How to write good requirements
Session 4 of 10
Converting stakeholder wants to needs

Version 1.1.1

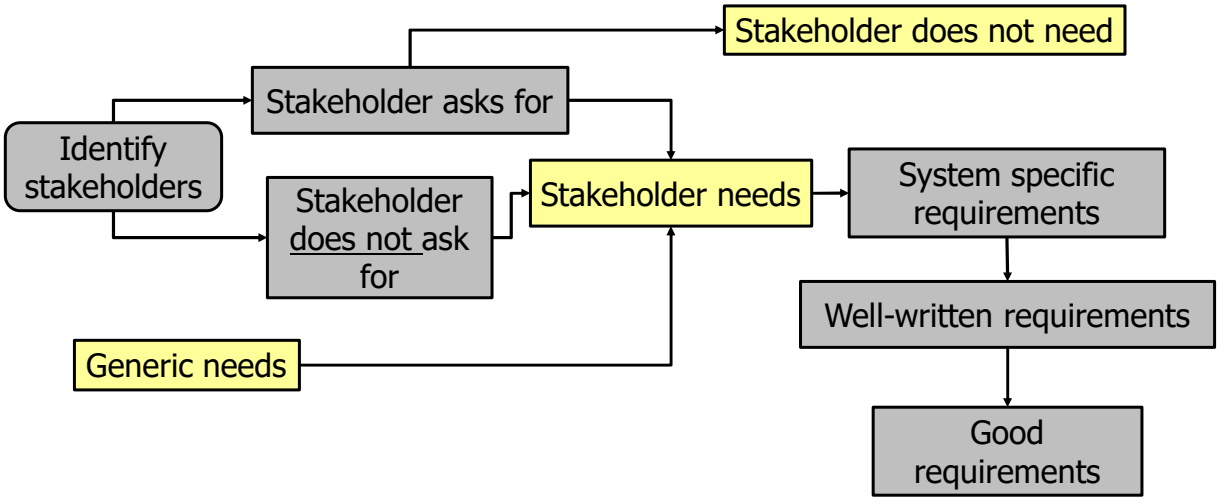
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  1. To be recorded
  2. Prof Kasser has the right, but not the obligation, to make the recording available to the participants
  3. Prof Kasser has the right to use the recordings in other classes (present and future)
- Prof Kasser agrees
  1. To delay publication of the recording for at least 48 hours to allow participants to request, in writing, removal of remarks they made in the session (nature of remarks and approximate timing to be provided with the request).
  2. To remove those requested remarks before publishing the recordings

Course session topics

1. Introduction to requirements
2. Stakeholders and their importance
3. Communicating with the stakeholders
4. **Converting stakeholder wants to needs**
5. Documenting stakeholders' needs
6. Converting stakeholder needs to requirements
7. Converting requirements to well-written requirements
8. Converting well-written requirements to good requirements
9. The use of requirements in the rest of the system development process
10. Summary and closeout

Workflow analysis for good requirements



Objectives of Session 4

1. To present and discuss the BWMQ and exercise presentations from previous session
2. To explain how to convert stakeholder functional and performance "wants" to "needs"
3. To explain the difference between functions and misuse functions
4. To introduce risk management
5. To explain need for prioritization of needs and how to prioritize them
6. To explain three ways to maximize the completeness of the needs
7. To explain how to influence the stakeholders to want the system they need
8. To explain how to determine if the need is for Commercial-off-the-Shelf (COTS) equipment
9. To provide the opportunity to exercise the 5 levels of knowledge in the updated Blooms taxonomy

Knowledge components

- Lecture
  - Sets the context and provides overview
- Readings
  - 0402 Systems Thinker's Toolbox Section 13.1: Checkland's Soft System Methodology
  - 0403 Kasser, J.E., Applying Holistic Thinking to the Problem of Determining the Future Availability of Technology, IEEE Transactions on Systems, Man, and Cybernetics: Systems, Volume 46, Number 3, 2016.
- Exercises
  - 4-1 Scenarios to requirements
  - 4-2 Knowledge reading 0402
  - 4-3 Knowledge reading 0403 (optional)

Session topics



- **BWMQ**
- Exercise presentations
- Converting wants to needs
- An introduction to Misuse Functions (risks and risk management)
- Prioritization of needs
- Converting needs to functions
- Scoping for affordable cost and realistic schedules
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BWMQ

- Best
  - WBR#3 covered useful communication tools like active listening, asking good questions, and using generic models to understand stakeholder needs.
  - I really liked the videos to reinforce some of the points.
- Worst
  - Interim connection issues led to the audio quality being poor in some sections, making it hard to understand the speaker.
- Missing
  - More examples of stakeholder communication scenarios would have been helpful.
- Question
  - How do you ensure stakeholders understand generic models if they have no systems engineering knowledge?
  - Do you have any example of orthogonal question?

