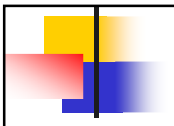
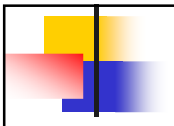


Creating Outstanding Problem Solvers

Module 1 Session 3:
Systems Thinking and Beyond

Rev 3.1.7



Topics : Systems thinking and beyond

1. Why true understanding requires perceptions from different perspectives
2. The myth of open and closed systems
3. The distribution of HTPs
4. Exercises

Knowledge component

1. Lecture
   - Overview and summary of readings
2. Readings
   - 0104 A systemic and systematic approach to finding out-of-the-box solutions https://youtu.be/52awMkJkNgg
   - 0105 Holistic Thinking Section 4.3: The Holistic Thinking Perspectives updated in Systems Thinker's Toolbox Chapter 10
   - 0106 Kasser, J.E., Lerner B., Two major misconceptions of systems thinking exposed, British Computer Club Webinar, April 2023 (https://youtu.be/fxZa-qpnAnU)
3. References
   - Systems Thinker's Toolbox for individual tools discussed
4. Exercises

Thinking about a system

- Human nature – non-systems approach
  - Thinks about ideas from
    - Single viewpoint
    - Different non-standardized viewpoints in random order depending on person
- Systems approach (1986)*
  - Thinks about ideas from 3 standardized views in order
    - Think about the purpose and function first
    - Think about physical structure later
- Seven streams of systems thinking (1993)**
  - Seven standardized views in ordered and random order
- Systems Thinking Perspectives (2008)***
  - Nine standardized views in ordered and random order
    - Follows human nature
  - *Purpose*, functional, physical and more
    - Provides multiple perspectives
    - Provide anchor points on 'same page'

* Churchman, C. West, The Systems Approach, Dell Publishing Co, 1968, Page 13
** Richmond, B., *Systems thinking: critical thinking skills for the 1990s and beyond*, System Dynamics Review, Vol 9 (1993), no. 2, 113-133.
*** Kasser, J. E. and Mackley, T., *Applying systems thinking and aligning it to systems engineering*, proceedings of the 18th INCOSE International Symposium, Utrecht, Holland, 2008.

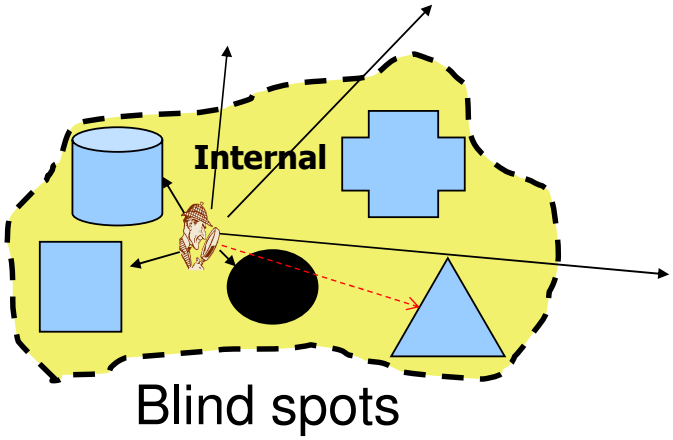
To understand a thing

1. Analysis (machine age)*
   - Take apart the thing to be understood;
   - Try to understand how these parts worked;
   - Assemble an understanding of the parts into an understanding of the whole.

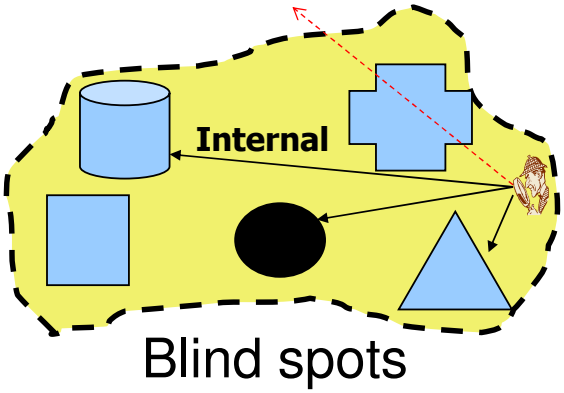
1. Systems Thinking (systems age)*
   - A thing to be understood is conceptualized as a part of one or more larger wholes, not as a whole to be taken apart;
   - An understanding of the larger system is sought;
   - The system to be understood is explained in terms of its *role or function* in the containing system.

