Minimizing Subjectivity in Risk Assessments

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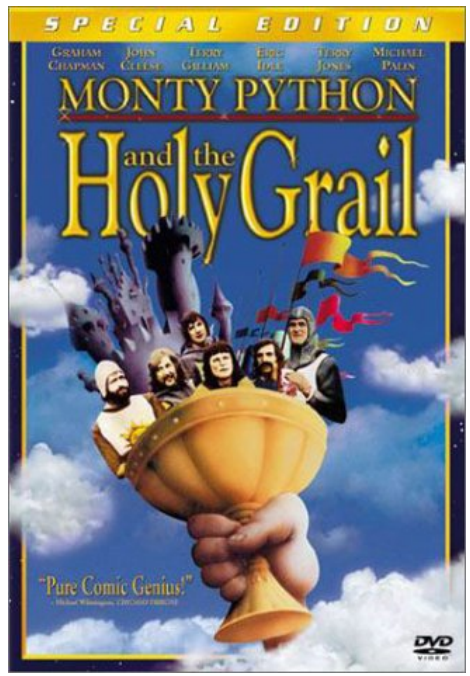
Question: What is One of Our Greatest Problems?

How to get all (or most) risk assessments, regardless of type (software, hardware, integration, management, external, etc.) justifiable, repeatable and comparable has been one of the holy grails of Risk Management for years.



Objection to Risk Assessments

• Objection to implementing Risk Management and acting upon risk information - **risk assessments are subjective.**

• Are the risk assessments justifiable, repeatable and comparable over an entire project?

• One cannot easily justify assigning a 80% likelihood to a risk occurring when others with more, the same or less experience are ascribing a 10% - 90% likelihood of occurrence to the same or a similar risk.

So, How to Address This Problem?

One possible methodology that meets at least some of this requirement.

Incorporate the estimated Likelihood of Occurrence into a set of specifically defined levels under each risk rather than considering it as a separate factor. Basically, the assumption behind this methodology is that the more mature the process, the more experience available, the more detailed the design, etc., the lower the likelihood of occurrence of a specific risk becomes.

Risk Areas

- Cost Development
- Schedule Development
- Requirements Definition and Stability
- *Design and Engineering Maturity*
- Legal
- Transportation Complexity
- History/Experience
- *Technology Maturity*
- Customer/User Interaction
- Maturity of COTS/GOTS/NDI/Reuse component
- *Fabrication Resources*
- Testing Required to Establish Functionality
- Methodology and Process Maturity
- Development Support Resources
- *Personnel*
- Hardware and Software Interface Definition and Control
- Hardware Product Integration Maturity
- Hardware and Software Integration Maturity
- Integration Environment and Resources
- Testing Required to Establish Functionality
- Logistics Requirement
- Performance Functionality
- Testing Support Resources
- Facility/Site Resources
- Data Requirements

Risk Assessment

Technology Maturity Likelihood Levels

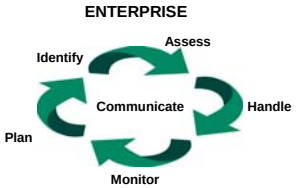
A - Pre-Concept. Scientific research required & no supporting tech base

B - Concept. Documented design meeting functional requirements is complete

C - Engineering Model/Breadboard. Functional hardware model has passed performance/functional tests for component maturation

D - Prototype. Fit, form, and function have been demonstrated by a technically analogous hardware component. Prototype passed qualification & acceptance tests.

E - Operational. A technically identical (but not necessarily physically identical) hardware item is currently operational and deployed in an environment similar to XXX.



Risk Assessment

Design and Engineering Maturity Likelihood Levels

A - New or breakthrough advance in design capability is required (e.g., concept design not formulated or modeled).
B - Moderate engineering development is required using published design knowledge (e.g., preliminary design not completed).
C - Design effort required using standard, existing components beyond their original accepted specifications levels (e.g., simple packaging changes, minor configuration changes, and tailored component changes).
D - Design effort required using standard, existing components within their original specification levels (e.g., design effort and drawings completed).
E - Designed or off-the-shelf item meets XXX performance requirements, but needs qualification.

