

A systems thinking approach for managing complex systems

Session 2 of 6

Systems and System of Interest



Version 1.0.2

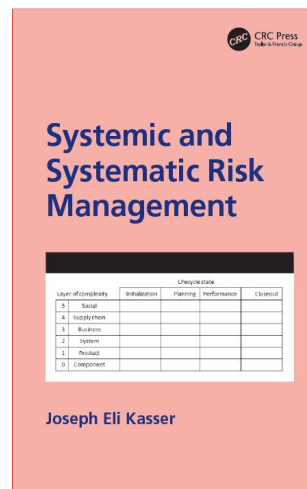
A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

11



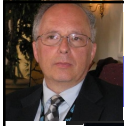
Topics

- Purpose
- Thinking and systems thinking
- Systems and system of interest
- Principle of hierarchies
- Emergence and emergent properties
- Problems and solutions
- The problem formulation template
- Complexity
- Interface partitioning
- Classification and types of problems



A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

12



Which system are we discussing?



<https://youtu.be/0yOvbx7MUEE>

A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

13



(Sub)Topics

1. **The undesirable situation**
 1. The different definitions of a system in the literature
 2. There is no consensus on "what is a system"
2. **The assumptions**
 - There is a valid reason for the different definitions
3. **The Feasible Conceptual Future Desirable Situation (FCFDS)**
 1. An understanding of the reasons for the different definitions
 2. There is a consensus on "what is a system"
4. **The problem (what to do; steps to get to the solution, working backwards)**
 1. Infer the FCFDS
 2. Understand the context in which the definitions were made
 3. Look for the common elements in the definitions and specific differences
 4. Collect a reasonable sample of definitions
5. **The solution (how the what was done)**
 1. Examine the definitions
 2. Use critical thinking to infer conclusions

A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

14



Is this the system?

[https://nationalinterest.org/sites/default/files/main-images/R42%20\(1\).jpg](https://nationalinterest.org/sites/default/files/main-images/R42%20(1).jpg)



A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

15



Or is this the system

US Navy's first
female F-14
Tomcat pilot, Lt.
Carey Lohrenz.
<https://www.reddit.com/media?url=https%3A%2F%2Freddit.it%2Fz6hqu8it0mk01.jpg>



A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

16



What is the system?

■ Examined

- 51 different dictionary entries for the word "system" (Webster, 2004)
- 21 different publication definitions from 1963 - 2004
 - ([Johnson, et al., 1963](#)), ([Miles, 1973](#)), ([Blanchard and Fabrycky, 1981](#)), ([Flood and Jackson, 1991](#)), ([Rechtin, 1991](#)), ([Aslaksen and Belcher, 1992](#)), ([Chapman, et al., 1992](#)), ([Checkland, 1991](#)), ([Deming, 1993](#)), ([Beer, 1994](#)), ([Kline, 1995](#)), ([FS-1037C, 1996](#)), ([Dewitz, 1996](#)), ([Martin, 1997](#)), ([Sommerville, 1998](#)), ([IEEE 1220, 1998](#)), ([Westerman, 2001](#)), ([INCOSE, 2002](#)), ([Arnold, 2002](#)), ([Scuderi, 2004](#))

A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

17



Sample definitions -1

- An array of components designed to accomplish a particular objective according to a plan ([Johnson, et al., 1963](#)).
- A set of concepts and/or elements used to satisfy a need or requirement ([Miles, 1973](#)).
- An assemblage or combination of components or parts forming a complex or unitary whole ([Blanchard and Fabrycky, 1981](#)).
- A number of elements and the relationships between the elements ([Flood and Jackson, 1991](#)).
- A set of different elements so connected or related as to perform a unique function not performed by the elements alone ([Rechtin, 1991](#)).
- The model of a whole entity; when applied to human activity, the model is characterised fundamentally in terms of a hierarchical structure, emergent properties, communication and control. An observer may choose to relate this model to real-world activity. When applied to natural or man-made entities, the crucial characteristic is the emergent properties of the whole ([Checkland, 1991](#)).
- A network of interdependent components that work together to try to accomplish the aim of the system ([Deming, 1993](#)).