* Ackoff, 1991

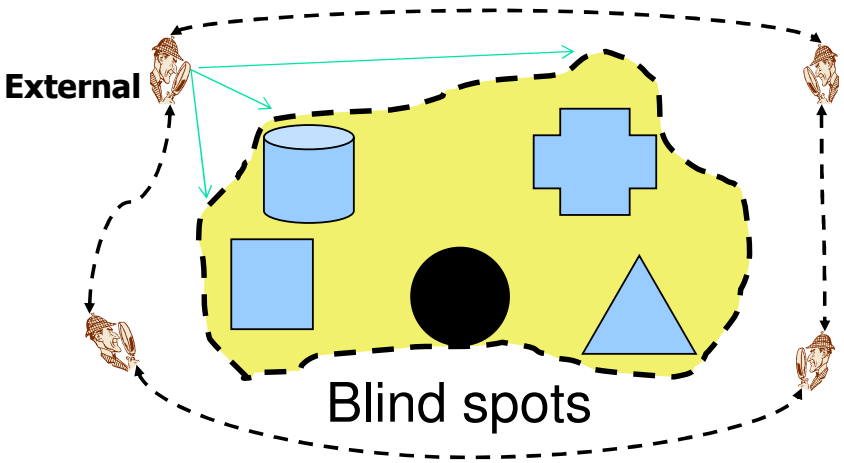
Perspectives of a situation-1



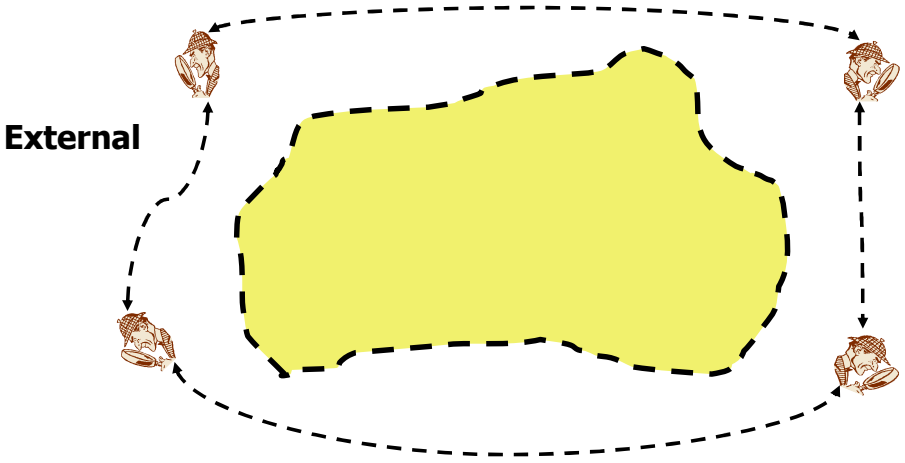
Perspectives of a situation-1a



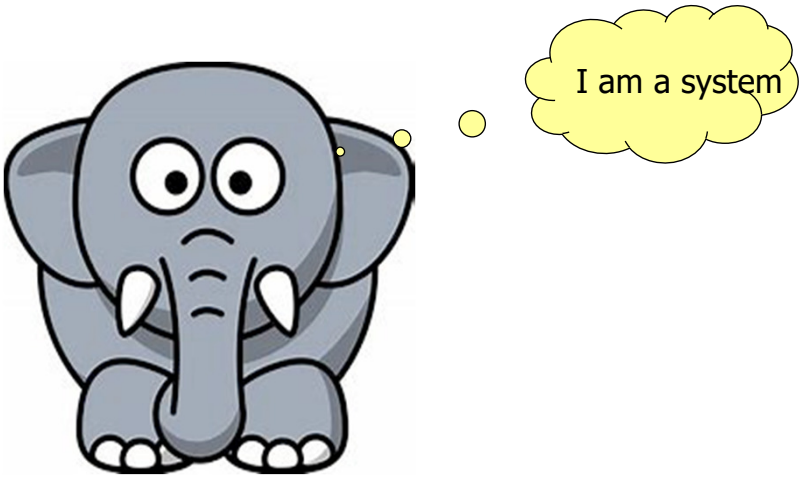
Perspectives of a situation-2



Perspectives of a situation-3



Limits of a single perspective



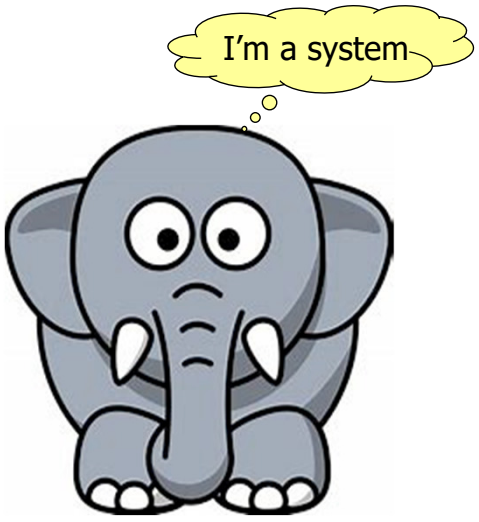
Benefits of several perspectives*

