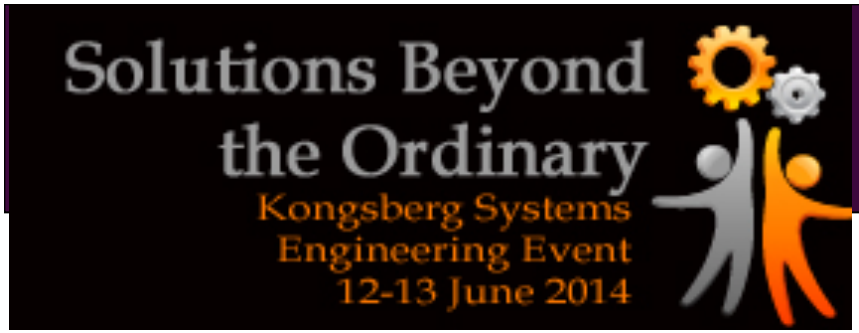

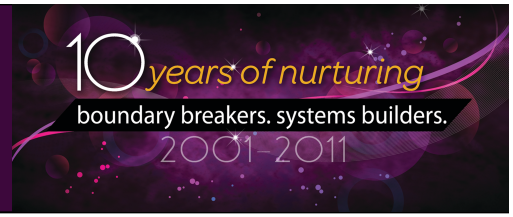

Solution Engineering: An Integrated Innovative Holistic Approach to Managing Complex Problems

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With help from Prof Yang-Yang Zhao

Version 1.0

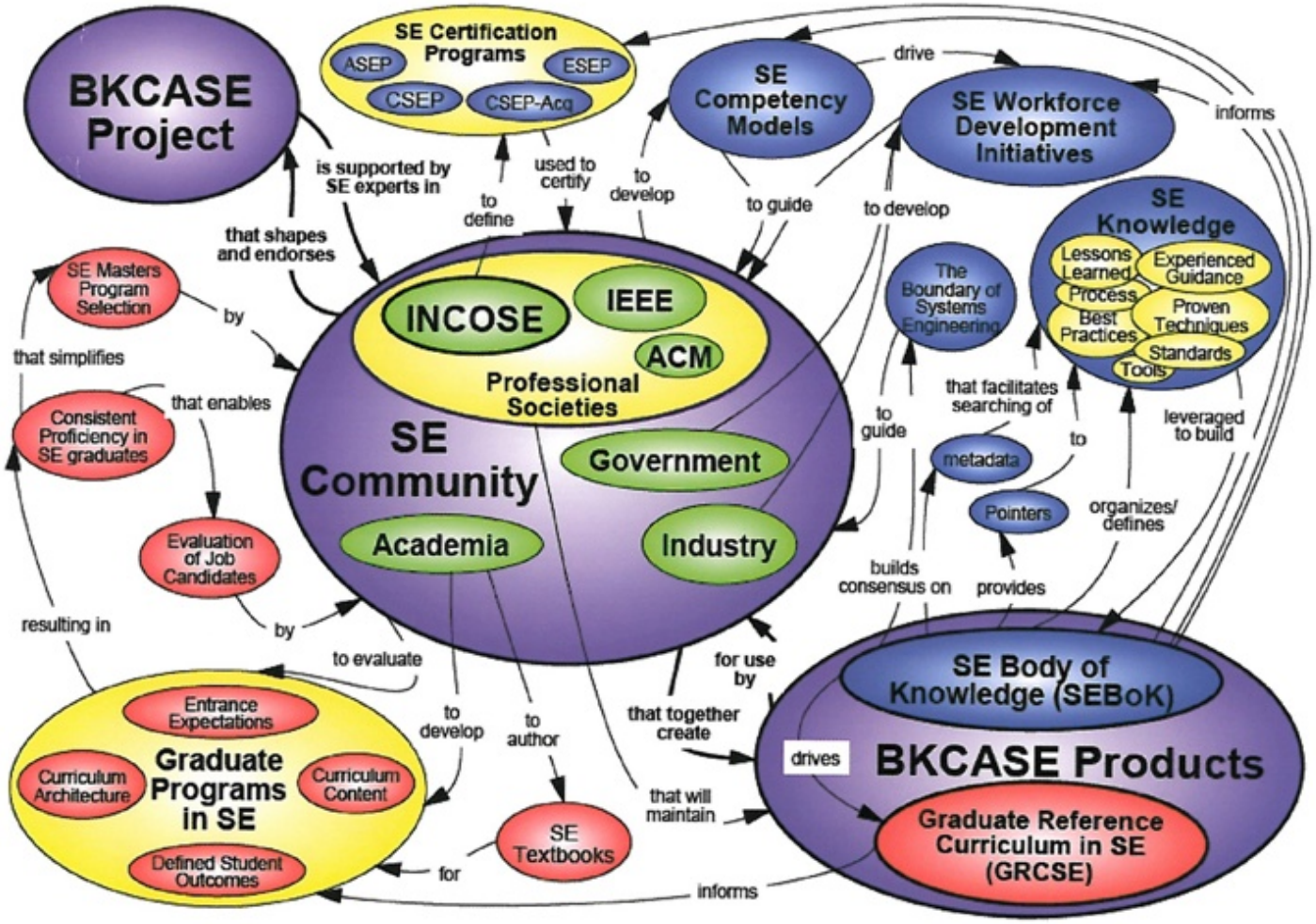
Joseph Kasser

- The real world
  - Electronic engineer, London, UK
  - ALSEP, Apollo's 15,16 & 17, USA
    - Systems engineer
  - TT&C, Comsat
  - LuZ SEGS-1, Israel
  - NASA-GSFC ground support
  - Small business experience
- Academia
  - GWU, UMUC
  - A/Prof, Deputy Director, UniSA
  - Leverhulme Visiting Professor, Cranfield, UK
  - NUS Visiting Associate Professor

