



## Creating Outstanding Problem Solvers

# Module 1 Session 3: Systems Thinking and Beyond

Rev 3.1.8

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0101-63



## 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

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## 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

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## 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.

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## 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)\*

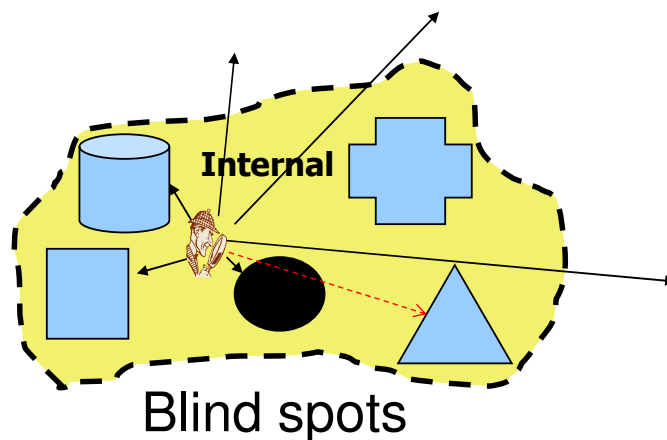
- A thing to be understood is conceptualized as a part of one or more larger wholes, not as a whole to be taken apart;
- An understanding of the larger system is sought;
- The system to be understood is explained in terms of its *role or function* in the containing system.

\* Ackoff, 1991

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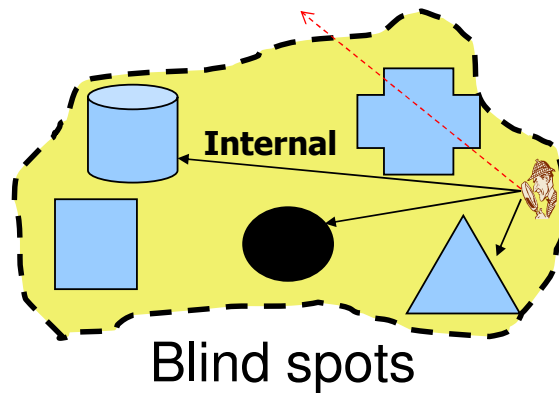
## Perspectives of a situation-1



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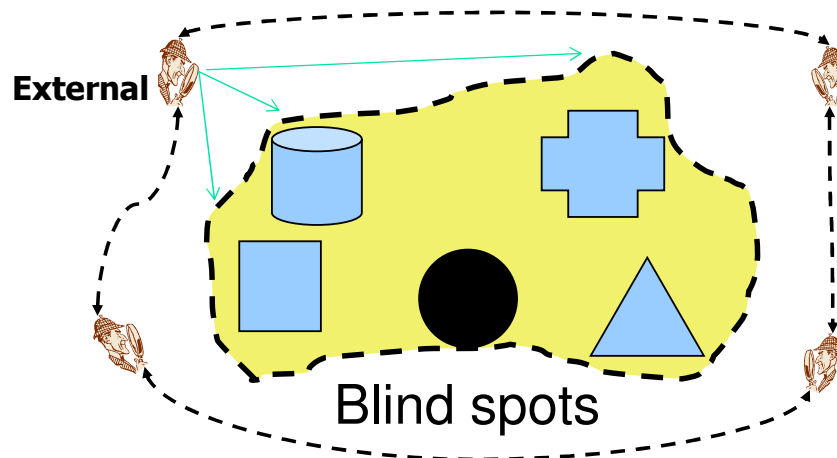
## Perspectives of a situation-1a