"People who learn to read situations from different (theoretical) points of view have an advantage over those committed to a fixed position. For they are better able to recognize the limitations of a given perspective. They can see how situations and problems can be framed and reframed in different ways, allowing new kinds of solutions to emerge"

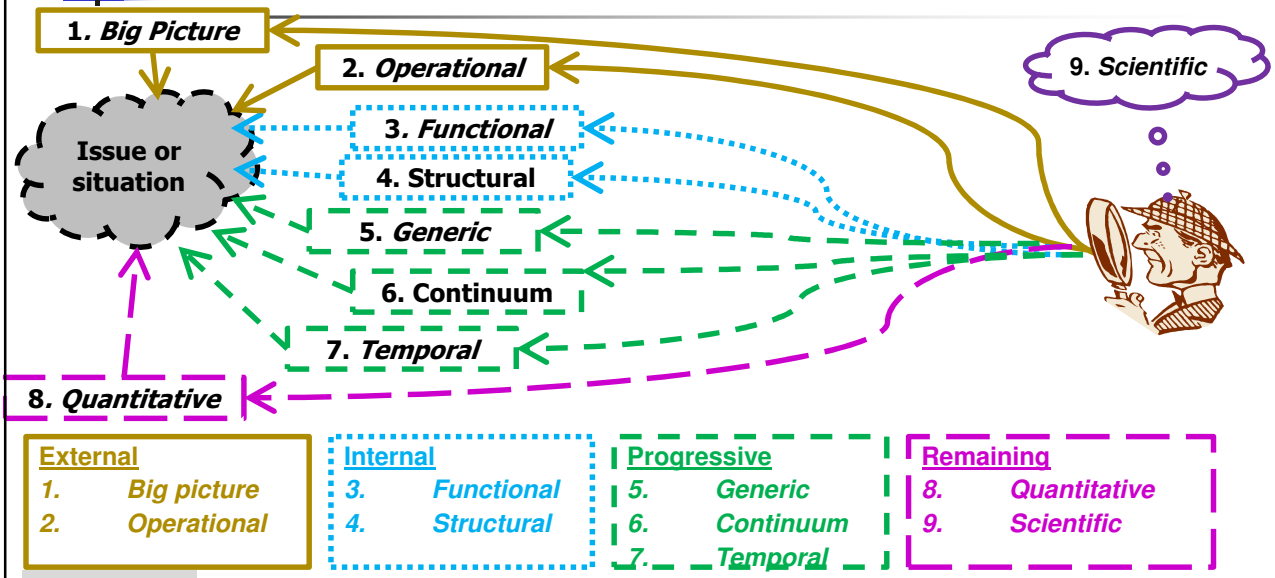
Morgan, G., *Images of Organisation*, SAGE Publications, Thousand Oaks, CA, 1997