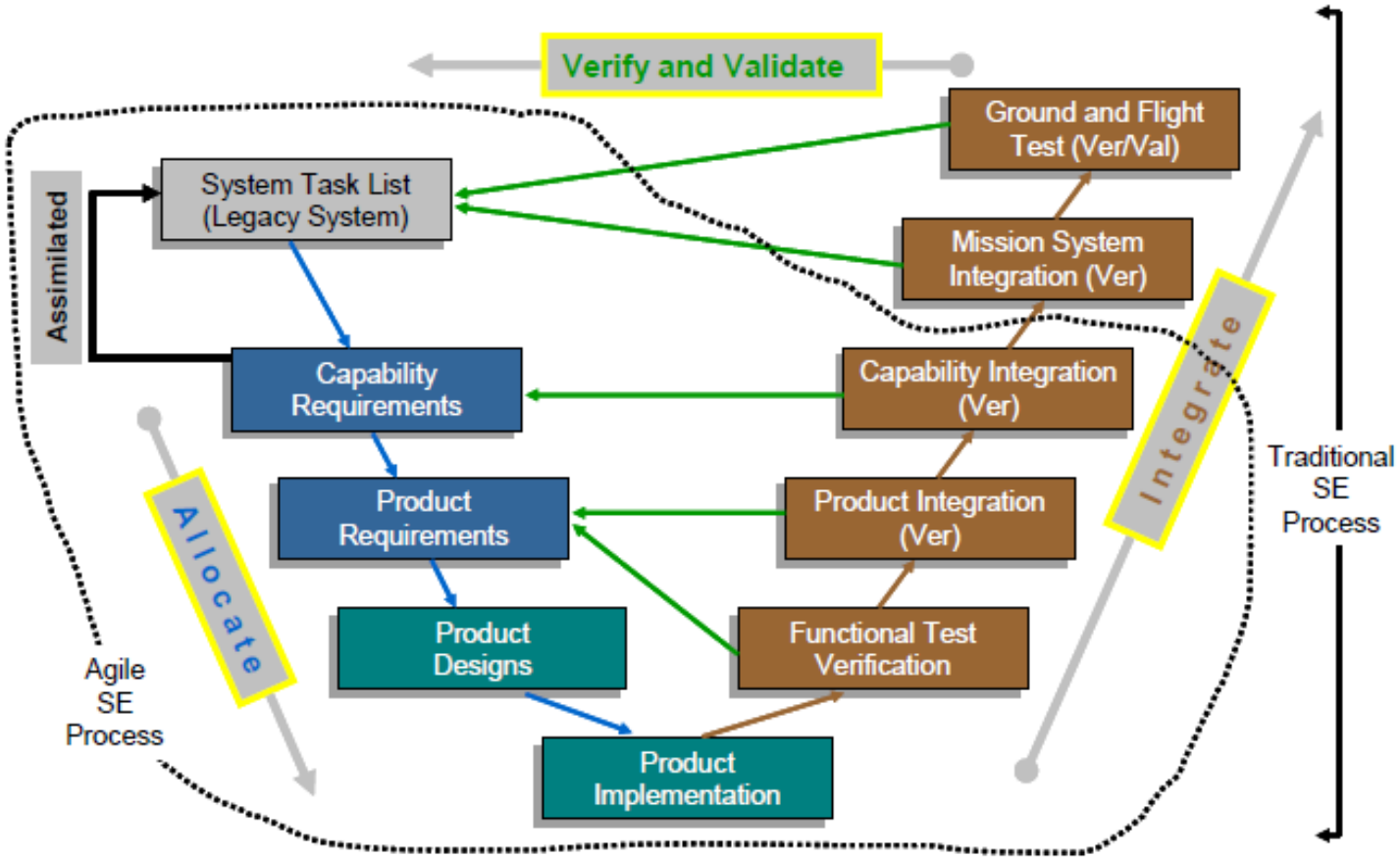
State of the art?

- Systems engineering has been defined as
  - "*the science of designing complex systems in their totality to ensure that the component subsystems making up the system are designed, fitted together, checked and operated in the most efficient way*" (Jenkins, 1969).
- However, in the ensuring 45 years, systems engineers seem to have been busy creating more and more complex models and processes.

Building artificial complexity*



IS 2009 submission (not in proceedings)



gure 5. Modified Vee Model for Streamlined Acquisition Programs

Streamlined?