Session topics



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- NY
  - DIY
  - KAL
- EU
  - LM
  - SZS

Exercise 3-1

1. Select one generic stakeholder from each of the three situations from Exercise 2-1.
2. Craft at least 5 questions for each stakeholder
3. Assume you met the stakeholders
4. Prepare a <5 minute presentation containing
   1. The generic stakeholders and why you selected them
   2. The questions you prepared for each stakeholder
   3. The information you recorded after meeting with the stakeholders and asking the questions (assume reasonable feasible answers)
   4. A compliance matrix for the exercise
   5. Formulated problem per COPS problem formulation template
   6. Lessons learned from exercise
5. Save as a PowerPoint file in format Exercise3.1-abcd.pptx
6. Post/email presentation as and where instructed

- NY
  - DIY
  - KAL
  - ST
- EU
  - RJNR
  - LM
  - SZS

Exercise 3-2 (10-20 minutes)

- The unintended ambiguity in the question "make sure he's dead?" resulted in an unintended outcome

1. Prepare a <3 minute presentation containing
   1. What was the requirement she was complying with?
   2. What question should the operator have asked?
   3. A compliance matrix for the exercise
   4. Formulated problem per COPS problem formulation template
   5. Lessons learned from exercise
2. Save as a PowerPoint file in format Exercise3.2-abcd.pptx
3. Post/email presentation as and where instructed

- NY
  - DIY
  - KAL
  - ST
- EU
  - LM

Exercise 3-3 knowledge reading

1. Prepare a brief on two main points in reading 0302 (< 5min)
2. Presentation to contain
   1. Formulated problem per COPS problem formulation template
   2. A summary of the content of the reading (<1 minute)
   3. The compliance matrix
   4. This slide
   5. A list of the two 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 Exercise3.3-abcd.pptx
4. Post/email presentation as and where instructed
5. Brief on one main point

- NY
  - DIY
  - KAL
  - ST
- EU
  - LM
  - SZS

Exercise 3-4 knowledge reading

1. Prepare a brief on two main points in reading 0303 (< 5min)
2. Presentation to contain
   1. Formulated problem per COPS problem formulation template
   2. A summary of the content of the reading (<1 minute)
   3. The compliance matrix
   4. This slide
   5. A list of the two 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 Exercise3.4-abcd.pptx
4. Post/email presentation as and where instructed
5. Brief on one main point

Session topics



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Converting "wants" to "needs"

- "Need" = "Want" (if it is a real need)
  - Validate the reason for the need
- Generic needs shall be adapted to specific situation
- Customer may have to be educated before approving adapted generic "need"
  - Reason for the generic "need"
  - Consequences of not incorporating it in system
- Needs the stackholders have not asked for (wanted)
  - Treat as tailored generic "need" (educate)
- Stakeholder insists on a" want" that is not a "need"
  - Don't argue, just document it as a "need" if stakeholder does not agree to withdraw request
  - Explain the reason and consequences to the customer
  - Let the customer argue with the stakeholder, or set it to a low priority

Determining the real need-1

- Create generic CONOPS (to-be) of the future (reference model)
  - Without undesirability of current situation
  - With improvements stakeholders want
- Use domain knowledge from similar systems (past and present)
- Include generic needs
- Discuss generic needs with the customer, other stakeholders may not be aware of them, nor might they need to become aware
- List assumptions
- Validate correctness in assumptions
- Don't assume you know better than the stakeholders
- Update generic CONOPS to become the specific CONOPS