ONE standard set of perspectives

1. Big Picture
2. Operational
3. Functional
4. Structural
5. Generic
6. Continuum
7. Temporal
8. Quantitative
9. Scientific



Systems thinking : The Holistic Thinking Perspectives*



External	Internal	Progressive	Remaining
1. Big picture	3. Functional	5. Generic	8. Quantitative
2. Operational	4. Structural	6. Continuum	9. Scientific
		7. Temporal	

*STT 10.1

Current situation

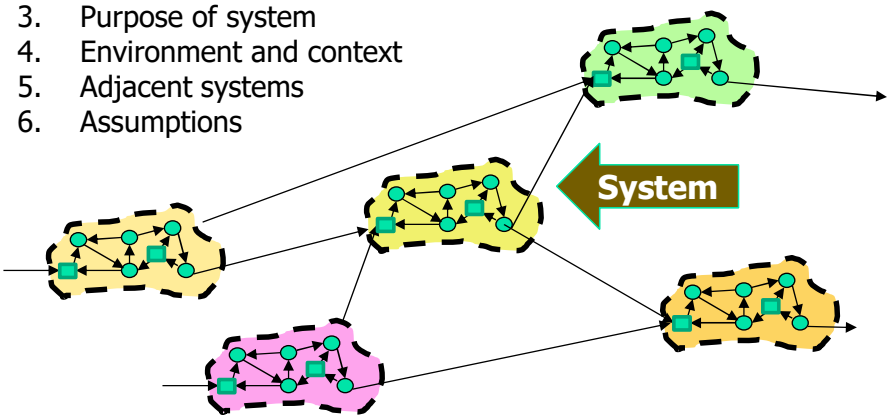
1. Some of us use these
   - All of the time
   - Most of the time
   - Some of the time
   - None of the time
2. When not thinking emotionally

External and internal perspectives

- **External perspectives:**
  1. ***Big Picture:*** the context for the system and any assumptions pertaining to the system
  2. ***Operational:*** what the system does: a black box perspective
     - **Causal loops**
- **Internal perspectives:**
  3. ***Functional:*** what the system does and how it does it: a white box perspective
     - **Causal loops**
  4. ***Structural:*** how the system is constructed and organized

Big picture perspective (Complex)

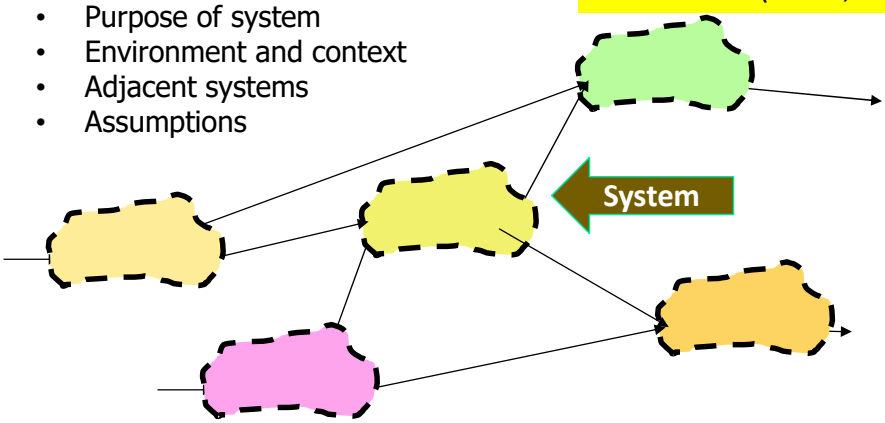
1. **External view**
   - Helicopter (Bird's eye)
2. Static view
3. Purpose of system
4. Environment and context
5. Adjacent systems
6. Assumptions