Framing the problem of managing complexity

- ***The undesirable situation***
  - The failure of systems engineering to manage the complexity of the systems development environment
- ***The feasible conceptual future desirable situation (FCFDS)***
  - Systems engineering managing the complexity of the systems development environment
- ***The solutions***
  1. A theory of how to manage complexity
  2. A set of tools for managing complexity based on the theory
- ***The problems***
  - How to develop
    1. a theory for managing complexity
    2. the tools for managing complexity based on the theory

Topics

- **Previous approaches to managing complexity**
- Systems thinking
- Gaining an understanding
- Holistic thinking
- Active brainstorming
- Classifications of problems
- Holistic problem-solving
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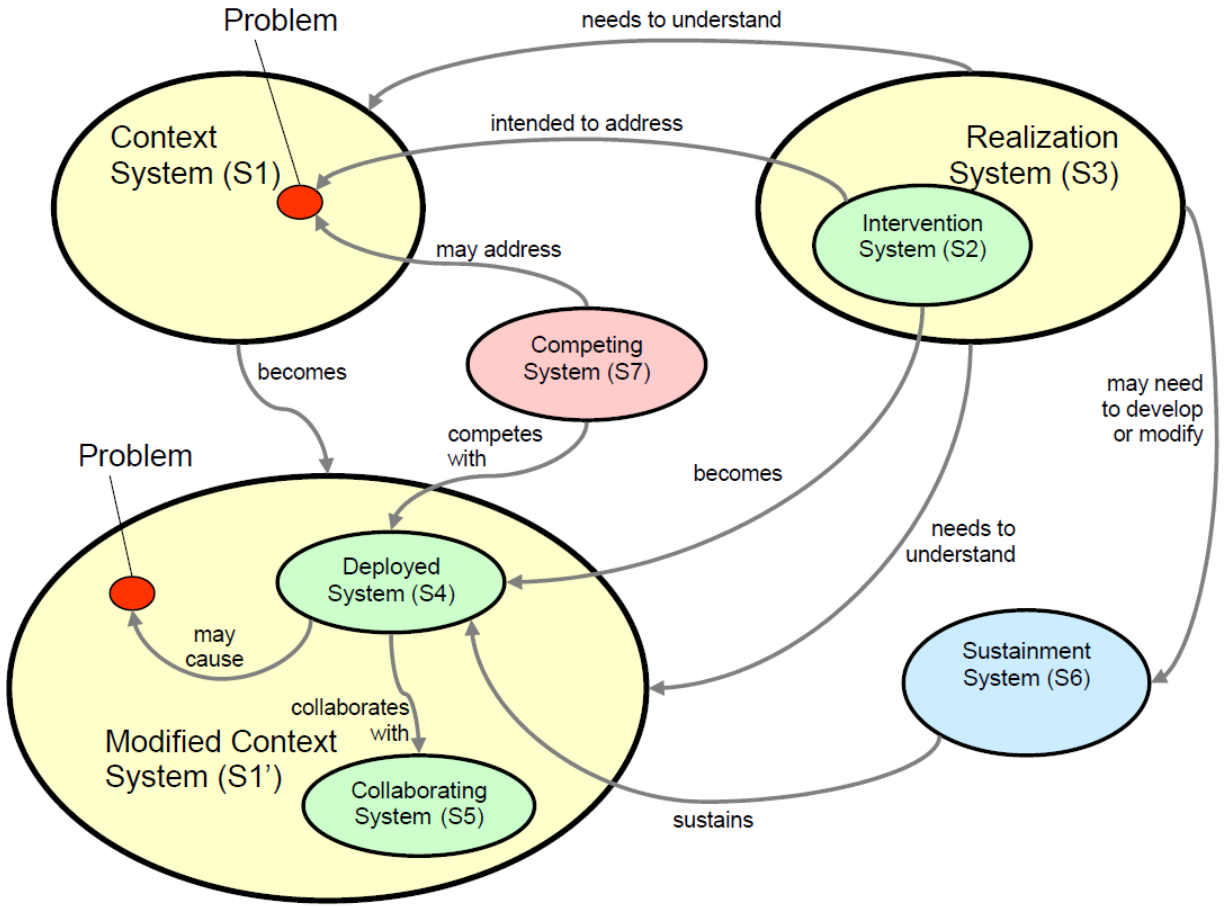
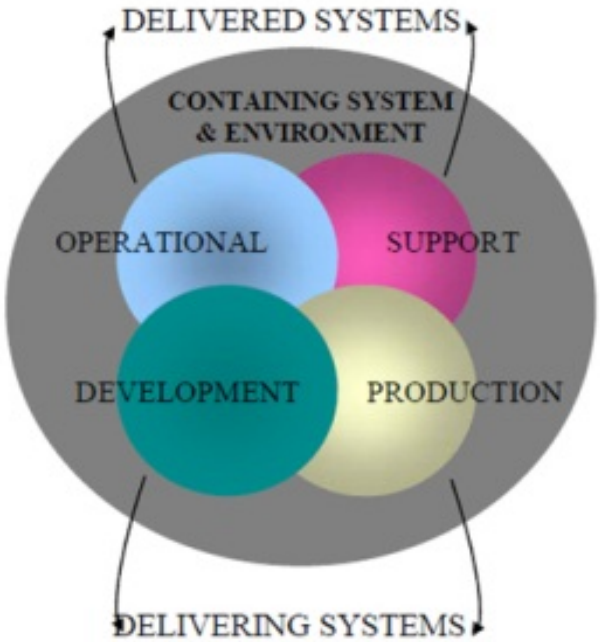
2004: Martin's 7 samurai*



* Martin, J. N., 2004, *The Seven Samurai of Systems Engineering: Dealing with the Complexity of 7 Interrelated Systems*, proceedings of 14th Annual Symposium of the International Council on Systems Engineering.

