Module 9: STAB Tools and applications in risk management Session 1 of 2

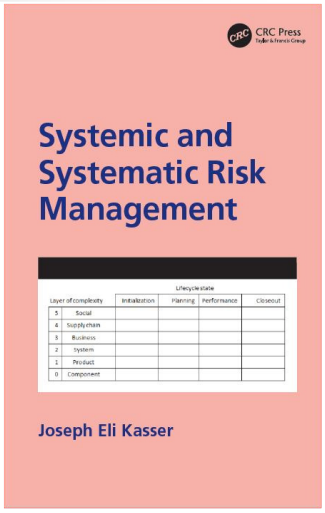
Rev. 1.3.6

Objectives

1. To show how systems thinking and beyond (STAB) tools can improve risk management
2. To explain a few STAB tools for risk management

Knowledge

- Lecture
  - Overview and summary of tools
- Readings/Videos
  - 0902 POSE Chapter 14.2 A competency model maturity framework
  - 0903 FUSE Chapter 28 Getting the right requirements right
  - 0904 HT Chapter 10, Examples of the application of the systems engineering approach to problem, Section 10.3.1 Developing an optimal classroom teaching and learning environment.
    - How easy it is to go wrong
  - 0905 FUSE Chapter 10, Systems engineers are from Mars, software engineering are from Venus.
    - How easy it is to miscommunicate and not realize it
- Exercise



Topics

- **Definitions**
- Risks based on technological uncertainty
- Risk rectangles and why not to use them
- Risk profiles and framework
- Risks in using poor people (lecture and 0902)
- Risk and opportunity identification and mitigation
- Opportunity identification
- Survivorship bias
- The flaw in the 'B' paradigm (0903)
- The doomed classroom project (0904)
- Mitigating communications risks (0905)
- Exercise

Structural HTP: Definitions

- **Risk:** the possibility of suffering loss.
- **Failure:** the occurrence of a risk (*Generic* HTP); a risk changed from a possibility to an event (it happened)
- **Risk Statement:** a concise articulation of a program condition leading to risks, with one or more consequences foreseen from that condition
- **Risk Management*:** a software engineering practice with processes, methods, and tools for managing risks in a project. It provides a disciplined environment for proactive decision-making to:
  - Assess continuously what can go wrong (risks)
  - Determine what risks are important to deal with
  - Implement strategies to deal with those risks

* Van Scoy, Roger L. *Software Development Risk: Opportunity, Not Problem.* Software Engineering Institute, CMU/SEI-92-TR-30, ADA 258743, September 1992.

Risks/opportunities become events

- Uncertainties (risks/opportunities) are probabilities until they occur
- If one occurs it becomes an event
- Events have impacts
  - Cost (financial)
  - Schedule (time)
  - Scope
  - Technology
  - Political
  - Credibility
  - Others
- The impacts of the event need to be managed

Risk or opportunity

- Bad weather
  - Moscow 1812
    - Russians – opportunity
    - French – risk
- Time between aircraft flight and connecting flight
  - Event arrival of flight
- Factors
  - Aircraft early arrival
    - long wait for connecting flight
    - earlier connecting flight and earlier arrival at destination
    - Minimal shopping at transfer airport
  - Aircraft flight late arrival
    - Can miss earlier connecting flight
    - shorter wait for connecting flight
    - Some time for shopping at transfer airport
- Risk quantification is in the mind of the beholder
- Risk attitude
  - Sets the numbers

Risk or opportunity ?

Myths of traditional risk management

1. Risk management is a separate activity from design and project management
   - **Reality it must be integrated in a holistic manner**
2. Risk can be quantified as a single number
   - The product of the probability of occurrence of a mishap and the severity of the potential outcome:
     - Traditional risk assessment matrix
     - Project managers and decision-makers want simplicity when making high-risk decisions
3. Published project risk assessment models provide consistent and rationale measures of project risks
4. Projects with high cost-contingencies succeed and do not have cost overruns
5. Maintain risk registers for all the risks
   - **Reality, maintain 6-10 risks at each level, or ~7±2 (Miller's and Military rulea)**