Big picture (abstracted complexity)

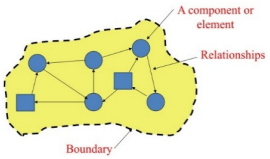
- **External view**
  - Helicopter (Bird's eye)
- Static view
- Purpose of system
- Environment and context
- Adjacent systems
- Assumptions

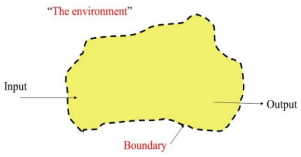
Miller's rule (Miller, 1976)



Myth of open and closed systems

1. Myth
   - Two different types of systems
- **Reality**
  - **Two views of same system**
2. Closed system
   - **Internal** or 'white box' view
   - Functions performed by the system
   - Structure of system
3. Open system
   - **External** or 'black box' view
   - Big picture – Metasystem and adjacent systems
   - Missions/operations performed by the system
- How myth arose
  - Often only one view is used for a system





Example: Docking in Space

Docking in Space

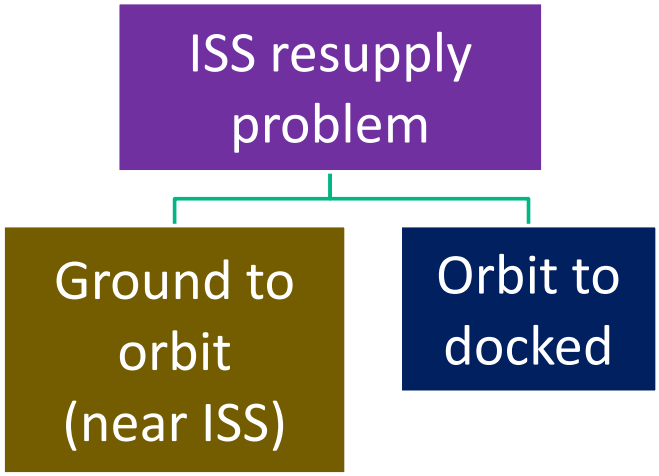
1. **We construct a closed system**
   - We abstract out everything other than information pertinent to
     - Relative positions of the spacecraft
     - Relative velocity
     - Relative alignment in X, Y and Z orientation
2. Sub problem of transporting from Earth to International Space Station (ISS)
   - Problem 1: move vehicle from Earth to near space station
   - Problem 2: dock vehicle to space station

Progressive and remaining perspectives

- **Progressive perspectives:**
  5. ***Generic***: where the system is perceived as an instance of a class of similar systems
     - **Out of the box**
  6. ***Continuum:*** where the system is perceived as but one of many alternatives; differences
     - **Out of the box**
  7. ***Temporal:*** which perceives the past, present and future of the system
- **Remaining perspectives:**
  8. ***Quantitative:*** the numeric and other quantitative information associated with the system
  9. ***Scientific:*** a prescriptive perspective; the hypothesis or guess about the issue, cause and solution