2005 Whole System Model*

1. Operational system
   - The system which goes into service
2. Support system
   - The system which supports the Operational system in service
3. Production system
   - The system which manufactures the relevant parts of the Operational and support systems
4. Development system
   - The system, which develops the Operational, Support and Production systems
5. Containing system
   - The related systems and the environment in which the above systems interact

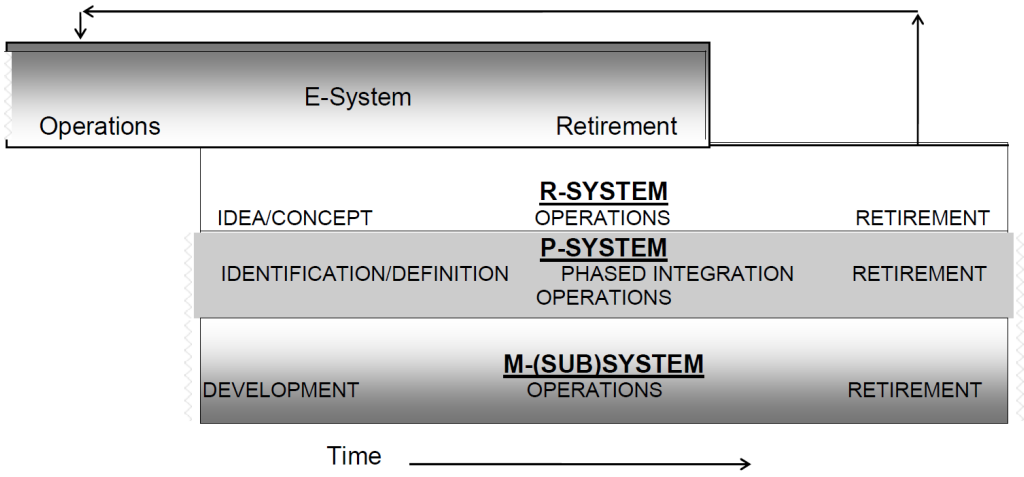


These systems need to be developed to meet their individual requirements but are strongly linked

* Adcock, R. D., "Tailoring Systems Engineering Lifecycle Processes to meet the challenges of Project and Programme applications," *The 15th International Symposium of the International Council on Systems Engineering (INCOSE)*, Rochester, NY., 2005.

2006: Systems project*

1. The Existing system
2. The Required system
3. The Producing system
4. The Maintenance and Support system



* Paul, A. S. and Owunwanne, C., "The Systems Project: Life Cycle Development/Management of as Many as Four Interrelated Systems," *16th Annual Symposium of the International Council on Systems Engineering*, Orlando, FL., 2006.

Comparing the models:1

Systems addressed by the models	7 Samurai	WSM	SP
Existing "as-is" situation	Context (S1)	-	-
Existing system in "as-is" situation	-	-	E-system
Process to develop conceptual solution system	-	-	-
Conceptual solution system at time development begins	Intervention (S2)	-	R-System
Process to plan transition from existing situation to situation in which the solution system will be deployed	Realization (S3)	Production	P-System
Process to realize solution system	Realization (S3)	Production	P-System
Solution system at and after time of deployment	Deployed (S4)	Operational	R-System
[new] situation after solution system has been deployed	-	-	-

Comparing the models:2

Systems addressed by the models	7 Samurai	WSM	SP
Adjacent systems operating in association with the solution system at and after time of deployment	Collaborating (S5)	-	-
System or systems that keeps the solution system operational at and after deployment	Sustainment (S6)	Support	M-System
Process to determine situation after deployment of solution system contains no undesirable elements	Implied Realization (S3)	Implied Production	Implied P-System
Resources to be applied to realize the solution system	Realization (S3)	Development	P-System
Alternative solution systems	Competing (S7)	-	-
Enterprise and environment	Realization (S3)	Containing	-

Conclusions

- Models couple system (product) and realization process
- Each model is a different set of systems.
- Each model is incomplete since other models contain systems that the model does not.
- Systems present in one model are not present in another model.
- Each model invokes the temporal perspective (considers the time to realize the solution system) but in different ways.
- The situation after the solution system has been deployed is not considered in any of the three models
  - Martin does refer to it as a *modified context system* (S1').
- **The models are not very useful to practitioners**