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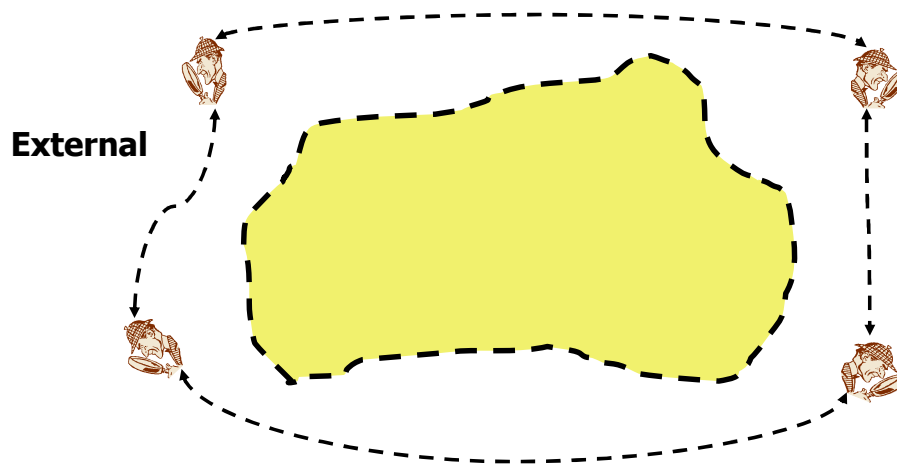
## Perspectives of a situation-2



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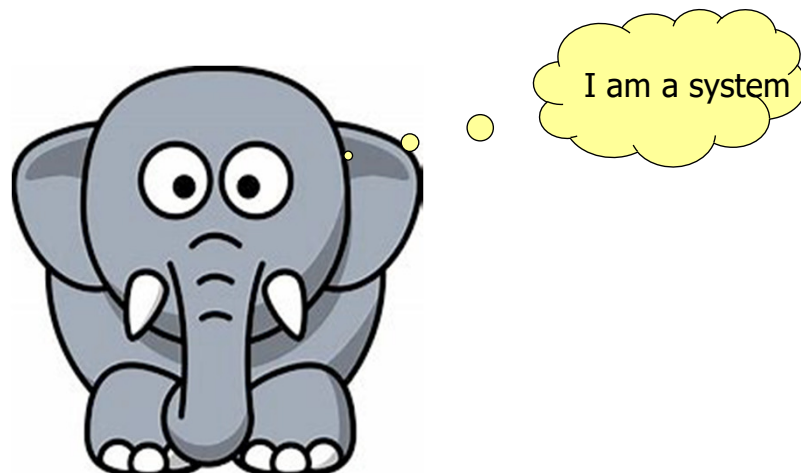
## Perspectives of a situation-3



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## Limits of a single perspective



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## 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"

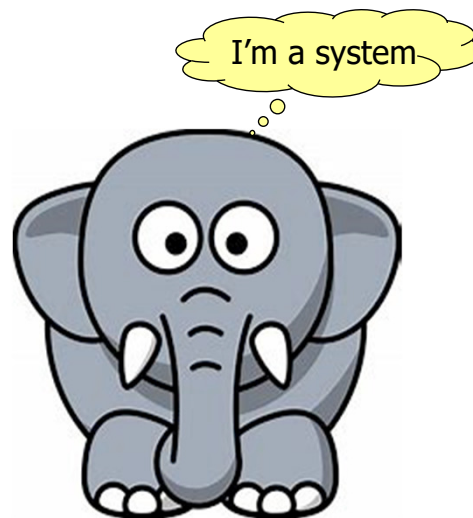
Morgan, G., *Images of Organisation*, SAGE Publications, Thousand Oaks, CA, 1997