A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

18



Sample definitions -2

- A group of elements dynamically related in time according to some coherent pattern ([Beer, 1994](#) page 7).
- A set of **integrated** end products and their enabling products ([Martin, 1997](#) page 17).
- A collection of **interrelated components** that work together to **achieve** some objective ([Sommerville, 1998](#) page 24).
- An **entity** designed to function so as **to achieve** an objective ([Westerman, 2001](#) page 5).
- An integrated set of **elements** that accomplish a defined objective ([INCOSE, 2002](#)). **INCOSE** then adds, "*People from different engineering disciplines have different perspectives of what a "system" is*" ([INCOSE, 2002](#)).
- A combination of **interacting elements** organized to **achieve** one or more stated purposes ([Arnold, 2002](#)).
- A bounded **object** which is capable of **responding to external stimuli**, and in response to external stimuli a system's internal components interact with each other to produce internal and external effects ([Scuderi, 2004](#)).

A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

19



Comments

- There are two different classes of definitions shown:
 - 1) generic definitions
 - 2) definition of engineered systems
- A system can be anything we choose ([Kline, 1995](#))
- The choice is wholly and absolutely at the discretion of the person doing the analysis ([Kline, 1995](#))
- Thus the definition of a system is much like the view of words expressed by Humpty Dumpty in Lewis Carroll's *Through the Looking Glass* when he said, "**When I use a word, it means what I choose it to mean - neither more nor less.**" ([Kline, 1995](#))
- So it is with **the system**; it is just what you, or I, or anyone else doing a study say **the system** is.*
- Hence the different definitions in the literature and the continuing appearance of new definitions
- So will the dispute continue into the future?

A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

20



Continuum thinking

- Looking at the context in which the definitions were written
 - Each definer was **not** defining a **system**
 - Each definer was using the word '**system**' to describe **the system, namely their system of interest** (SOI)
 - It is just what you, or I, or anyone else doing a study say the system is.
 - And that is why they are all different
- **key concept** English grammar uses the word 'a' for a general object and the word 'the' for the specific instance of the object
 - **There is a difference between**
 - "the system", and
 - "a system"

A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

21



"A system" and "the system"

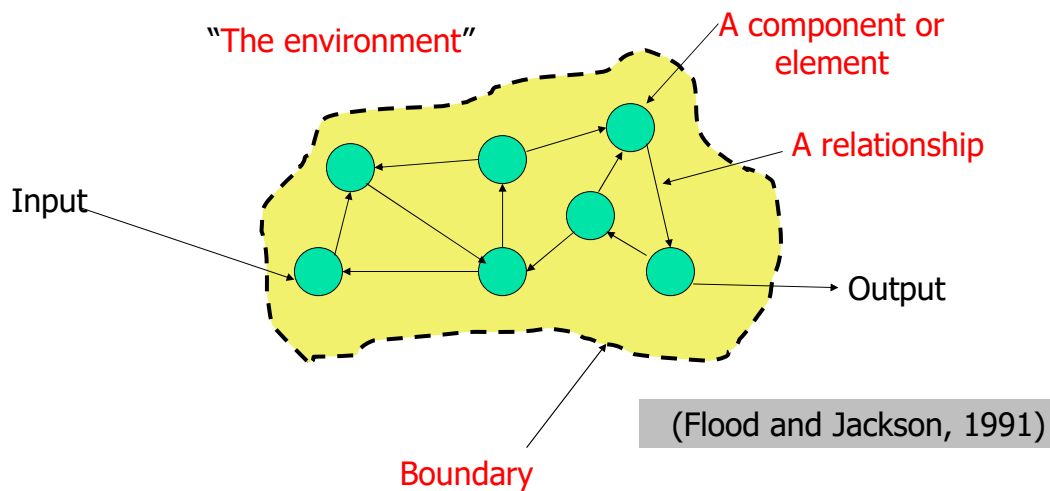
- A system
 - An agreement on a definition has not happened yet
 - A candidate definition based on core commonality in the SOIs
 - A system consists of **three** related sets, a set of **elements**, a set of **interactions** between the elements, and a set of **boundary** conditions ([Aslaksen and Belcher, 1992](#)).
- The system (of interest)
 - The **object of study**, what we want to discuss, define, analyse, think about, write about and so forth ([Kline, 1995](#)).
 - *"Our **choice of boundaries and interactions** depends on what **we are trying** to understand and what we, as engineers, want to achieve by this understanding, so that **system [of interest] definitions are inherently subjective**. In effect, defining a system **[of interest]** is the first step in creating a model of some part or aspect of reality"* ([Aslaksen, 2004](#)).