Topics

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- **Systems thinking**
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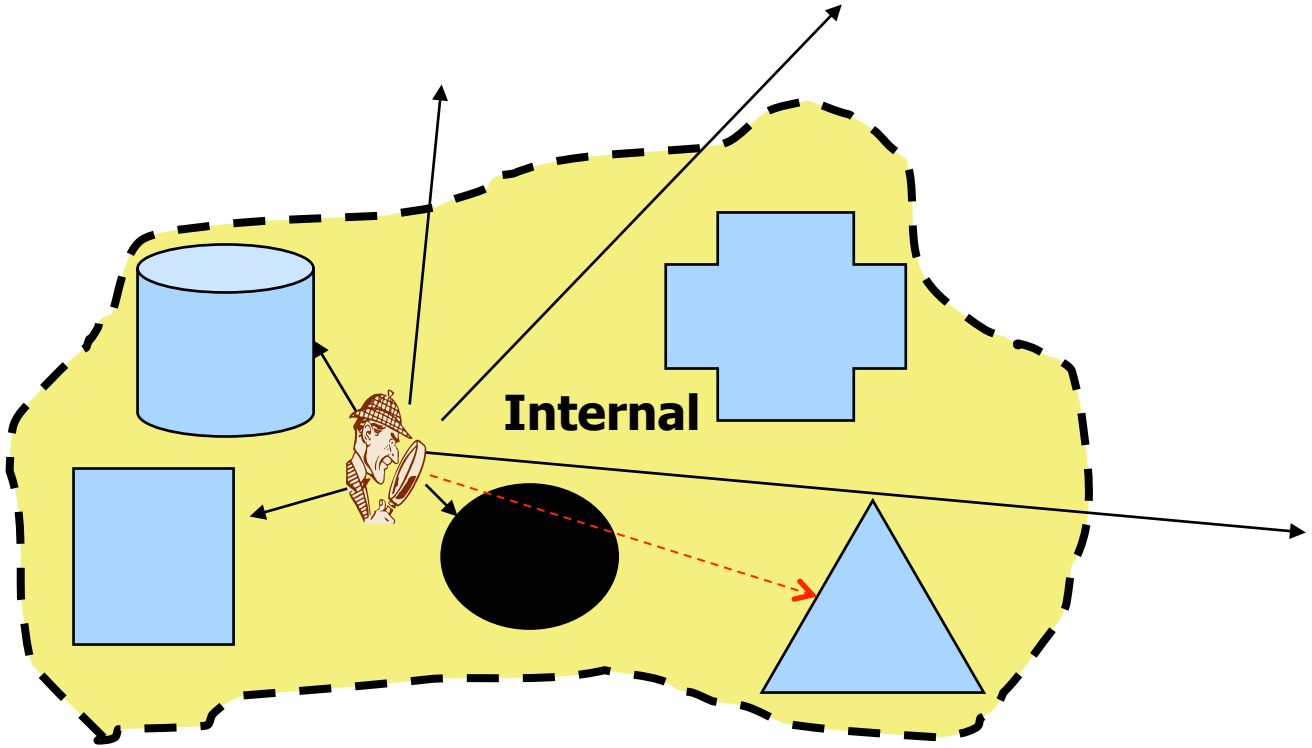
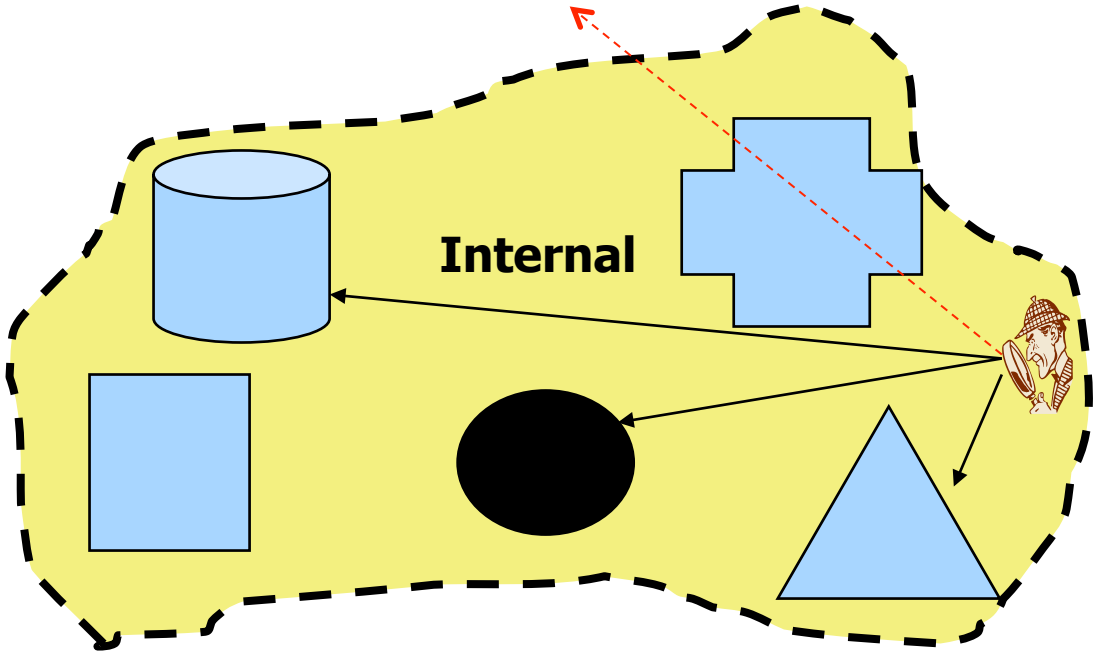
Perspectives of an issue -1