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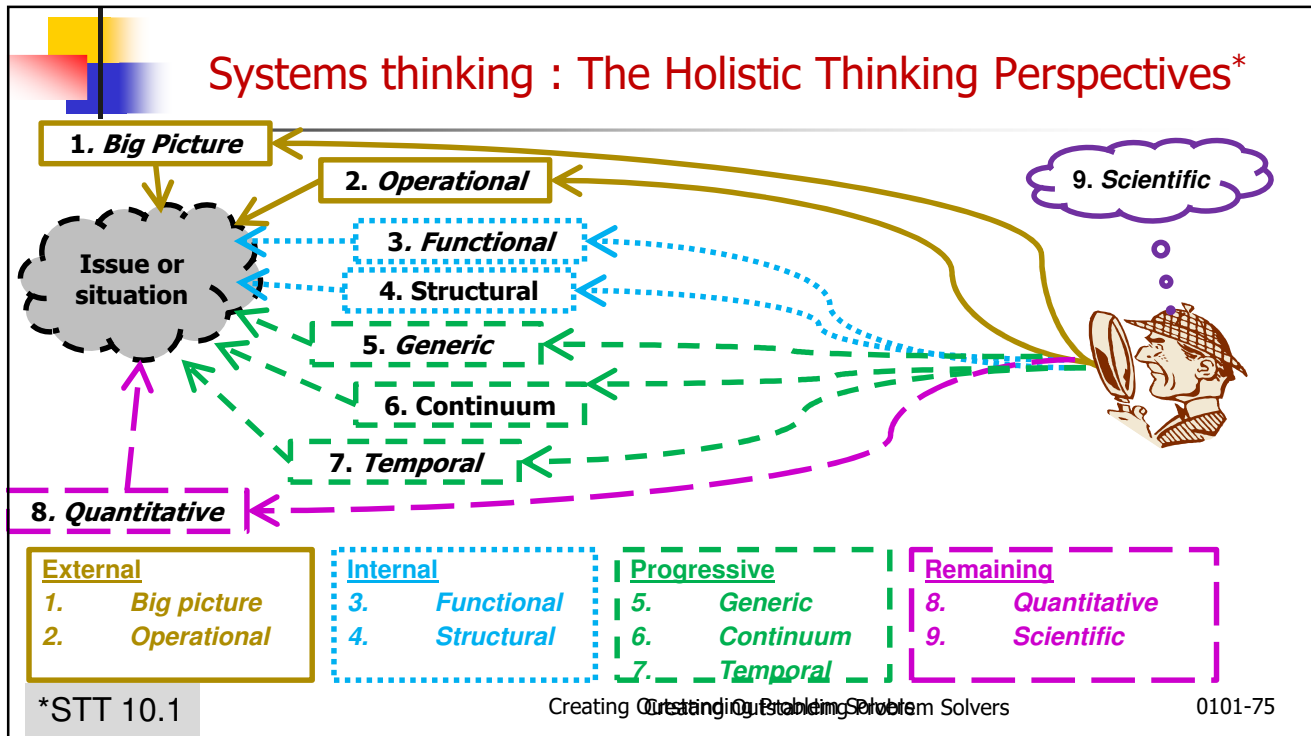
## ONE standard set of perspectives

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



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## Current situation

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

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## 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

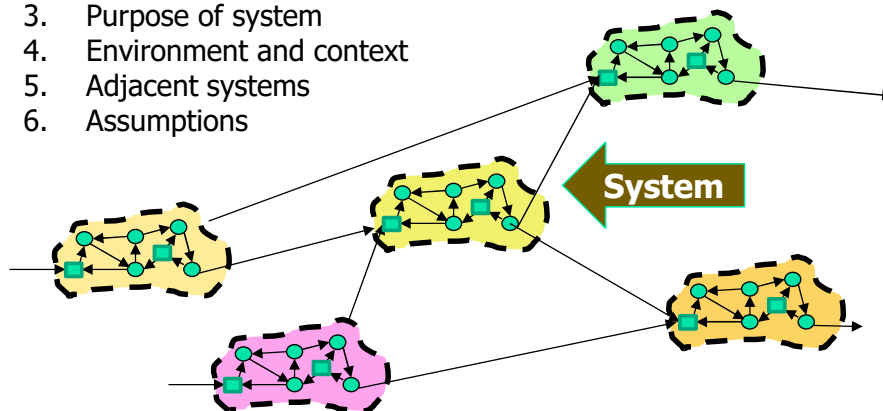
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## Big picture perspective (Complex)