Risk Assessment

Fabrication Process Likelihood Levels

A - No comparable process exists and one or more key attributes are expected to exceed the state-of-the-art.

B - Integrated process is a combination of demonstrated processes and all relevant attributes are within the state-of-the-art, but are not within the norm demonstrated by the XXX team.

C - Integrated process is a combination of demonstrated processes and two or more key attributes exceed the norm demonstrated by the XXX team.

D - Integrated process is a combination of demonstrated processes and one key attribute exceeds the norm demonstrated by the XXX team.

E - Modification of an existing XXX integrated process to meet key attributes.

Risk Assessment

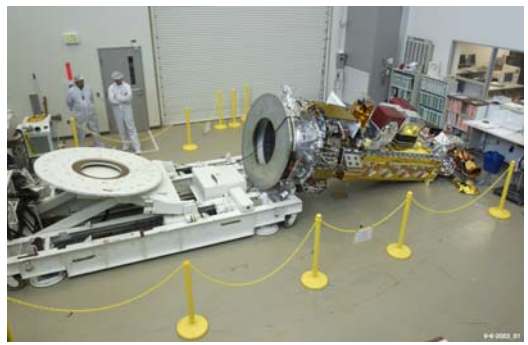
Personnel Likelihood Levels

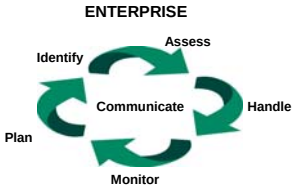
A - No approved plan to staff the development activities.
B - An approved plan exits to staff the development activities, but sufficient personnel are not available.
C - Sufficient personnel exist, but have less than one year average experience.
D - Sufficient personnel are available with average experience exceeding one year and are functioning as a team.
E - Sufficient personnel are available and have created similar Systems and have experience on XXX items.

How About Importance of the Risk Likelihood Level?

Once the risk likelihood level definitions are agreed on – a Project can then use the 1-5 standard or establish a weighing factor for each level,

And determine if they will consider any dependencies between risks.





Consequence (Co) Definitions

5 **0.95**	**Catastrophic - Failure to meet the objectives would result in significant non-achievement of Key Performance Parameters, or Program derivatives of them.** ***The failure could not be recovered in subsequent project phases without significant cost (>20% of Program budget, or $5M, whichever is greater) or schedule impact (> 10 months to critical path), or equivalent combination thereof.***
4 **0.75**	**Major - Failure to meet the objectives would degrade the system below the Key Performance Parameters, or project derivatives of them.** ***The failure could be recovered in subsequent project phases with moderate cost (10-20% of Program budget, or $1-5M, whichever is greater) or schedule impact (6-10 months to critical path), or equivalent combination thereof.***
3 **0.55**	**Significant - Failure to meet the objectives would result in degradation of secondary performance requirements or a minimal to small reduction in performance.** ***The failure could be recovered in subsequent project phases with minimal cost (5-10% of Program budget, or $500K – $1M, whichever is greater) or schedule impact (3-6 months to critical path), or equivalent combination thereof.***
2 **0.35**	**Minor - Failure to meet the objectives would result in minimal degradation of secondary requirements.** ***No reduction in performance. Impact to cost (<5% of Program budget or < $500K, whichever is greater) and schedule is minimal (< 3 months), or equivalent combination thereof.***
1 **0.15**	**Negligible - Failure to meet the objectives would create insignificant impact on secondary performance requirements. No cost or schedule impact.**

Risk Analysis

Level of Risk

Likelihood

5
4
3
2
1

17	10	6	3 CC	1 High
20	13 EE	9 Moderate	4 YY	2
22	15	11	7	5
24 Low	19 ZZ	14	12	8
25	23	21	18 XX	16