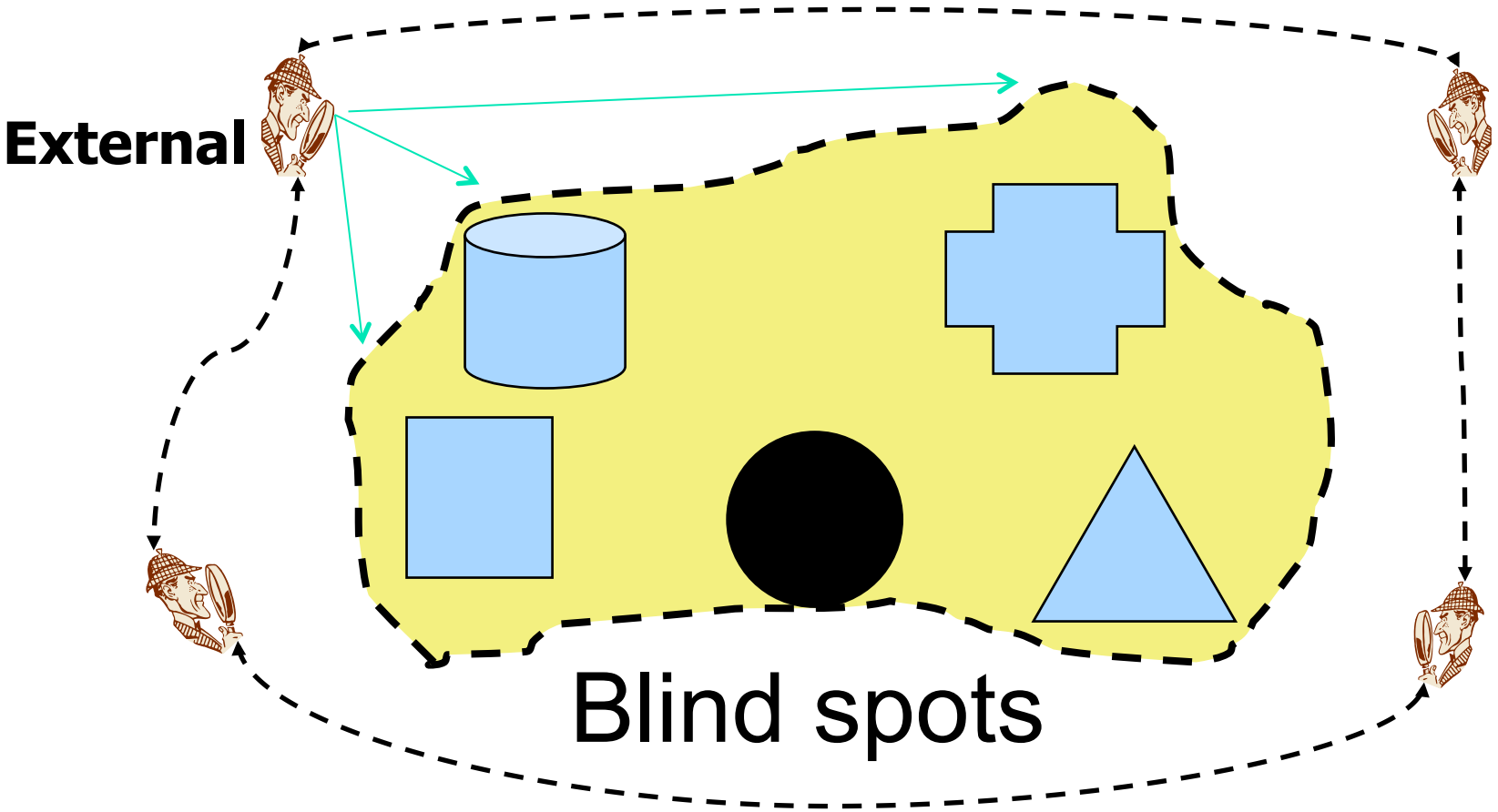
Blind spots

Perspectives of an issue -1a



Blind spots

Perspectives of an issue -2



Topics

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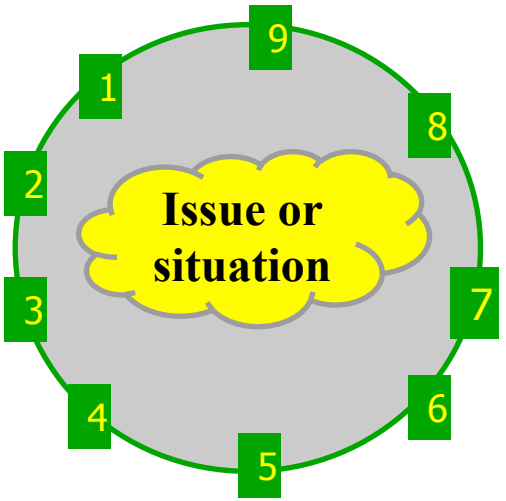
Understanding and remedying something

- To observe behaviour (symptoms)
  - View from multiple perspectives
  - Use systems thinking
- To determine cause [of undesirability]
  - Go beyond systems thinking to **holistic thinking**
    - Use Holistic Thinking Perspectives (HTP)
      - See next slide
    - Articulate
      - causes
      - ideas of what to do to remedy them