A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

22



Common elements



A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

23



Is this "the" system?



A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

24



Is this "the" system?

https://wallup.net/wp-content/uploads/2018/03/20/323320-Grumman_F-14_Tomcat-aircraft-military-aircraft-carrier-United_States_Navy.jpg



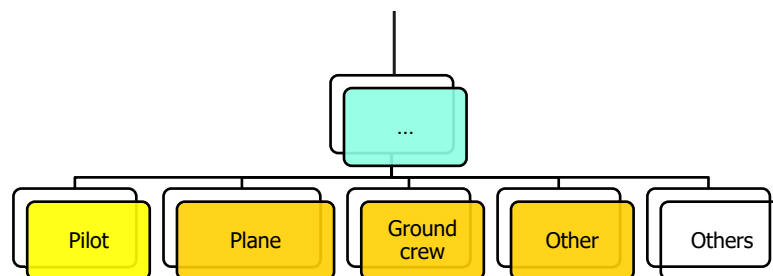
A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

25



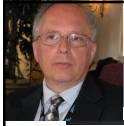
Which is the system?

1. Poorly phrased or wrong question
2. Question should be "What is the SOI?"



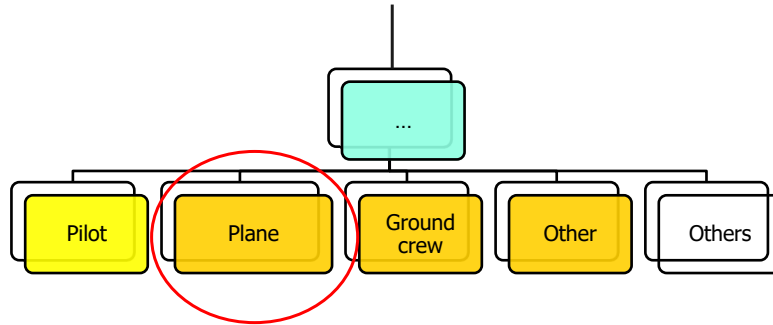
A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

26



Which is the system?

1. Poorly phrased or wrong question
2. Question should be "Which is the SOI?"



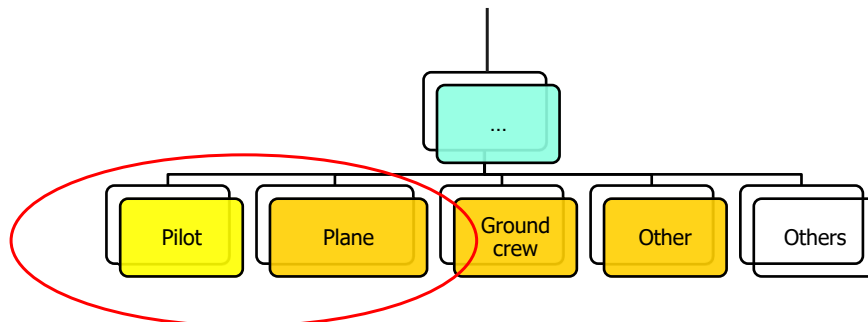
A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

27



Which is the system?

1. Poorly phrased or wrong question
2. Question should be "Which is the SOI?"



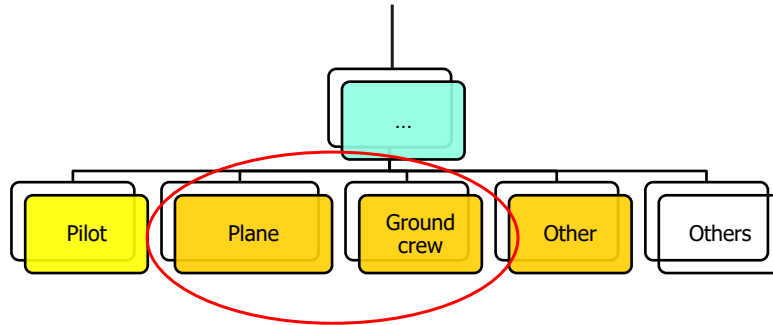
A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

28



Which is the system?