Operational HTP: Traditional risk management*

1. **Identify all the risks you can**.
   - Review the **WBS elements** down to the level being considered and identify risk events.
2. Analyze each risk event to determine probability of occurrence and consequences/ impacts, along with any interdependencies and risk event priorities.
3. Plan mitigation actions and contingency plans.
   - Translate risk information into decisions and actions (both present and future) and implement those actions.
4. Track the risks.
   - Monitor the risk indicators and actions taken against risks.
5. Control the risks by monitoring them and correcting deviations from planned risk actions.
6. Communicate the risks to the team and management.
   - Provide visibility and feedback data internal and external to your program on current and emerging risk activities

* [US] DOD, Program Manager's Guide for Managing Software, Draft 0.4, 2001

Operational HTP: Approaches to ~~manage~~ reduce ~~uncertainty~~ risk

- People
  - Eliminate poorly performing people
  - Improve the performance of poorly performing people
    - Motivate, educate and train
  - Open communications between stakeholders
  - Trust and respect
  - Domain expertise
  - Who know what they don't know and are not afraid to admit it (in the right way)
- Technology
  - Robust design
    - Solutions continue to function if conditions change
    - Based on work of R.A. Fisher (1935) and Taguchi methods
  - TAWOO
- Simulations and models
  - Provide understanding, not solutions
  - Only as good as assumptions underlying models

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Risks based on technological uncertainty*

- **Type A—Low-Tech Projects:** projects that rely on existing and well-established technologies to which all industry players have equal access.
- **Type B—Medium-Tech Projects:** projects that rest mainly on existing technologies and incorporate a new technology or a new feature of limited scale.
- **Type C—High-Tech Projects:** projects in which most of the technologies employed are new, but existent — having been developed prior to the project's initiation.
- **Type D—Super-High-Tech Projects:** projects based primarily on new, not entirely existent, technologies

* Shenhar, A. J. and Bonen, Z., "*The New Taxonomy of Systems: Toward an Adaptive Systems Engineering Framework*", IEEE Transactions on Systems, Man, and Cybernetics - Part A: Systems and Humans, Vol. 27 (1997), no. 2, 137 - 145.

NASA's TRL* (reading 0802)

9	Actual system "flight proven" through successful mission operations
8	Actual system completed and "flight qualified" through test and demonstration (ground or space)
7	System prototype demonstration in a space environment
6	System/subsystem model or prototype demonstration in a relevant environment (ground or space)
5	Component and/or breadboard validation in relevant environment
4	Component and/or breadboard validation in laboratory environment
3	Analytical and experimental critical function and/or characteristic proof-of concept
2	Technology concept and/or application formulated
1	Basic principles observed and reported

* TECHNOLOGY READINESS LEVELS A White Paper, April 6, 1995, John C. Mankins, Advanced Concepts Office, Office of Space Access and Technology, NASA

The TAWOO (reading 0802)

TAWOO		TRL	Comments
6	Antique	12	Few if any spares available in used equipment market
5	Obsolete	11	Some spares available, maintenance is feasible
4	Approaching obsolescence	10	Use in existing products but not in new products
3	Operational	9	Available for use in new products (in general).
2	Development	8	Actual system completed and "flight qualified"
		7	System prototype demonstration
		6	System/subsystem model or prototype demonstration
1	Research	5	Component and/or breadboard validation
		4	Component and/or breadboard validation in laboratory environment
		3	Proof-of concept
		2	Technology concept and/or application formulated
		1	Basic principles observed and reported

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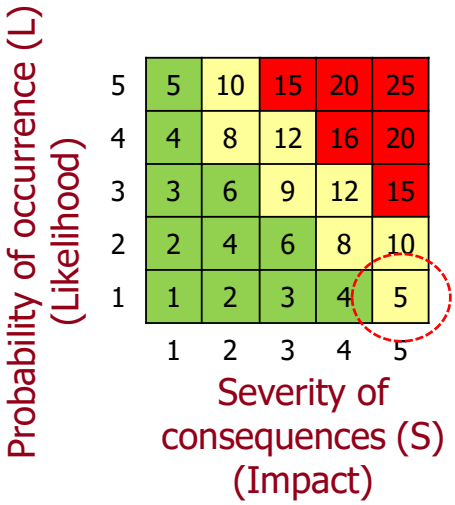
Quantitative HTTP: Risk likelihood (probability)