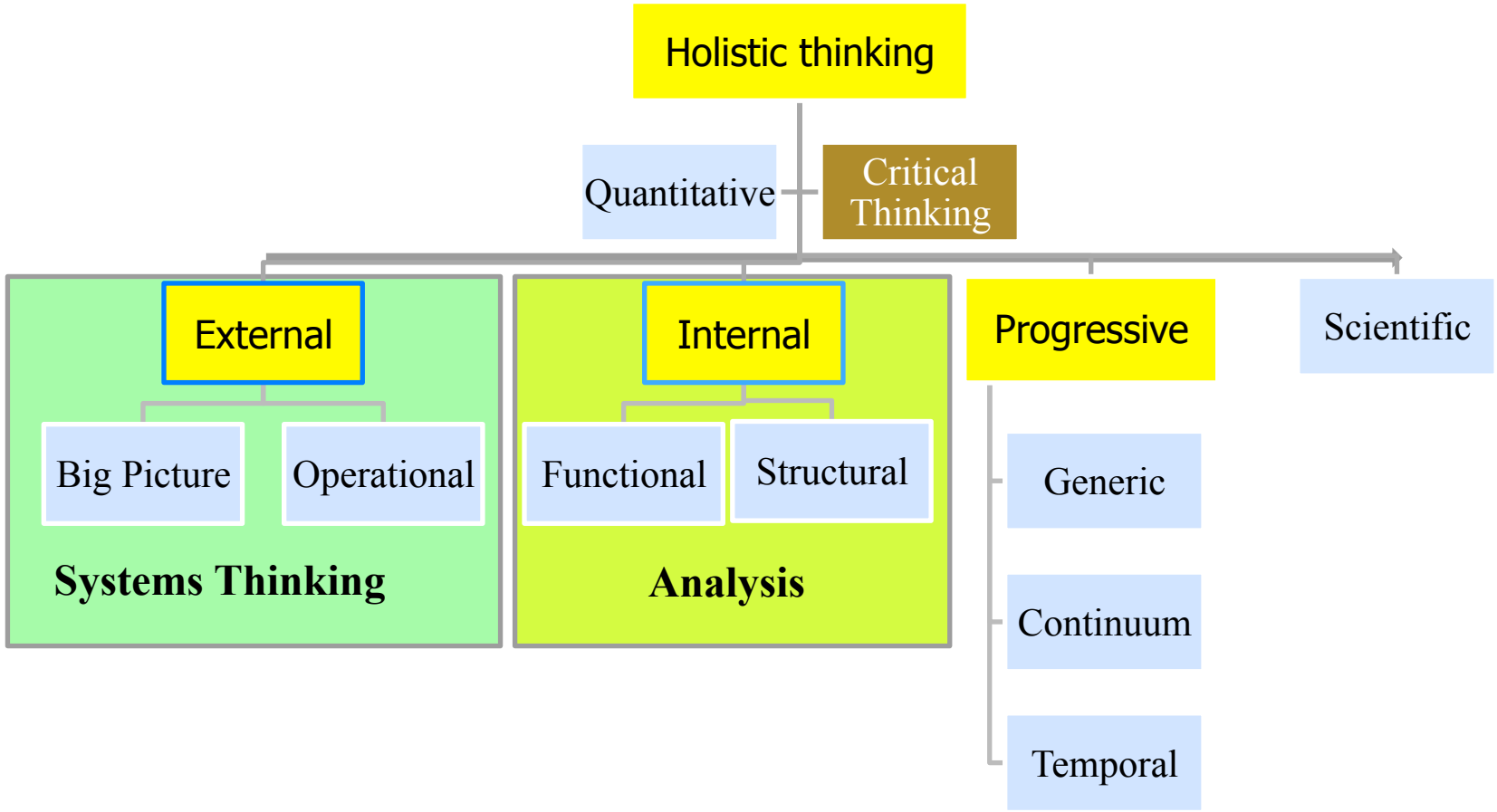
Holistic Thinking Perspectives*

1. **Big picture**
   - Purpose, adjacent systems
2. **Operational**
   - Missions which the system performs
3. **Functional**
   - Functions performed by the system (used in missions)
4. **Structural**
   - Technology, hardware, resources comprising the system
5. **Generic**
   - Pertinent information from similar systems
6. **Continuum**
   - Pertinent differences between system and similar systems
7. **Quantitative**
   - Numerical information, pertaining to other perspectives
8. **Temporal**
   - Past present and future aspects of the system
9. **Scientific**
   - Conclusions, inferences about the problems



* Kasser, 2013 Holistic Thinking

Holistic thinking: Structural perspective



Active Brainstorming*: HTP Matrix for triggering ideas

	1	2	3	4	5	6
HTP	**Who?**	**What?**	**Where?**	**When?**	**Why?**	**How?**
Operational						
Functional						
Big picture						
Structural						
Generic						
Continuum						
Temporal						
Quantitative						
Scientific						

There may not be an immediate answer to every question
Input tool, not a storage tool

Typical Operational perspective questions

- **Who** is going to operate/administrate it?
- **What** do they need to operate/administrate it?
- Under **what** conditions will it be operated?
- **Where** will they operate it?
- **When** will they operate it?
- **Why** will they operate it?
- **How** will they operate it?
- **How** will they gain access to it?

Typical Generic perspective questions

- **Who** has had a similar problem?
- **What** is this similar to?
- **What** does this remind you of?
- **What** applies to both situations?
- **Where** can I find a similar situation?
- **When** was there/will there be a similar situation?
- **Why** is this similar/different?
- **How** is this similar/different?