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



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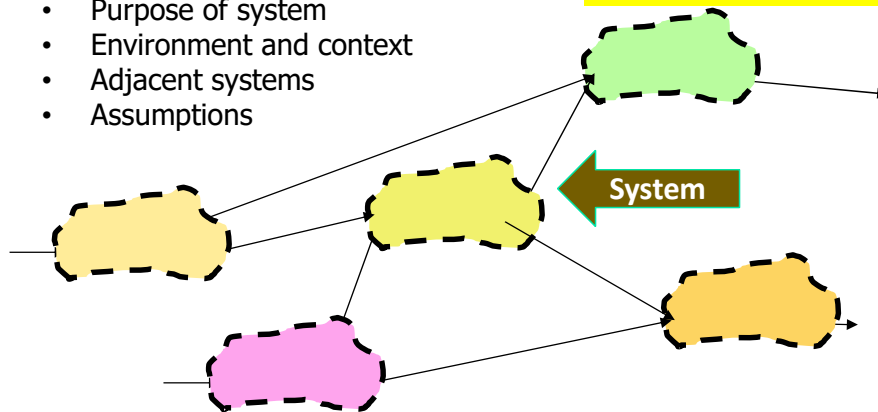


## Big picture (abstracted complexity)



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

Miller's rule (Miller, 1976)

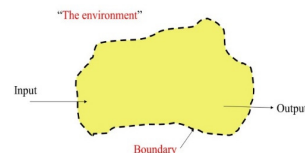
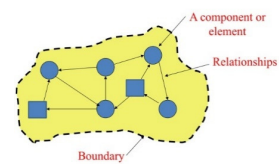


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## Myth of open and closed systems

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



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## Example: Docking in Space



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## 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

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## 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

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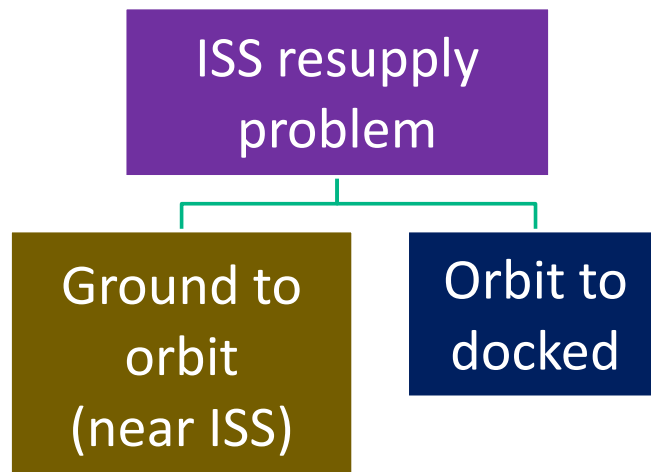
## Example: Refueling electric cars



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## Example: Docking in space



### Generic HTP

Golf

1. Hole in one
2. Hole in two via green

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## Software project outcomes\* (Table view)

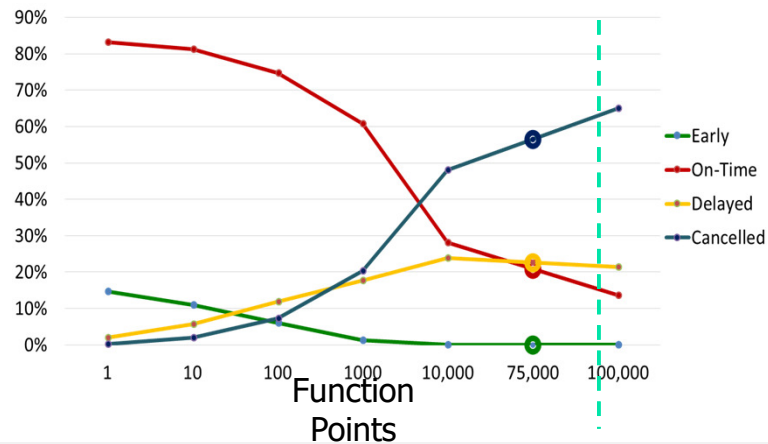
FPS	Early	On-Time	Delayed	Cancelled
<b>1</b>	<b>14.68%</b>	<b>83.16%</b>	<b>1.92%</b>	<b>0.25%</b>
<b>10</b>	<b>11.08%</b>	<b>81.25%</b>	<b>5.67%</b>	<b>2.00%</b>
100	6.06%	74.77%	11.83%	7.33%
1000	1.24%	60.76%	17.67%	20.33%
<b>10,000</b>	<b>0.14%</b>	<b>28.03%</b>	<b>23.83%</b>	<b>48.00%</b>
<b>100,000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