1 2 3 4 5

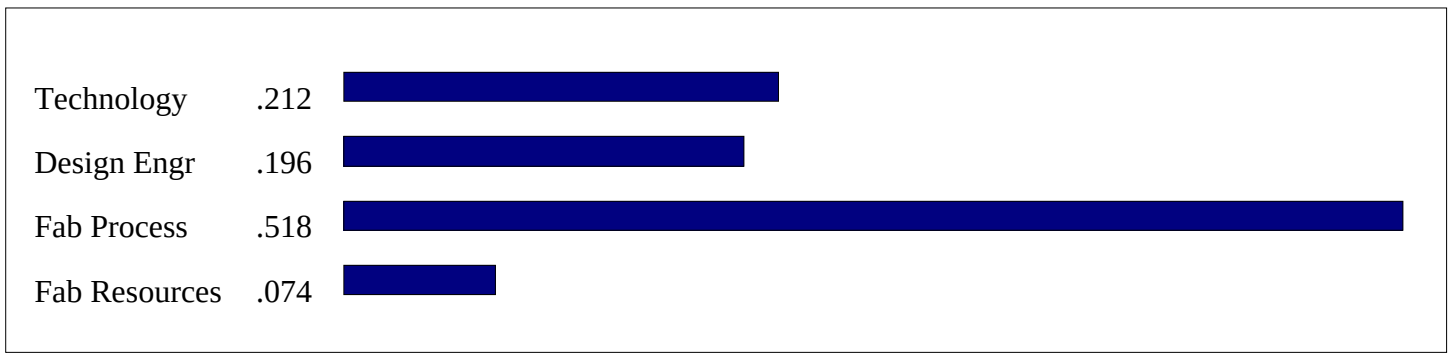
Consequence (Impact)

COMPARE THE RELATIVE IMPORTANCE WITH RESPECT TO: GOAL

1=EQUAL 3=MODERATE 5=STRONG 7=VERY STRONG 9=EXTREME

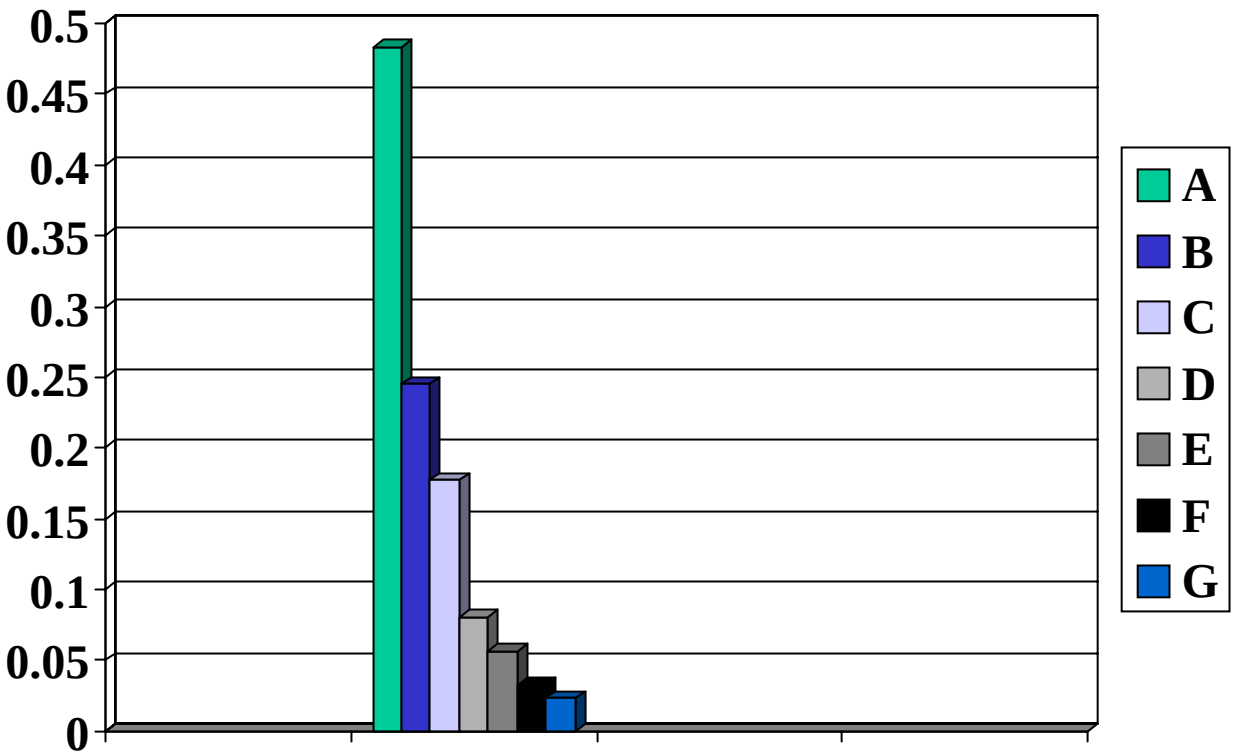
1	Technology	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Design Engr
2	Technology	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Fab Process
3	Technology	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Fab Reqmts
4	Design Engr	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Fab Process
5	Design Engr	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Fab Reqmts
6	Fab Process	9	8	7	6	5	4	3	2	**1**	2	3	4	5	6	7	8	9	Fab Reqmts