1. Poorly phrased or wrong question
2. Question should be "Which is the SOI?"



A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

29



Thinking about a camera

Using the Camera (systems analysis)

- **Capturing images**
 - The SOI contains the **camera and operator** and **whatever is being photographed**
- **Transporting camera**
 - The SOI contains the **camera, operator** and **camera case**
- **Recharging a camera**
 - The SOI contains the **camera, operator** and **charger**



Developing/Designing the Camera (engineering)

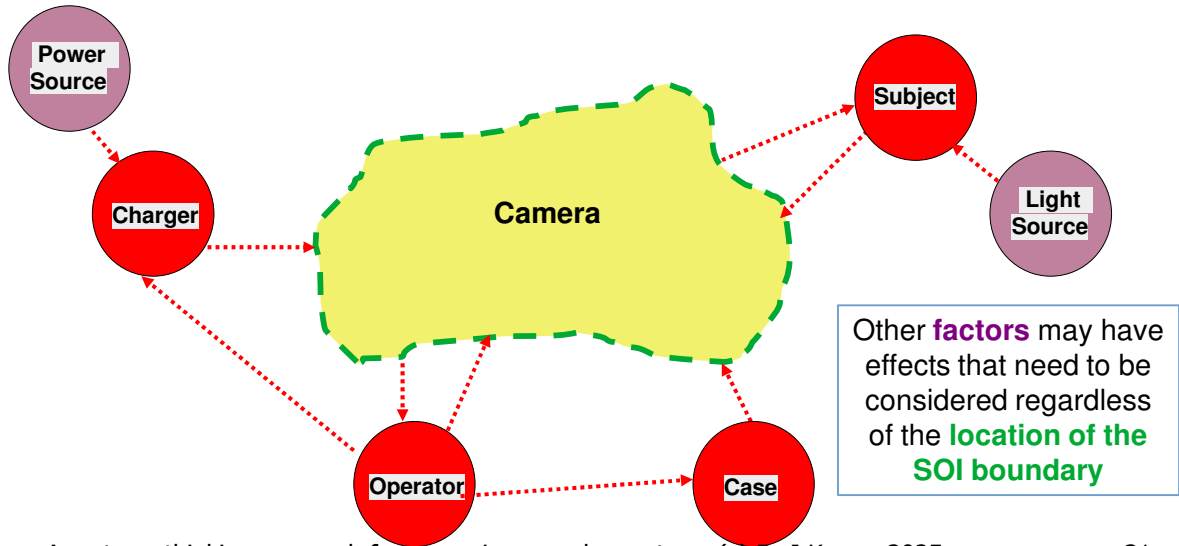
- **Understanding how a camera works**
 - The SOI is the **camera** and contains its functions/components

A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

30



Meta-system context (external view)