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

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## Software project outcomes\* (graphical view)



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

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## 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



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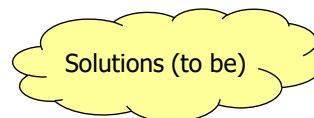
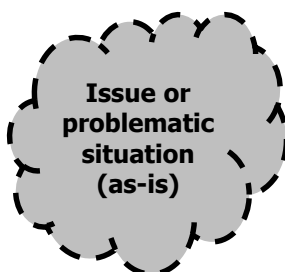
## Which perspective is needed?

1. It depends on the problem
2. External
  - ~Systems thinking
    - How object relates to other ...
3. Internal
  - Analysis
    - How object functions
4. Progressive and Remaining
  - Beyond systems thinking

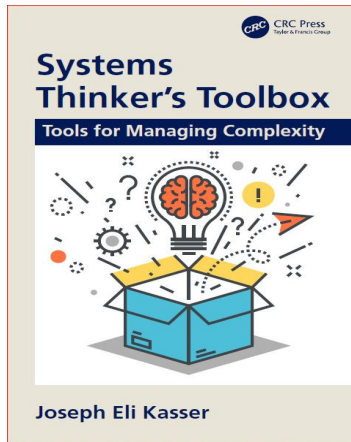
Understanding  
of situations

Solutions

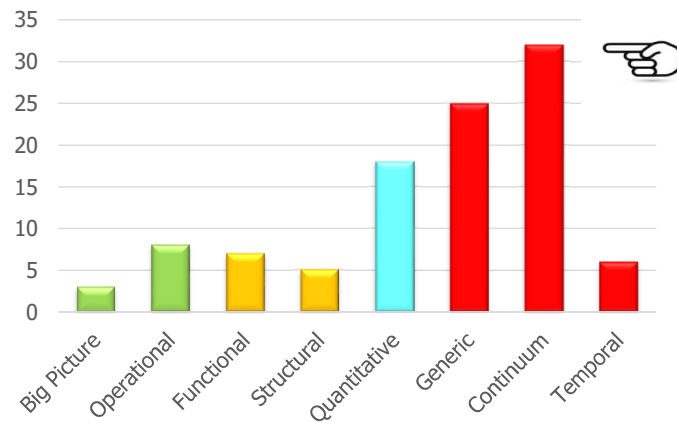
## Use of HTPs



## Distribution of HTPs - Toolbox



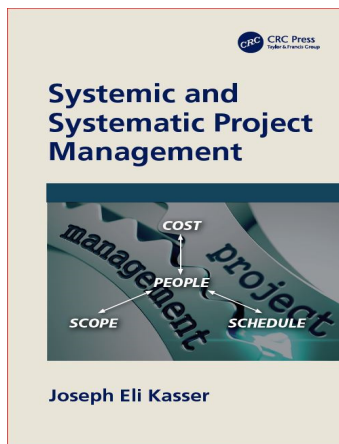
September 2018



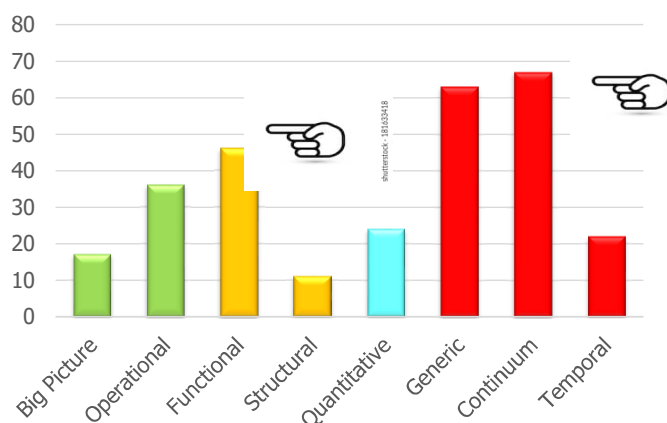
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## Distribution of HTPs – Project management