Abbreviation	Definition
Goal	Hardware Risk Assessment - Meeting PD/RR Exit Criteria
Technology	The uncertainty in ... availability and promise of technology
Design Engineering	The uncertainty ... due applying technology to meet the requirements
Fabrication Process	The uncertainty associated with the fabrication process
Fabrication Resources	The uncertainty with the...fabrication elements used to build...



Inconsistency Ratio =0.14

Technology Maturity



Risk Scoring

Technology Maturity Likelihood Levels

48 - Pre-Concept. Scientific research required & no supporting tech base

24 - Concept. Documented design meeting functional requirements is complete

16 - Engineering Model/Breadboard. Functional hardware model has passed performance/functional tests for component maturation

9 - Prototype. Fit, form, and function have been demonstrated by a technically analogous hardware component. Prototype passed qualification & acceptance tests.

4 - Operational. A technically identical (but not necessarily physically identical) hardware item is currently operational and deployed in an environment similar to XXX.

Base - 100

Risk Assessment Method

Risk Score= Lo * Co

Where Lo = Likelihood Level
and Co = Consequence

Performance (Technical) Difficulty can be assessed in several areas:

Hardware

Technical Maturity
Design and Engineering Maturity
Fabrication Process
Fabrication Resources
Personnel
COTS vs Developed

Software

Design and Engineering Maturity
Methodology and Process Maturity
Development and Support Resources
Personnel