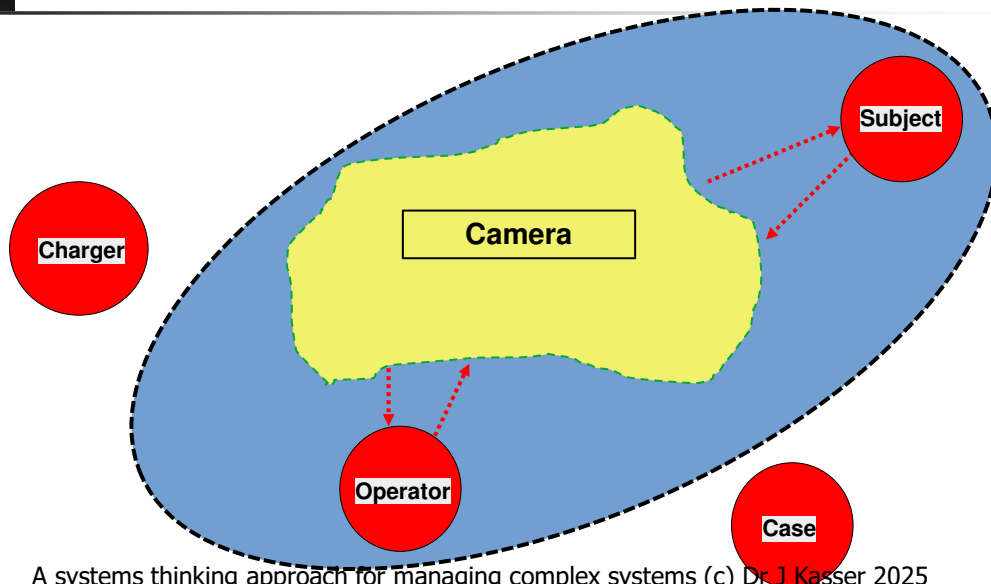


A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

31



Capturing images SOI

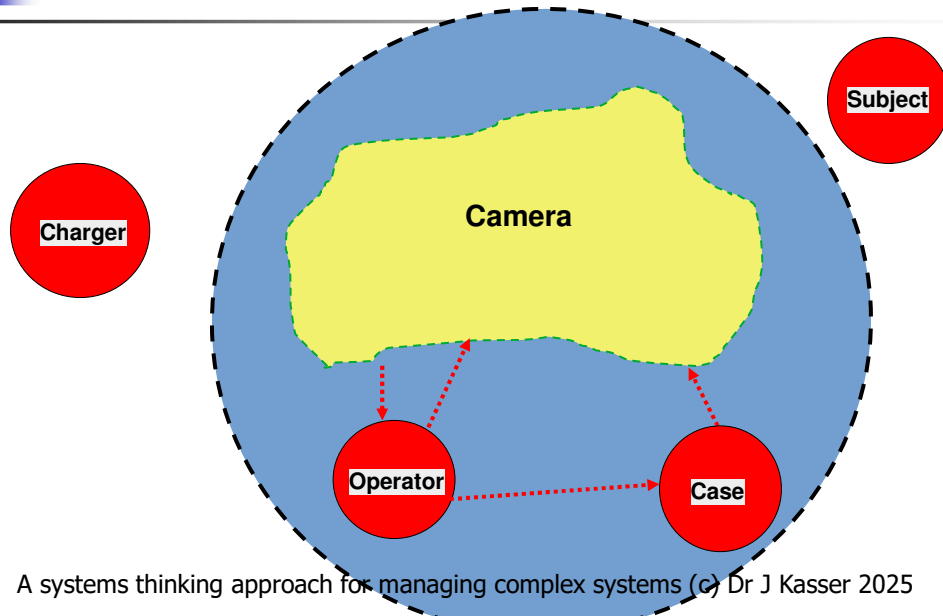


A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

32



Transporting camera SOI

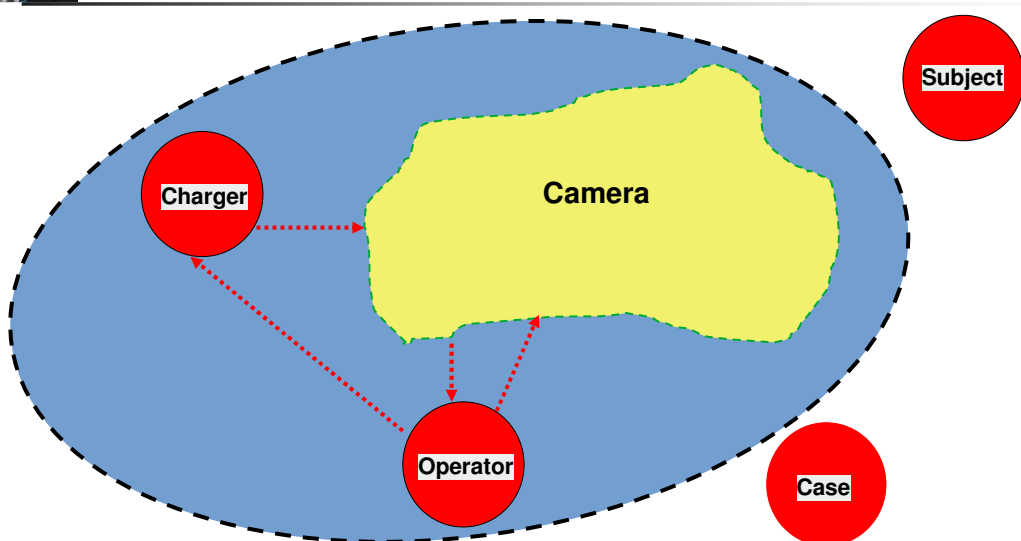


A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

33



Recharging camera SOI

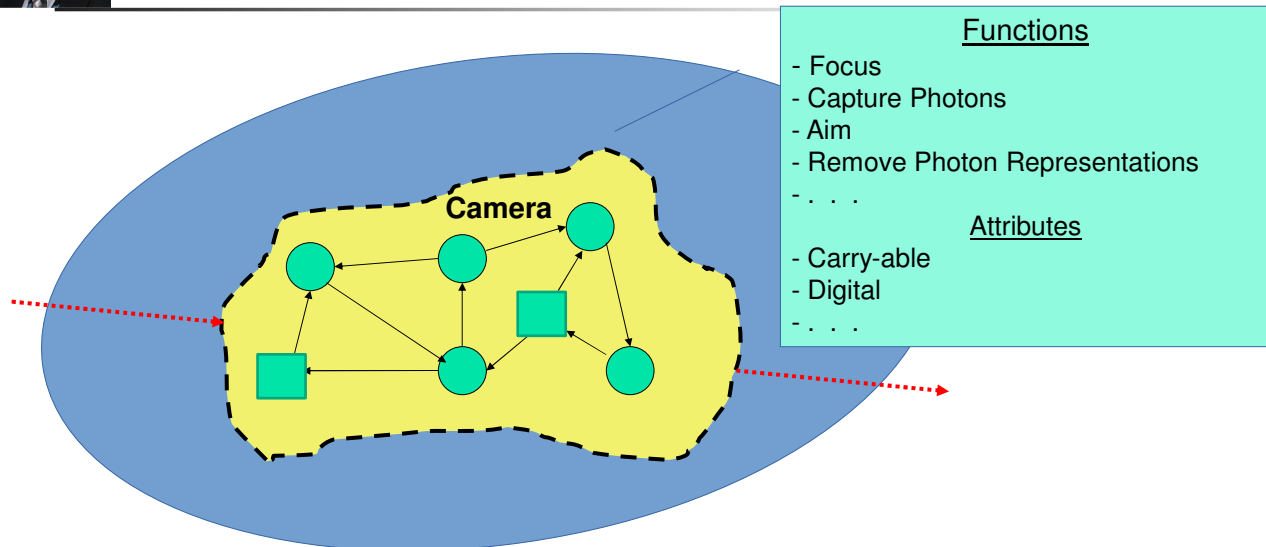


A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

34



Understanding the camera (internal view)



A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

35



The FCFDS (summary)

- The reason for the dispute has been discovered
 - Many of the definers are using the word "system" for their SOI
 - They should be using the word "SOI"
- Benefits
 - Understanding different SOIs helps manage complexity by using different SOIs **for different problems**
 - Defining and assessing different (appropriate) SOIs helps manage complexity by bounding for specific problems

A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

36



The YouTube presentation

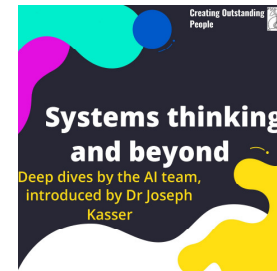
Which system are we discussing?



Joseph Kasser and Bruce Lerner
18 September 2024

Which system are we discussing?