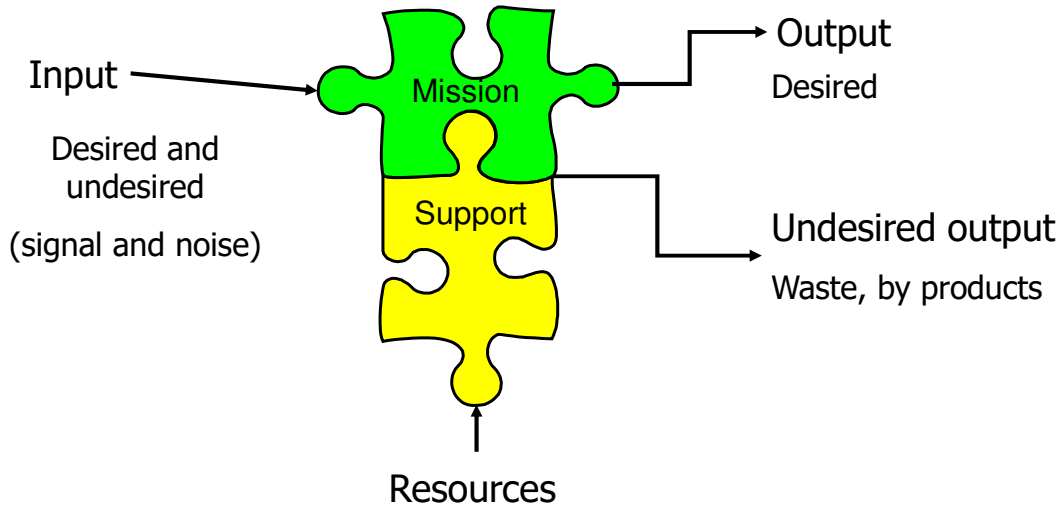
Determining the real need-2

- Validate each stakeholder requirement request (want) against specific CONOPS
- Don't show the specific CONOPS to the stakeholders, show sketches the stakeholder can understand
- If the request does not show up as a function in the specific CONOPS discuss the reason for the request with the originating stakeholder
  - Modify the specific CONOPS to meet the request if the need is valid.
  - If the need is not valid, then discuss don't argue
  - If stakeholder does not agree to withdraw request, document it and flag it for discussion with the customer

The three functional representations

1. Each representation contains quantified functional scenarios including 'don't cares'
   1. Current situation (as-is)
   2. CONOPS (to-be)
   3. Transition process
2. Compare wants/needs to generic CONOPS and transition representations
   - Checklands' SSM, see Reading 0402, can be tailored to situation
3. Adjust CONOPS and transition representations to include specific needs, creating the specific CONOPS

System functional template (stakeholders)



Generic support functions include …

- Stakeholders may not want or know they need
  - Backing up and recovering data
  - Complying with pertinent laws and regulations
  - Managing changes in needs
  - Maintaining and repairing
  - Monitoring and reporting
  - Ensuring safety
  - Ensuring security
  - Training
  - Disposing of waste (safely and in compliance to regulations)

Three ways to maximize completeness

1. Ensure the generic inputs and outputs of each scenario actually interface to another scenario (if appropriate)
   - Input (desired and undesired), output (desired and undesired), control and report
     - E.g., perhaps input and store functions exist, output function does not
   - N^2 chart is a useful tool
2. Ensure the generic processes are performed in each scenario
   - Storing, processing
3. Use templates
   1. Useful for related scenarios and functions
   2. E.g. if there is a "collecting statistics" scenario, there should also be scenarios for storing, retrieving and reporting on the statistics

Session topics

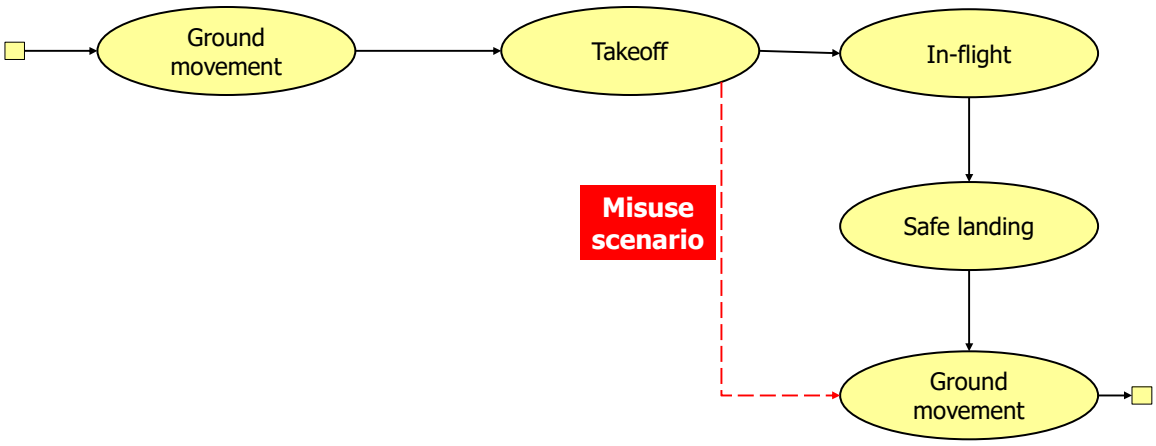


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Misuse functions in each scenario