Degree of Probability	Description
Likely (5)	Likely to occur immediately or within a short period of time. Expected to occur frequently or continuously to an individual item or person.
Probably (4)	Probably will occur in time. Expected to occur several times to an individual team or person or frequently to a group
May (2)	May occur in time. Can reasonably be expected to occur some time to an individual item or person or frequently to a group
Unlikely (1)	Unlikely to occur

Risk consequence

Category	Description
I	May cause death, loss of facility / asset or result in grave danger to mission
II	May cause severe injury, illness, property damage, damage to mission, or degradation to efficient use of assets
III	May cause minor injury, illness, property damage, degradation to efficient use of assets
IV	Presents a minimal threat to personnel safety or health, property, mission or efficient use of assets

Traditional Risk Assessment Matrix

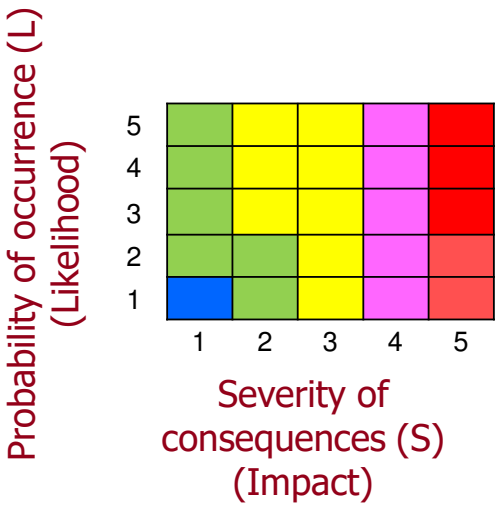


Based on one number (L*S)

The level of risk for each root cause is reported as:

1-4	Low (green),
5-12	Moderate (yellow),
15-25	High (red)

Continuum Risk Map - two dimensions



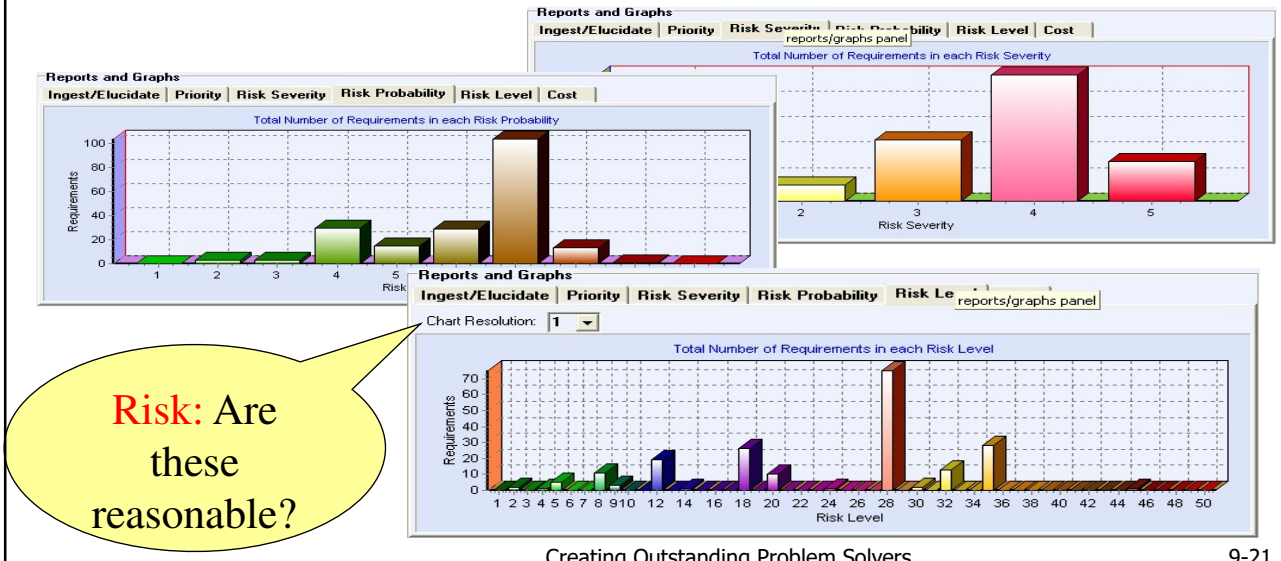
- Deal with yesterday (red)
- Deal with today (pink)
- Deal with soon based on analysis of consequences (yellow)
- Nuisances and should be dealt with when feasible (green)
- Can be ignored for now (blue)

- No numbers

Car risk

- Condition (all have to exist)
  1. The turn indicators are flashing
  2. The fuel tank is less than 50% full
  3. The car is rear-ended with a force greater than N
- Outcome of event
  - Fuel tank will be damaged, so fuel will leak
  - Turn indicator may break which may create one or more sparks
  - Fuel may catch fire
  - Occupants may be burned or killed
- Risk
  - Probability very low, severity of occurrence very high

Project Risk profiles – a better way?