1



<https://youtu.be/0yOvbx7MUUE>

<https://therightrequirement.com/podcast/which-system-are-we-discussing/>

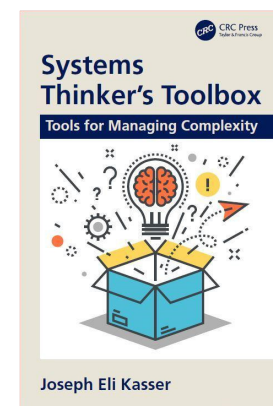
A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

37



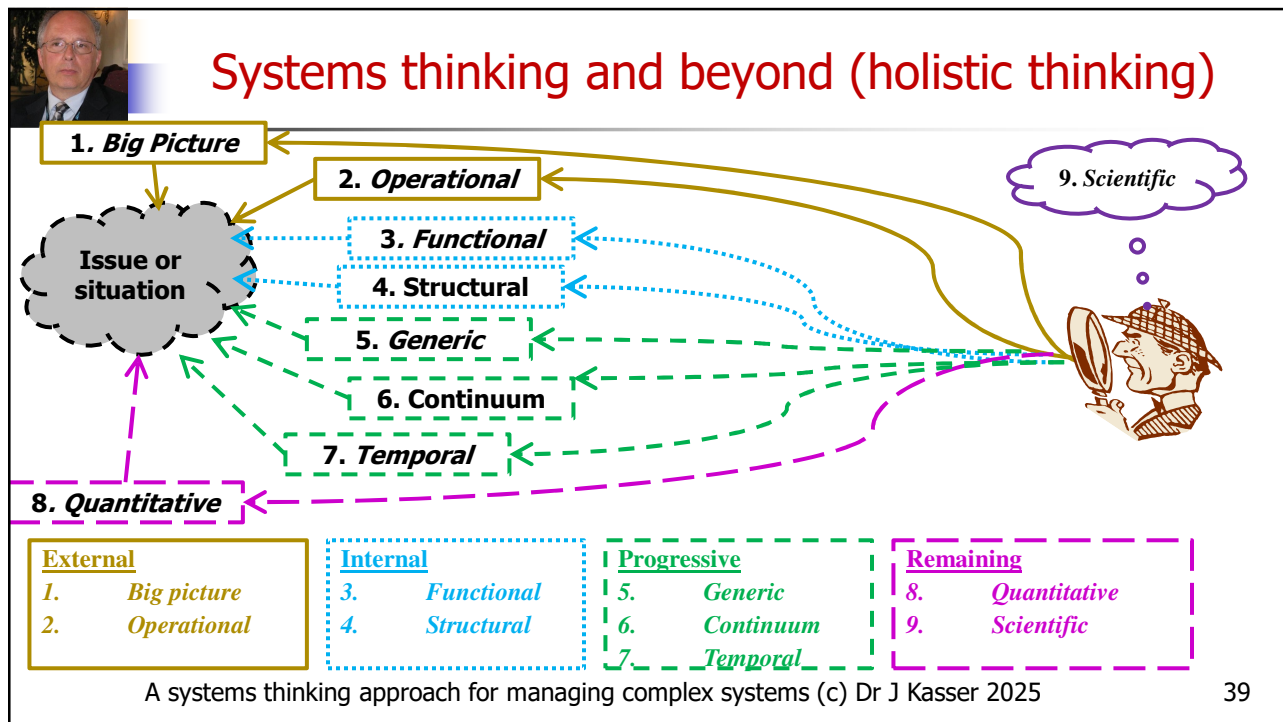
Tools, techniques and templates

	Tools, techniques and templates	Slide
1	Compliance Matrix	5
2	System of Interest (SOI)	13-36
3	Holistic Thinking Perspectives	
4	Active Brainstorming	
5	Principle of Hierarchies	
6	Continuum of Solutions	
7	Problem Formulation Template	
8	Hitchins-Kasser-Massie-Mabelo Framework (HKM ² F)	
9	Subjective and Objective Complexity	
10	Interface partitioning	
11	Mission and Support Systems Architecture	
12	Three Structures of a Problem (well-, ill- and wicked)	
13	Iterative Problem Solving	



A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

38



39

HTP example: Camera

- **Big picture:** where cameras are used and for what purpose
- **Operational:** capturing images, transporting safely, viewing images, adjusting settings, and charging the battery
- **Functional:** capturing images, storing images, retrieving images, deleting images, battery charging functions, etc.
- **Structural:** camera body, camera case and charger
- **Generic:** painting, sketching and other image capture methods/devices
- **Continuum:** different types and models of cameras, different materials used to construct camera
- **Temporal:** evolution of the image capturing media from photographic plates to film to solid-state memory
- **Quantitative:** numbers pixels per inch, lens characteristics, etc.
- **Scientific:** depends on problem or issue