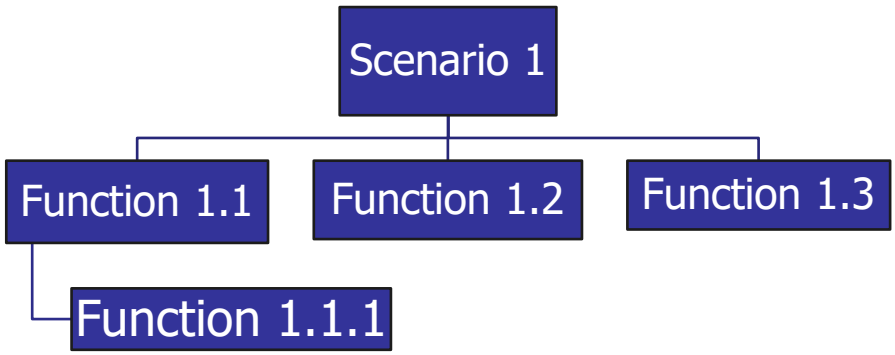
- Functions are assumed to be performed to meet the need
- Something could go wrong (misuse function or risk) in each scenario
- Active Brainstorm what could go wrong in each scenario (risk identification)
- Assign unique reference number to each risk
  - Internally (failure)
  - As a result of an undesired external input
- Assign probability of occurrence and severity of impact if it occurs
- How and where (in which scenario) to mitigate or prevent the risk
- If prevented move to inactive status (show its been identified and prevented)
- Update the appropriate scenarios or add new ones with the mitigation or prevention functions
  - Scenario rational includes "preventing Risk TBS from occurring in scenario TBS")
- Builds (functional) risk management into process up-front

Scenario mapping (Flight)

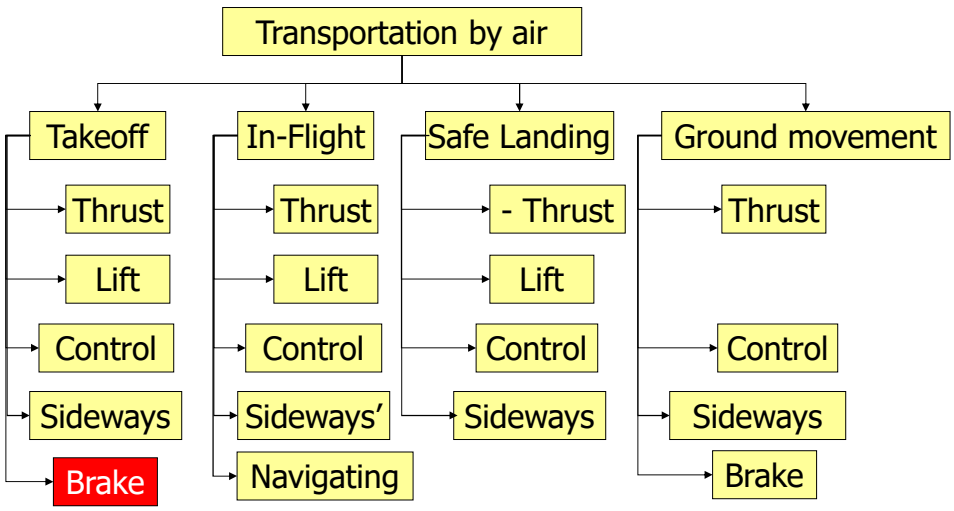


Converting scenarios to functions

- Use Principle of Hierarchies



Example: Scenarios/functions of flight



Scenario to function mapping

	Takeoff	In-flight	Safe landing	Ground movement
Thrusting	X	X	(reverse) X	X
Lifting	X	X	X	
Braking	X (misuse)			X
Controlling	X	X	X	X
Moving sideways	X	X	X	
Navigating		X		
Communicating	X	X	X	X

- Functions can be reused in different scenarios
- Table tool can be used at design time for function to component mapping

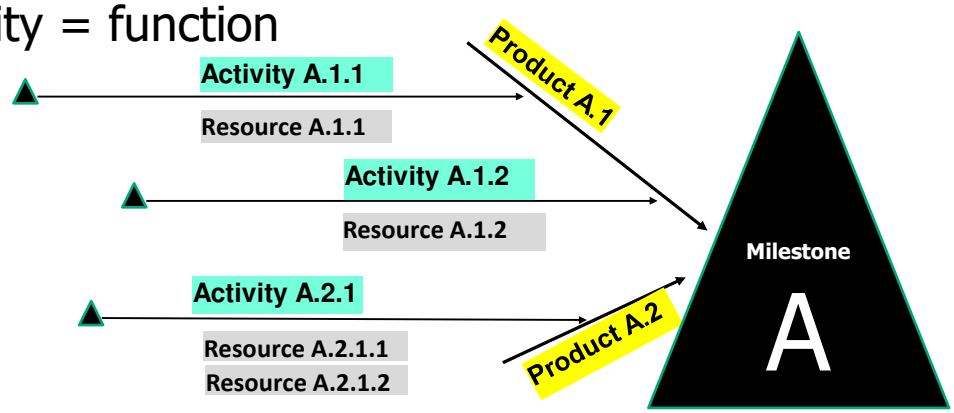
Scenario to function mapping (cup of coffee)

- Scenario making a cup of coffee
- Functions in reverse order
  1. Stirring the mixture in the cup
  2. Adding the ingredients in the cup
     1. Add hot water
     2. Add coffee
     3. Add creamer (if required)
     4. Add sweetener (if required)
     5. Add cup
  3. Heating the water
     1. Switching heating element off
     2. Heating the water
     3. Switching heating element on
  4. Obtaining ingredients
  5. Obtaining resources (spoon, pot, etc.)
  6. ...