Example: Refueling electric cars

Example: Docking in space



***Generic* HTP**
Golf
1. Hole in one
2. Hole in two via green

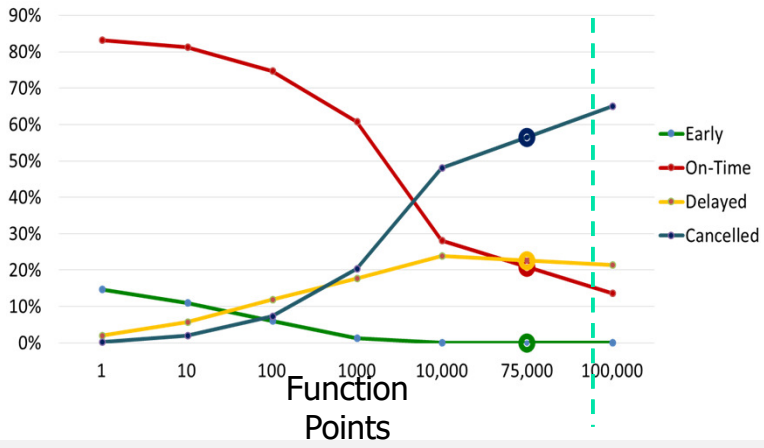
Software project outcomes* (Table view)

Project Software Design Review Estimate ~75,000 FPs

FPs	Early	On-Time	Delayed	Cancelled
1	14.68%	83.16%	1.92%	0.25%
10	11.08%	81.25%	5.67%	2.00%
100	6.06%	74.77%	11.83%	7.33%
1000	1.24%	60.76%	17.67%	20.33%
10,000	0.14%	28.03%	23.83%	48.00%
100,000	0.00%	13.67%	21.33%	65.00%

* Capers Jones, *Patterns of Software Systems Failure and Success,* International Thomson Computer Press, 1996

Software project outcomes* (graphical view)



* Data from Capers Jones, *Patterns of Software Systems Failure and Success*, International Thomson Computer Press, 1996

Scientific perspective

1. Statement of the problem and solution
   - Filtering out pertinent information
   - Similar to 'trial and error' approach to problem solving
2. Hypothesis formulation and testing
3. Guesses
4. Designs
5. Research questions

Which perspective is needed?

1. It depends on the problem
2. External
   - ~Systems thinking
     - How object relates to other …
3. Internal
   - Analysis
     - How object functions

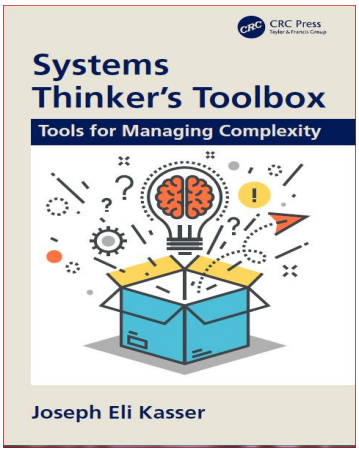
Understanding of situations

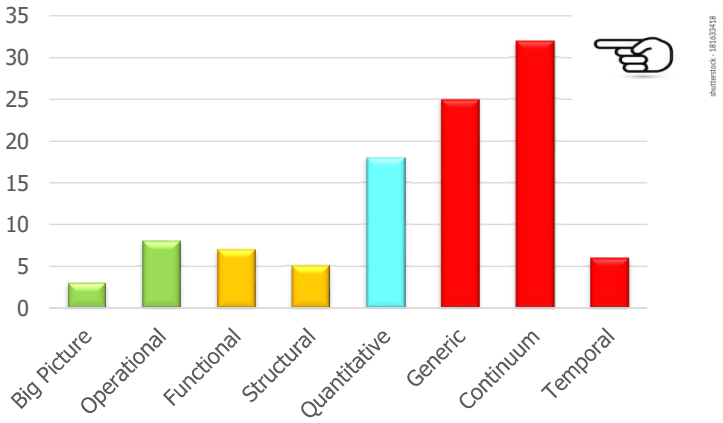
4. Progressive and Remaining
   - Beyond systems thinking