Integration

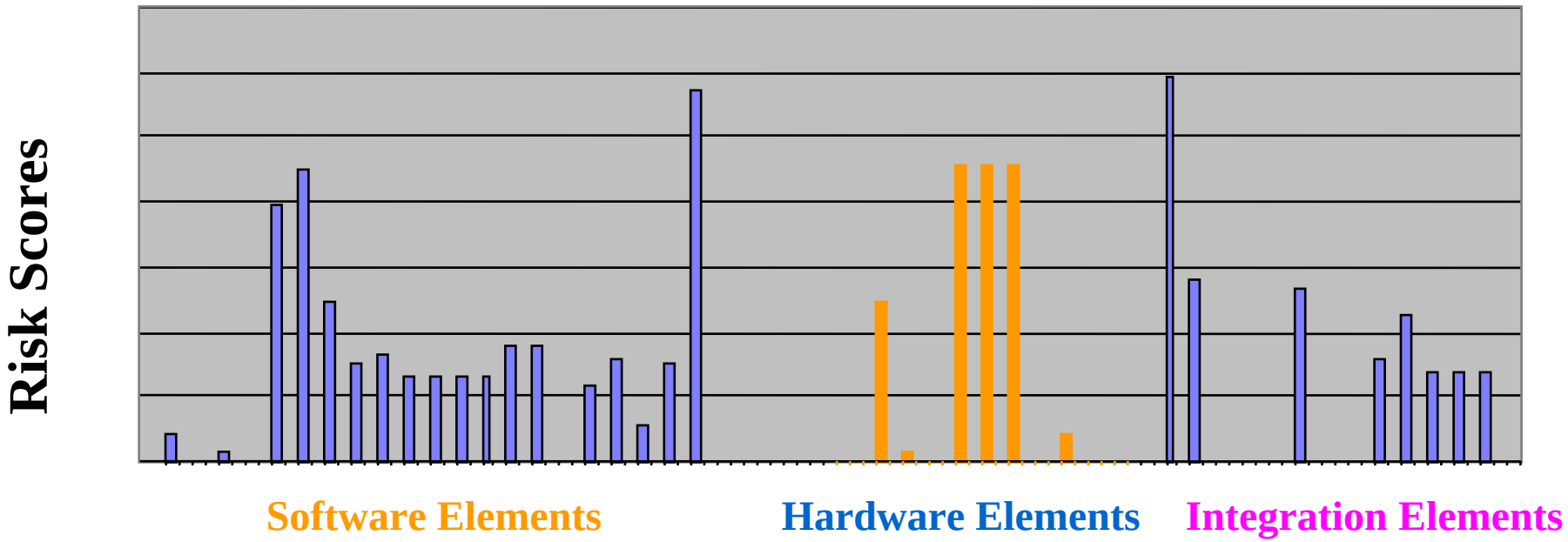
Hardware/Software Interface Definition and Control
Hardware Product Integration Maturity
Hardware/Software Integration Maturity
Integration Environment and Resources
Personnel

Example: Software WBS XX Risk Assessment

Risk Factors	Lo Level			Comments
			0.353	
#1 Design & Engineering Maturity	**0.240**		*0.240*	Other programs have similar
Engineering development is required using proven design knowledge & similar products exist			0.125	Software – YYYY, BBBB and MM26
			0.032	
		0.234	0.024	
#2 Methodology & Process Maturity	**0.200**	*0.200*		XXX processes are defined, but only a portion of the total development process has been utilized. Processes may change prior to June 2003
XXX process defined, but not in place for the CSCI or documented for design applications		0.092		
		0.068		
		0.026		
			0.031	
			0.021	
#3 Development Support Resources	**0.010**		*0.010*	Currently host equipment and test tools are in use. Not all automated support tools are in use
Three or more required XXX software Development support resources are not in use. Those available are proven to work together			0.006	
			0.005	
		0.148		
		0.093		
#4 Personnel	**0.018**	0.033		At or above Phase II staffing profile. Average experience is greater than one year.
Sufficient personnel are available with average Experience exceeding one year and are Functioning as a team		*0.018*		
		0.012		

Consequence of Failure : 0.7 (Degradation of Performance)

Example: WBS Element Risk Scores



Towards Better Methods

Risk Mgt poses difficult quantitative problems. Much of conventional statistics has to do with the "average" or the "norm" or the "expected". Risk Mgt has more to do with the extreme, the abnormal and the unexpected.

Three Technical Issues:

1. How do you model volatility?
2. How do you model extremes and stress events?
3. How do you model correlation and concentration risks? "Extremes occur together".

Summary/Conclusions

We will never get absolute results.

- Risk Management mainly deals with people's actions, perceptions, feelings and concerns.
- Very few of our risks are "Acts of God".

This technique aids in reducing subjectivity and demands evaluation and justification for decisions about risks and reduces the objections to using risk information.

It provides a technique to get all (or most) risk assessments, regardless of type (software, hardware, integration, management, external, etc.) justifiable, repeatable and comparable.