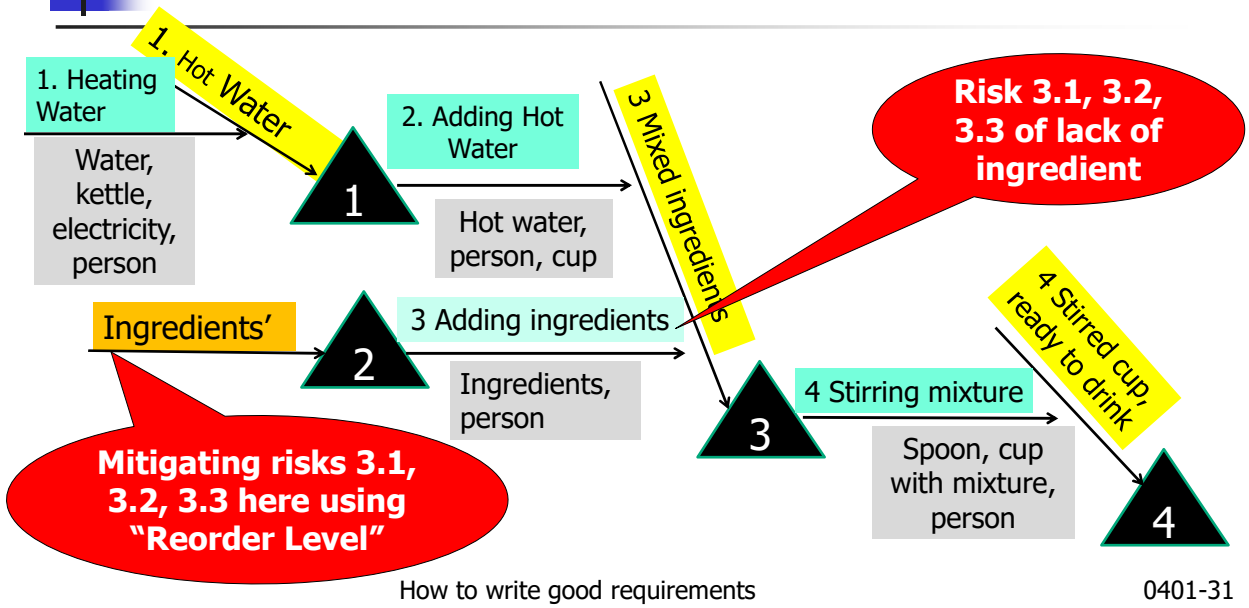
Product-Activity-Milestone (PAM) chart*

- Activity = function



Systems Thinkers Toolbox 2.14

Risk identification and mitigation/prevention (e.g.)



Quantitative HTP: 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 (severity)

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

Traditional Risk Assessment Matrix

Probability of occurrence (L) (Likelihood)					
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5
	1	2	3	4	5

Severity of consequences (S) (Impact)

Based on one number (L*S)

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

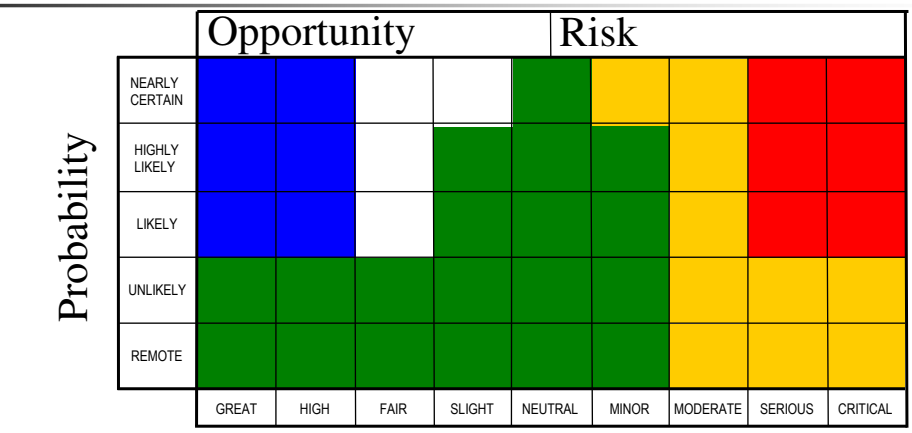
1-4	Low (green)
5-12	Moderate (yellow)
15-25	High (red)

Where do numbers come from?