Risk rectangles and profiles

- **Risk rectangle**
- Easy to understand
- Combines likelihood and severity
- Flawed in use
  - When single number is used can be misleading
  - (L5, S1) and (S5, L1) have same value (1*5 = 5*1)

- **Risk profiles**
- Easy to understand
- Separates likelihood and severity
- Can provide comparison between several situations
- Allows for decision-making when more than one attribute is compared
  - E.g. low priority and high risk, high cost
- Links to CRIP charts
  - Plots of risk categories (L and S)

(Project) Risk framework

- Comparing proposed large infrastructure projects in pre-initialization state in investment decisions
- Complexity levels updated based on HKM^{2}F, November 2022

Objective complexity		Project lifecycle state							
		Initialization		Planning		Performance		Closeout	
		PROB	SEV	PROB	SEV	PROB	SEV	PROB	SEV
7	Global								
6	Regional								
5	Social								
4	Supply chain								
3	Business								
2	System								
1	Product								
0	Component								

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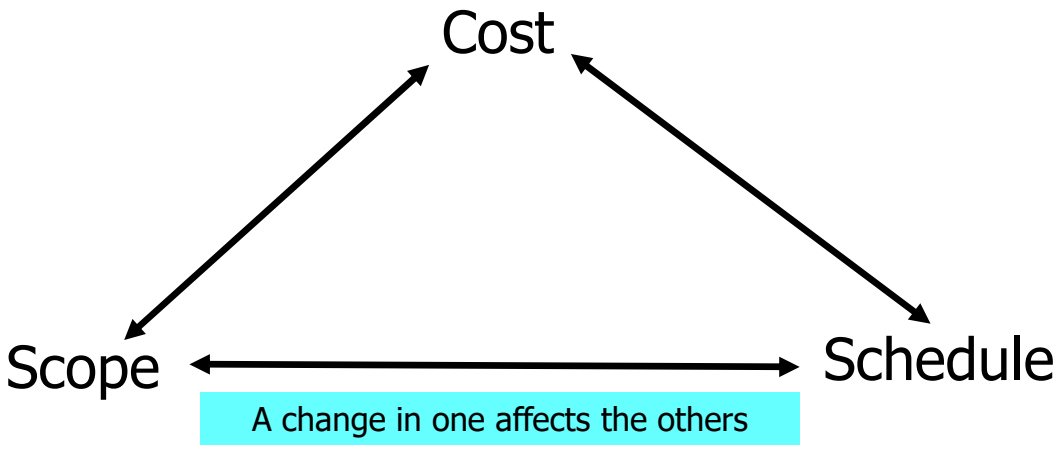
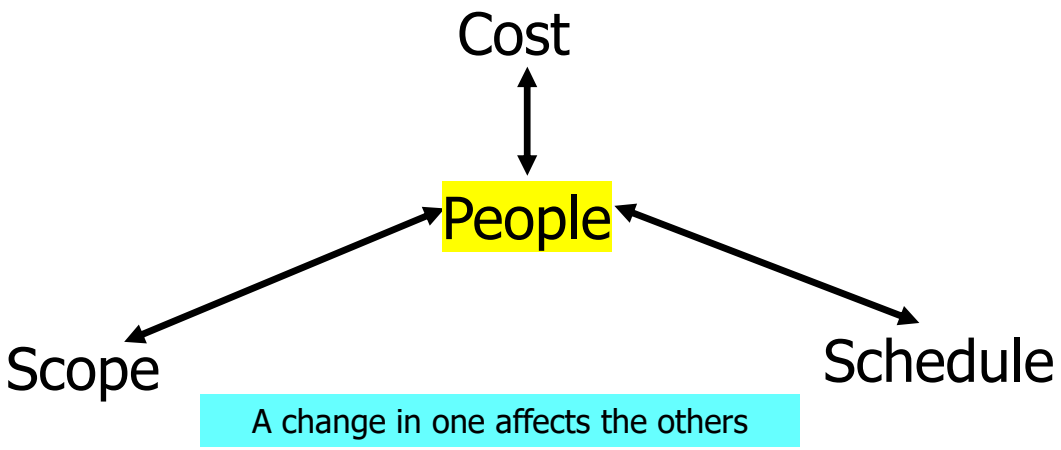
Traditional: Triple constraints



Quadruple constraints



Temporal: Risk emphasis change over time

Acceptance of policy, policy remedies wrong problem, poor choice of partners, poor planning, etc.