Solutions

Use of HTPs

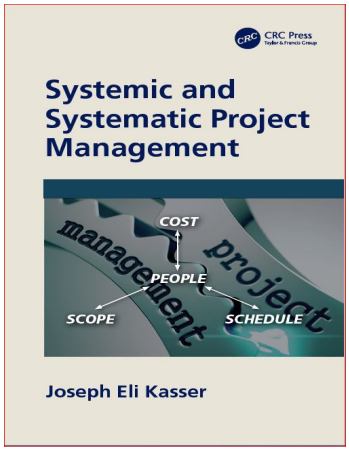
Distribution of HTPs - Toolbox

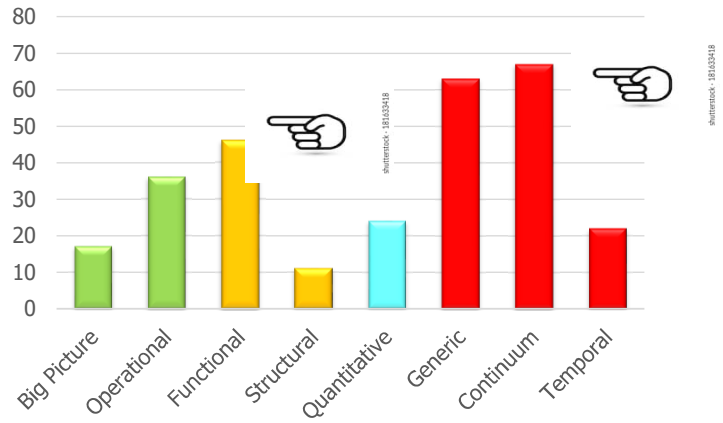




September 2018

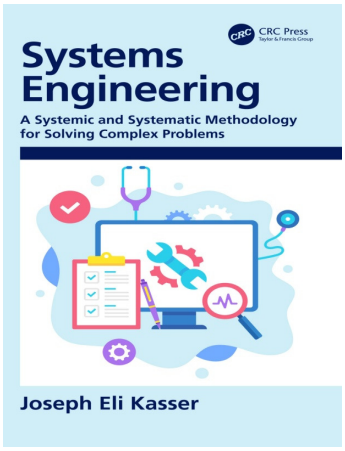
Distribution of HTPs – Project management



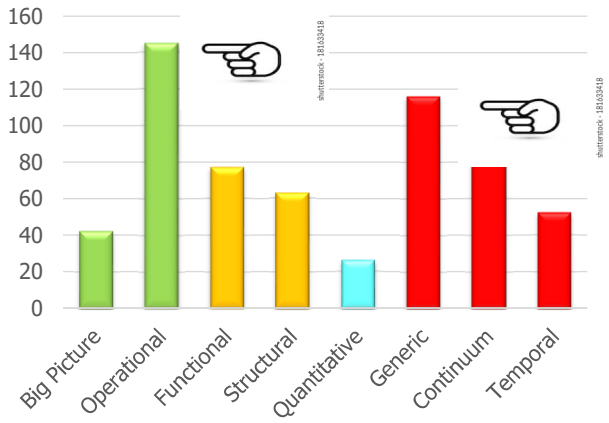


August 2019

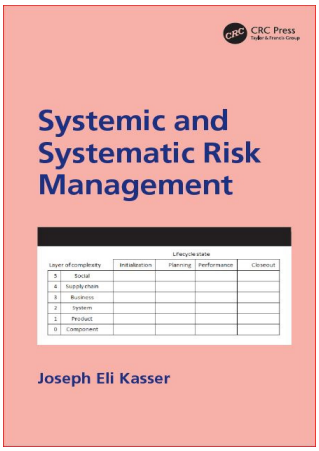
Distribution of HTPs – Systems engineering