- Experience
- Historical data
  - E.g., actuarial data
- Expert estimates
- Standards
- Assumptions
- Guesses
- Other places



Opportunities and risks (DOD EPMC course)*

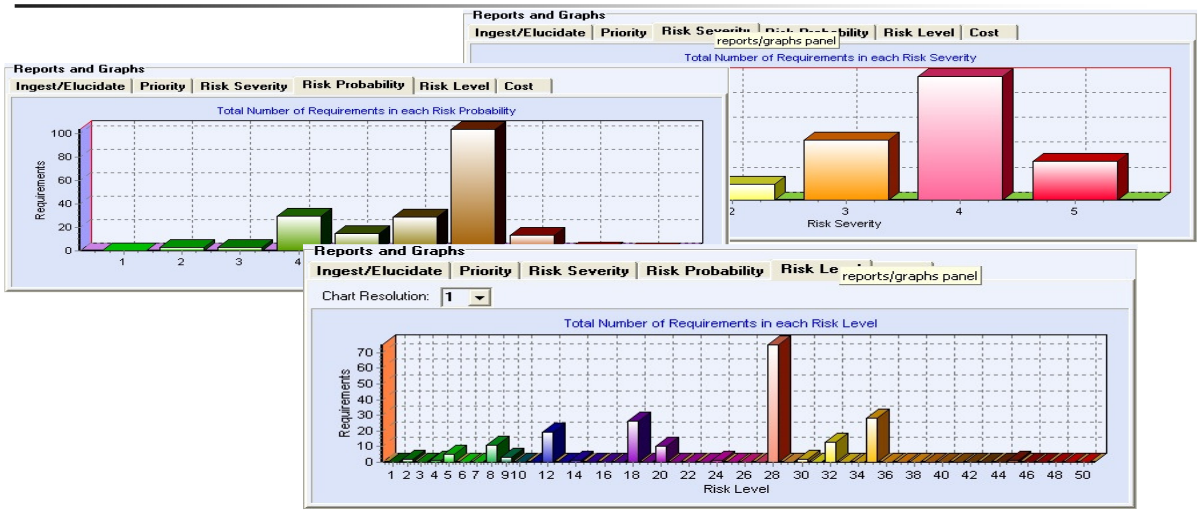




Red & Blue ratings justify major investment of resources & effort
Yellow & White ratings justify secondary consideration
Green ratings are low priority (monitor but leave alone)
Probability rating = odds of achieving opportunity or risk occurring

* US DOD, 2004

Project Risk profiles*



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Why prioritize?

- Value for money spent
- Identify relative importance
- Schedule planning
  - Implement high priority needs early in program
- Contingency planning
  - Budget cuts
  - Feasibility issues

How to prioritize

- Use decision-making tools appropriate to the situation and number of requirements
- Quantitative and qualitative
  - Decision trees*
  - Multi-attribute variable analysis (MVA)*
  - Ordering and ranking*
  - Pair-wise comparison
    - useful with stakeholders who are not sure
  - Perfect score*
  - Pugh Matrix
  - Best guess

Session topics

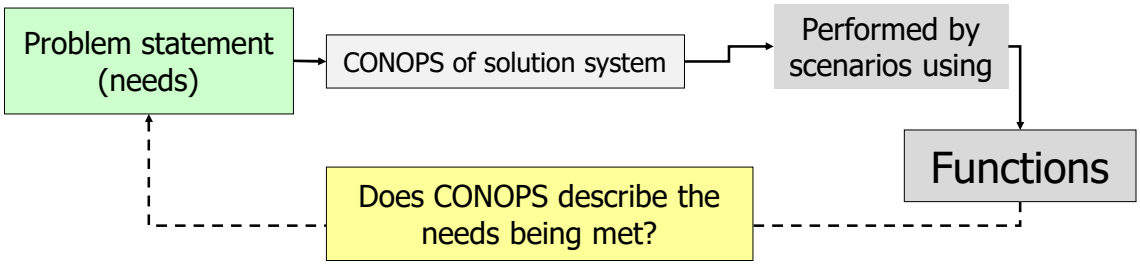


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What' next?

- Traditional approach
  1. Convert the quantified needs scenarios to system requirements
  2. Write system requirements
  3. Estimate cost and schedule to implement requirements (ideal)
  4. Adjust for feasible schedule and affordable cost (ideal)
  5. Do some risk management
  6. Create
     1. Project Plan (PP) or Systems Engineering Master Plan (SEMP)
     2. Test and Evaluation Master Plan (TEMP)
     3. Other appropriate documents
- Systems approach
  1. Add quantified misuse scenarios (risk management)
  2. Estimate cost and schedule to implement need scenarios
  3. Prioritize needs
  4. Adjust for feasible schedule and affordable cost
  5. Write good system requirements
  6. Create
     1. Project Plan (PP) or Systems Engineering Master Plan (SEMP)
     2. Test and Evaluation Master Plan (TEMP)
     3. Other appropriate documents