Social and political

Budgeting, poor choice of financing package, etc.

Financial

Poor choice of technology, poor choice of architecture, poor management, etc.

Constant risk: poor people

Technological and managerial

Conceptual

Realization

Uncertainty decreases over time

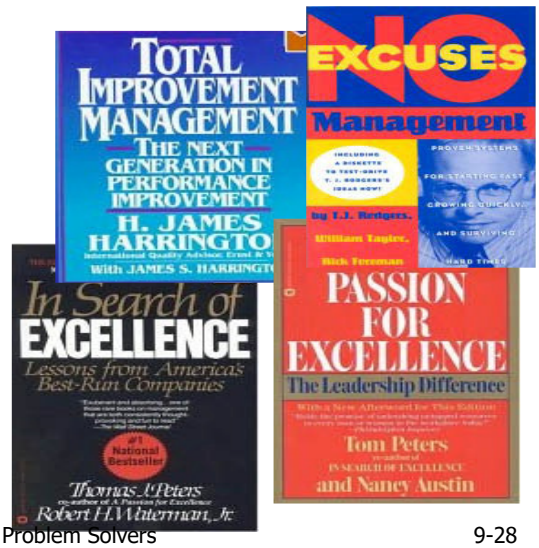
Start

End

Creating Outstanding Problem Solvers 9-27

The focus is on people not process*

- Literature
  - Is full of advice as to how to make projects succeed
  - Has little if anything to say about the proliferating process standards
- Garbage-in-garbage-out



* Kasser, J. E., "*The Certified Systems Engineer - It's About Time!*" proceedings of the 10th Annual Symposium of the INCOSE, Minneapolis, MN, 2000.

Creating Outstanding Problem Solvers 9-28

Exercise 9-11

- You are part of a car manufacturer's risk management team assessing what to recommend when incident (failure) reports are received
- The analysis summarized in slide 22 identified the causes of a risk
- Prepare a <5 minute presentation which shows:
  1. Risk profiles for the properties and attributes would result in each of the following recommendations
     1. Ignore
     2. Recall and repair
     3. Repair at next scheduled service
     4. Other
  2. This slide and the version number of lesson
  3. Properties and values of attributes for each recommendation
  4. The problem formulated per the Problem Formulating Template
  5. Lessons learned from the exercise
  6. Compliance matrix for meeting the requirements of the exercise
- Save as a PowerPoint file as Exercise9.11-abcd.pptx
- Post in the Asynchronous group as instructed

Knowledge reading exercise 9-12

1. Prepare a brief on two main points in reading 0902 (< 5min)
2. Presentation to contain
   1. A summary of the content of the reading (<1 minute)
   2. The compliance matrix
   3. The problem formulated per the problem formulation template
   4. This slide and lesson version number
   5. A list of the main points
   6. The two briefings
   7. Reflections and comments on reading (<2 minute)
   8. Comparisons of content with other readings and external knowledge
   9. Why you think the reading was assigned to the module
   10. Lessons learned from module and source of learning e.g. readings, exercise, experience, etc. (<2 minutes)
3. Save as a PowerPoint file as Exercise9-12-abcd.pptx
4. Post/email presentation as, when and where instructed
5. Brief on one main point

Summary of Session 1

- Definitions
- Risks based on technological uncertainty
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- ~~Risk and opportunity identification and mitigation~~
- ~~Survivorship bias~~
- ~~The flaw in the 'B' paradigm (0903)~~
- ~~The doomed classroom project (0904)~~
- ~~Mitigating communications risks (0905)~~
- Exercise

Any questions ?

1. Best
2. Worst
3. Missing

Separate email:
beyondsystemsthinking@yahoo.com
Subject: <class title> BWM Lesson #