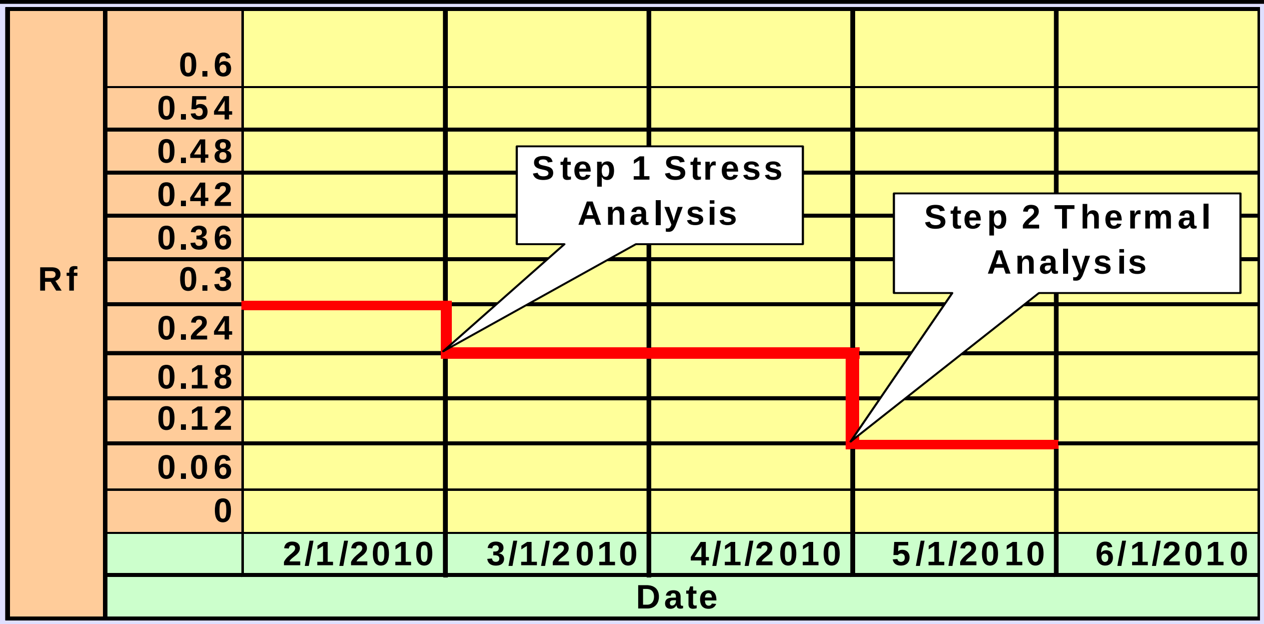
- Transfer Risk to Supplier
  - Supplier claims that modifications to firmware will be minimal and that they will not impact overall schedule
  - Get supplier to agree to a firm fixed price contract to perform the work, not based on hours required
  - Provide a fee structure based on delivery date, incentive for early delivery, penalty for late delivery

Step 4 - Risk Handling - Mitigate

- Example from case study: Use the option to "Mitigate" the risk that the increased power requirements for the Power Supply will cause a thermal issue for adjacent components.
- Mitigate by performing a thermal and stress analysis under the new load conditions prior to laying out the new module design
- Elements of a good mitigation plan
  - Risk Reduction
    - » Make sure each step (or group of related steps) reduces your P_f or C_f. Otherwise, why perform that step?
  - Cost Benefit
    - » The cost of performing the step must be worth the benefit gained by completing the step
  - Schedule Benefit
    - » Clearly identify the start and complete dates of each step
    - » Make sure they support the overall schedule
  - Clearly define success
    - » What are the expected results of the analysis that will show the step successfully lowers the risk

Step 4 - Risk Handling - Mitigate

STEP #		START	COMPL	DESCRIPTION	RESP. ENG.
1	DATE	2/1/2010	3/1/2010	Perform electrical stress analysis to verify that no components are stressed beyond their derating guidelines. Reduces Pf from 0.5 to 0.4	Joe Stress
	PF	0.5	0.4		
	CF	0.6	0.6		
	RF	0.3	0.24		
2	DATE	3/1/2010	5/1/2010	Perform thermal analysis to verify that case temperature of the power supply does not exceed 60 degrees C., so that module component re-layout will not be required. Reduces Pf from 0.4 to 0.2.	Joe Thermal
	PF	0.4	0.2		
	CF	0.6	0.6		
	RF	0.24	0.12		



Summary

- A Risk Has To Have Two Components
  - Probability Of Occurrence Less Than 100%
  - Negative Consequence (Cost, Schedule, Performance, Etc.)
- Risk Management vs. Crisis Management
  - Proactive vs. Reactive
  - Pay Me A Little Now Or A Lot Later
- Risk Management is a closed loop process
  - Plan, Identify, Assess, Handle, Track and Report
- Multiple Options To Handle Risk
  - Avoidance, Assumption, Transfer, Mitigation
- Be Part Of The Solution, Not Part Of The Problem
  - Identifying risks is everyone's responsibility
  - Don't be the "I knew that was going to be a problem" person after the risk becomes a problem!

Why Risk Management?

"Intellectuals solve problems;
Geniuses prevent them"

Albert Einstein

If Risk Managers help prevent potential problems from occurring; Then…

Risk Management = Genius !

Questions?