Converting needs to functions



- Do for all needs
- Join scenarios into a representation
- Assign identification to scenarios
- Ensure no (minimal) missing scenarios
- Group scenarios into functions
- Ensure misuse functions are prevented/mitigated (risk management)

At this time

- All needs are stored in a set of functional scenarios
  - Mission and support product/system
  - Acquisition process (build/buy) and transition
- Remove contradictions and duplications from set of scenarios
- Perform appropriate feasibility studies
  - Technical
  - Cost
  - Schedule
- Adjust until affordable and achievable within time constraints
  - Remove needs or add costs and schedule time

Estimating schedules and costs

- Project management
- Work to be done from transition model
- Schedules are based on need-by dates and resource availability
  - Personnel, specialized capital equipment, etc.
- Costs are based on schedules
  - Salaries (hours * $/hour) + materials + overhead
  - Produces pre-baseline estimates
- Estimate 1: Pre-baseline estimate of real cost and schedule of needed system

Two ways of scoping cost and schedule

1. Iterate until feasible, acceptable and affordable (with customer)
   - Remove low priority (and high cost) needs
   - Adjust schedule
   - Alternatively, increase priority and cost, and extend schedule
   - Let customer explain why (any) needs were removed to remaining stakeholders
- Baseline
   - Estimate 2: Cost of affordable system (customer is willing to pay for)
2. Truth or consequences
   1. Use Real Estimate 2 to bid low
      - To get the contract (true cost or schedule being unnacptabble)
      - To enter new market, or attract new customer
      - To make it up on changes
      - Hope customer will agree to pay excess or extend the schedule once the incomplete project runs out of funds or time

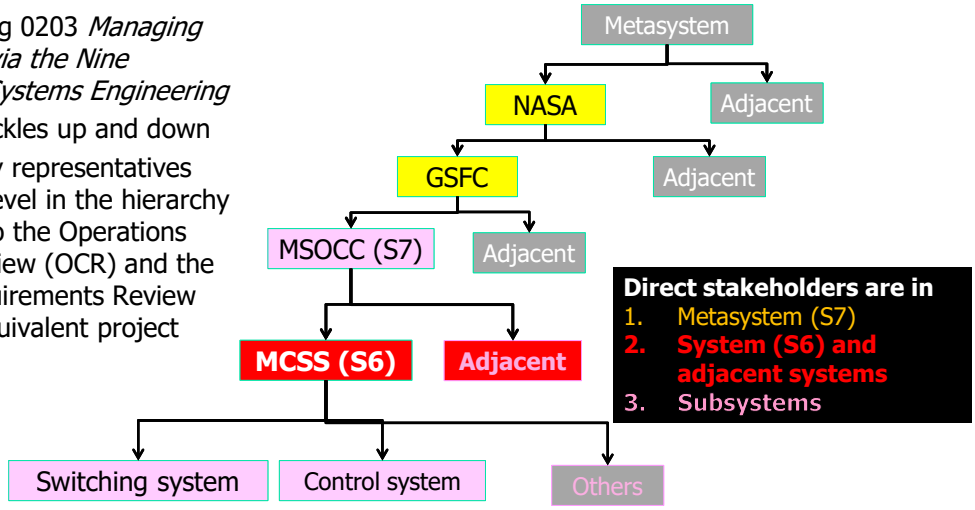
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Influencing direct/indirect stakeholders

- From Reading 0203 *Managing Complexity via the Nine Systems in Systems Engineering*
- Influence trickles up and down
- Which is why representatives from each level in the hierarchy are invited to the Operations Concept Review (OCR) and the System Requirements Review (SRR) (or equivalent project milestones)



Three ways to influence stakeholders*

1. Gentle persuasion for mild or unintentional resistance
2. Trade to align interests and commitments
3. Power play to overcome significant resistance

* Kambil Ajit, influencing stakeholders: Persuade, trade, or compel, https://www2.deloitte.com/us/en/insights/focus/executive-transitions/influencing-stakeholders.html, accessed 12 September 2023

Influencing the stakeholders-1

- Building and maintaining relationships with stakeholders
  - Is a continuing process
  - Requires time, patience, and a genuine commitment to their interests
  - Often relies on your ability to create a sense of trust and collaboration, ensuring that all parties feel their concerns and interests are considered and addressed
  - Does not end once the requirements are written
  - Needs to be customized to the project