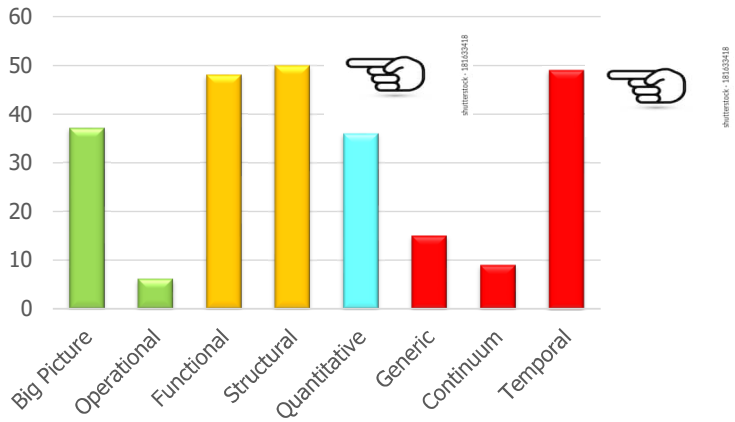
October 2019



Distribution of HTPs - Risk management



July 2020



Exercise 1-31

1. Perceive the classroom from the eight descriptive HTPs identifying aspects
2. Compare these perceptions with those from the previous exercises
3. Prepare a <5 minute presentation containing
    1. This slide
    2. The version number of the lesson
    3. Some of the perceptions of the classroom from the eight descriptive HTPs
    4. The differences between the perceptions identified in this exercise and the perceptions in the previous exercises
    5. A compliance matrix for this exercise
    6. Lessons learned from exercise
4. Save as a PowerPoint file in format Exercise1-31-abcd.pptx
    - abcd = 4 characters that will identify your postings in this course
5. Post in the asynchronous group as instructed

Exercise 1-32 knowledge presentation

1. Prepare a brief on two main points in reading 0104 (< 5min)
2. Presentation to contain
    1. A summary of the content of the reading (<1 minute)
    2. The compliance matrix
    3. This slide
    4. A list of the main points
    5. The two briefings
    6. Reflections and comments on reading (<2 minute)
    7. Comparisons of content with other readings and external knowledge
    8. Why you think the reading was assigned to the module
    9. Lessons learned from module and source of learning e.g. readings, exercise, experience, etc. (<2 minutes)
3. Save as a PowerPoint file as Exercise1-32-abcd.pptx
4. Post/email presentation as, when and where instructed
5. Brief on one main point

Exercise 1-33 knowledge presentation

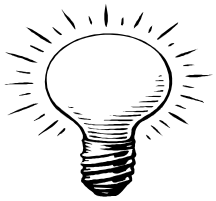
1. Prepare a brief on two main points in reading 0105 (< 5min)
2. Presentation to contain
    1. A summary of the content of the reading (<1 minute)
    2. The compliance matrix
    3. This slide
    4. A list of the main points
    5. The two briefings
    6. Reflections and comments on reading (<2 minute)
    7. Comparisons of content with other readings and external knowledge
    8. Why you think the reading was assigned to the module
    9. Lessons learned from module and source of learning e.g. readings, exercise, experience, etc. (<2 minutes)
3. Save as a PowerPoint file as Exercise1-33-abcd.pptx
4. Post/email presentation as, when and where instructed
5. Brief on one main point

Exercise 1-34 knowledge presentation

1. Prepare a brief on two main points in reading 0106 (< 5min)
2. Presentation to contain
    1. A summary of the content of the reading (<1 minute)
    2. The compliance matrix
    3. This slide
    4. A list of the main points
    5. The two briefings
    6. Reflections and comments on reading (<2 minute)
    7. Comparisons of content with other readings and external knowledge
    8. Why you think the reading was assigned to the module
    9. Lessons learned from module and source of learning e.g. readings, exercise, experience, etc. (<2 minutes)
3. Save as a PowerPoint file as Exercise1-34-abcd.pptx
4. Post/email presentation as, when and where instructed
5. Brief on one main point

Summary of Module 1

1. Thinking
2. Systems thinking
3. Tools to assist thinking
4. Systems thinking and beyond
5. Exercise
   - Opportunity to practice what you learnt



Meeting the objectives of the module

1. Learnt about thinking
2. Learnt about and used a number of systems thinking tools
3. Learnt that systems thinking is generally applied but in an incomplete ad-hoc manner
4. Recognized the need to go beyond systems thinking

Any questions ?

1. Best
2. Worst
3. Missing

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