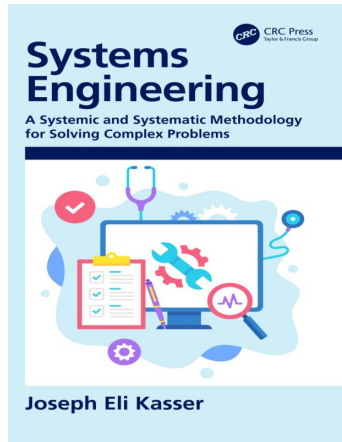
August 2019



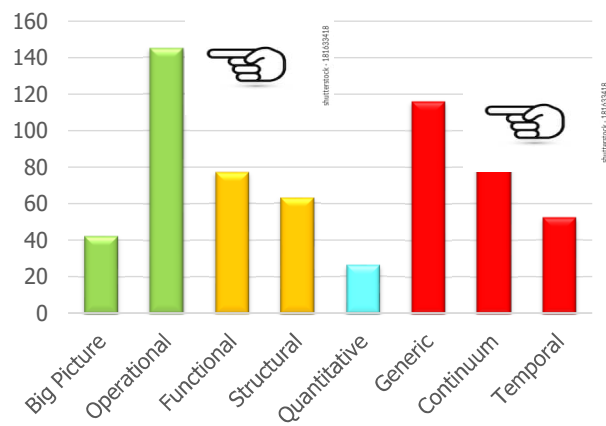
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## Distribution of HTPs – Systems engineering



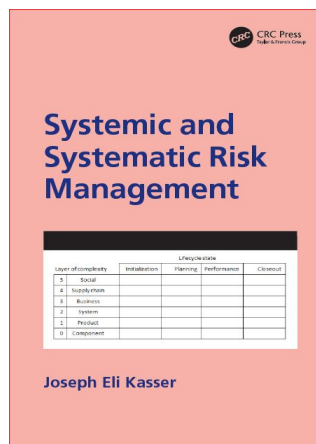
October 2019



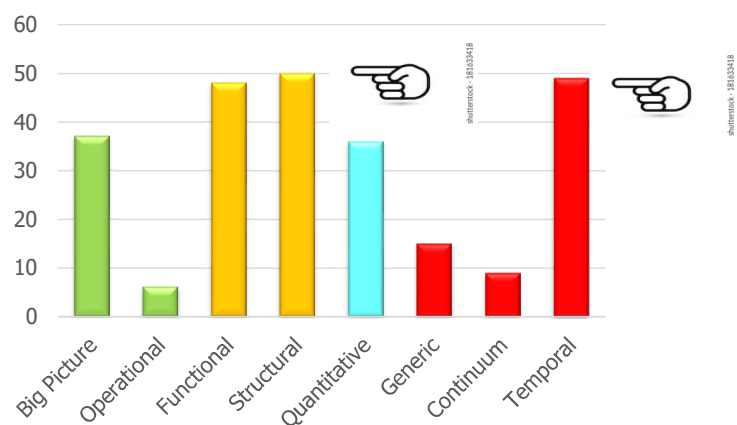
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## Distribution of HTPs - Risk management



July 2020



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## 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

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## 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 and the version number of the session
  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

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## 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 and the version number of the session
  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

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## Exercise 1-34 knowledge presentation

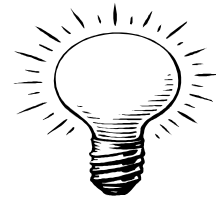
1. Prepare a brief on two main points in reading 0106 (< 5min)
2. Presentation to contain
  1. A summary of the content of the reading (<1 minute)
  2. The compliance matrix
  3. This slide and the version number of the session
  4. A list of the main points
  5. The two briefings
  6. Reflections and 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

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## 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



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## 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

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## Any questions ?

1. Best
2. Worst
3. Missing

Email: [beyondsystemsthinking@yahoo.com](mailto:beyondsystemsthinking@yahoo.com)  
Subject: <class title> BWM Lesson #



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