Influencing the stakeholders-2

1. Identify and understand your stakeholders:
   1. Create an appropriate list of all the stakeholders involved. The more influential the more information
   2. Analyze their interests, needs, and concerns
   3. Understand what motivates them and what they value
2. Build strong relationships:
   1. Establish open and honest communication channels with stakeholders
   2. Actively listen to their feedback and concerns
   3. Show empathy and respect for their perspectives
3. Communicate clearly and transparently:
   1. Use simple and understandable language, avoiding jargon
   2. Continuously update them on progress, but
   3. Customize your communication style and approach to suit each stakeholder
      - Some stakeholders may prefer regular updates, while others may not

Influencing the stakeholders-3

4. Address concerns and objections:
   - Be prepared to address questions, concerns, or objections from stakeholders
   - Provide evidence or data to support your arguments
   - Avoid a confrontational or win-lose mindset
5. Demonstrate credibility and expertise:
   - Showcase your knowledge and expertise in the subject matter
   - Build trust by delivering on your promises and commitments
   - Don't be arrogant or boring
6. Keep records:
   - Use emails to confirm agreements and other pertinent information
   - Maintain a record of all communications and agreements with stakeholders
   - This helps in accountability and ensures that commitments are met
7. Avoid the bad you have experienced or read/heard about
   - If you didn't like it, the probability is others won't like it as well

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Build - buy

- If need can be met by a cost effective purchase of a Commercial Off-The-Shelf (COTS) product
  - Need is for all or part of the COTS functionality
- Watch out for technical obsolescence
  - See 0403 Kasser, J.E., Applying Holistic Thinking to the Problem of Determining the Future Availability of Technology, IEEE Transactions on Systems, Man, and Cybernetics: Systems, Volume 46, Number 3, 2016.
- Specifying current version
  - Can end up with obsolescent systems
- Specifying current version or later
  - Can end up with incompatibilities
- Always specify product, and version (at least, equivalent, or better)

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Exercise 4-1 scenarios to requirements

1. Update the extracted scenarios in your Exercise 2-1 presentation
2. Assign an identification to each scenario
3. Add at least one misuse function to at least one scenario
4. Write at least 10 well-written requirements with traceability to any of the scenarios including the scenario(s) updated with the misuse function(s)
5. Prepare a <5 minute presentation containing
    1. The misuse function in its scenario highlighting the modification(s) if any
    2. At least 10 well-written requirements including some traceable to the misuse function
    3. Traceability of each requirement to the source scenario and function
    4. A compliance matrix for the exercise
    5. The exercise problem formulated per COPS problem formulation template
    6. Lessons learned from exercise
6. Save as a PowerPoint file in format Exercise4.1-abcd.pptx
7. Post/email presentation as and where instructed

Exercise 4-2 knowledge reading

1. Prepare a brief on two main points on reading 0402 (< 5min)
2. Presentation to contain
    1. The exercise problem formulated per COPS problem formulation template
    2. A summary of the content of the reading (<1 minute)
    3. The compliance matrix
    4. This slide
    5. The main points (<1 minute)
    6. Brief on one main point (<1 minute per point)
    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 Exercise4.2-abcd.pptx
4. Post/email presentation as and where instructed

Exercise 4-3 knowledge reading (optional)

1. Prepare a brief on two main points on reading 0403 (< 5min)
2. Presentation to contain
    1. The exercise problem formulated per COPS problem formulation template
    2. A summary of the content of the reading (<1 minute)
    3. The compliance matrix
    4. This slide
    5. The main points (<1 minute)
    6. Brief on one main point (<1 minute per point)
    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 Exercise4.3-abcd.pptx
4. Post/email presentation as and where instructed

Meeting the objectives

#	Objectives	Met
1	Presented and discuss the BWMQ and exercise presentations from previous session	11-13
2	Explained how to convert stakeholder functional and performance "wants" to "needs"	16-21
3	Explained the difference between functions and misuse functions	23-28
4	Introduced risk management	29-35
5	Explained three ways to maximize the completeness of the needs	21
6	Explained need for prioritization of needs and how to prioritize them	37-38
7	Explained how to influence the stakeholders to want the system they need	46-50
8	Explained how to determine if the need is for COTS equipment	52
9	Provided the opportunity to exercise 5 levels of knowledge in the updated Blooms taxonomy	54-56

Objectives of Session 5

1. To present and discuss the BWMQ and exercise presentations from previous session
2. To explain how to document and store the stakeholder needs
3. To provide reasons for documenting needs
4. To explain models and modelling
5. To discuss modeling tools
6. To explain some of the different types of models
7. To explain uses, advantages and limitations of models
8. To explain how to create functional models
9. To explain how to communicate functional and operational models to stakeholders
10. To practice creating parts of a model
11. To practice writing requirements traceable to scenarios
12. To provide the opportunity to exercise the 5 levels of knowledge in the updated Blooms taxonomy

Any questions ?

1. Best
2. Worst
3. Missing
4. Questions



Email: beyondsystemsthinking@yahoo.com
Subject: <class title> BWMQ Session #