A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

40



Thinking about a camera

- **Understanding how a camera works**
 - The *Functional* and *Structural* HTPs
 - The System of Interest contains the **camera**
- **Capturing images**
 - The *Operational* HTP
 - The System of Interest contains the **camera and operator** and **whatever is being photographed**
- **Transporting camera**
 - The *Operational* HTP
 - The System of Interest contains the **camera, operator** and **camera case**
- **Recharging a camera**
 - The *Operational* HTP
 - The System of Interest contains the **camera, operator and charger**

Notice how the system boundary (System of Interest) changed

A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

41



What's the problem?

- | | |
|---|---|
| <p>1. Need to understand how a camera works</p> <ul style="list-style-type: none"> ■ <i>Functional</i> and <i>Structural</i> System of Interest bounds <ul style="list-style-type: none"> ■ Camera | <p>3. Need to transport camera</p> <ul style="list-style-type: none"> ■ <i>Operational</i> ■ System of Interest bounds <ul style="list-style-type: none"> ■ Camera, operator and camera case |
| <p>2. Need to capturing images</p> <ul style="list-style-type: none"> ■ <i>Operational</i> ■ System of Interest bounds <ul style="list-style-type: none"> ■ Camera and operator and whatever is being photographed | <p>4. Need to recharge camera</p> <ul style="list-style-type: none"> ■ <i>Operational</i> ■ System of Interest bounds <ul style="list-style-type: none"> ■ Camera, operator, charger |

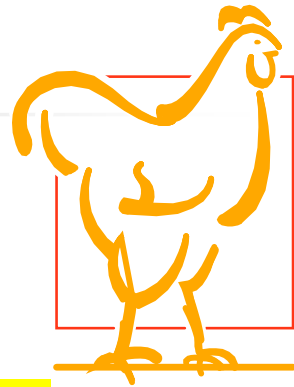
Four different Systems of Interest? - four views of a system?

A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

42



Simple problem



- What came first, the chicken or the egg?
 - Problem in the *Temporal* perspective
- There is a definitive answer
- Answer
 - It depends
 - 1. **Bible (literal):** the chicken was created and laid the egg
 - 2. **Theory of evolution:** something laid the egg which hatched into the chicken
- You wanted an answer everyone would accept!
 - Sorry, that's a different and complex problem

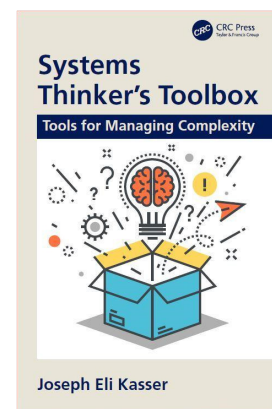
A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

43



Tools, techniques and templates

	Tools, techniques and templates	Slide
1	Compliance Matrix	5
2	System of Interest (SOI)	13-36
3	Holistic Thinking Perspectives	39-43
4	Active Brainstorming	
5	Principle of Hierarchies	
6	Continuum of Solutions	
7	Problem Formulation Template	
8	Hitchins-Kasser-Massie-Mabelo Framework (HKM ² F)	
9	Subjective and Objective Complexity	
10	Interface partitioning	
11	Mission and Support Systems Architecture	
12	Three Structures of a Problem (well-, ill- and wicked)	
13	Iterative Problem Solving	



A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

44



Exercise 2 Applying the HTPs

1. Perceive INCOSE from the HTPs
2. List the ideas that come to mind from each HTP on a sheet of paper
3. After the ideas stop flowing, sort the ideas into the HTPs
4. Add the ideas from Exercise 1 to the sorted list
5. Count the number of ideas generated in exercises 1 and 2
6. Create a PowerPoint file for the exercise containing
 1. The sorted list of ideas by HTP
 2. A completed compliance matrix for the exercise
 3. A copy of this slide and the version number of the lesson
7. Exceed expectations
8. Save file as yourlastname-firstname-2.pptx (e.g., mouse-michael-2.pptx)
9. Email file to Beyondsystemsthinking@yahoo.com

A systems thinking approach for managing complex systems (c) Dr J Kasser 2025

45