Benefit of changing perspective

1. You see things from a different perspective
   - New concepts
   - Revise existing concepts
   - Out of the box concepts
2. Makes you innovative

Factors conducive to innovation*

Ability to find similarities among objects which seem to be different Generic perspective	High	Problem solvers	Innovators
	Low	Imitators, Doers	Problem formulators
		Low	High
"Ability to find" generally comes from application of generic and continuum perspectives (beyond systems thinking)		**Ability to find** differences among objects which seem to be similar Continuum perspective	

* Based on Gordon G. et al. "A Contingency Model for the Design of Problem Solving Research Program", Milbank Memorial Fund Quarterly, p 184-220, 1974 cited by Gharajedaghi, System Thinking: Managing chaos and Complexity, Butterworth-Heinemann, 1999

Topics

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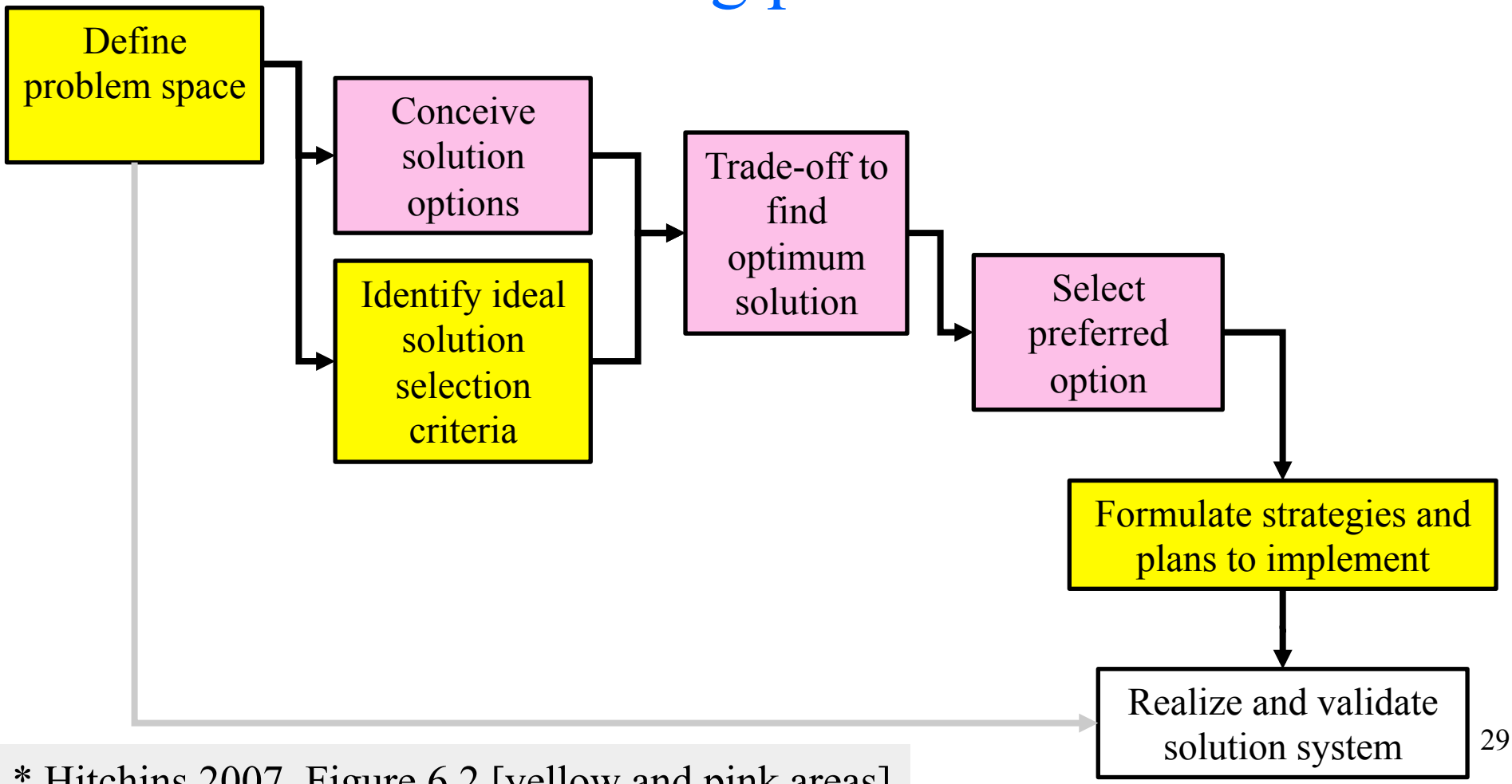
Problem with "problem"

1. A question proposed for solution or discussion (dictionary.com, 2013).
2. Any question or matter involving doubt, uncertainty, or difficulty (dictionary.com, 2013) For example:
   - ***An undesirable situation***. You might hear someone end a sentence with "… and that's the problem" when they should be saying "… and that's the undesirable situation"
   - ***The underlying cause of an undesirable situation***, usually a failure of some kind.
     - For example, one may hear someone say "*my phone stopped working; the problem was a discharged battery*".
     - In reality, the cause of the phone stopping working was a discharged battery; the symptom or effect was that the phone stopped working
3. The need to determine the necessary sequence of activities to perform the transition from an undesirable situation to a desirable situation
   - Schön, 1991

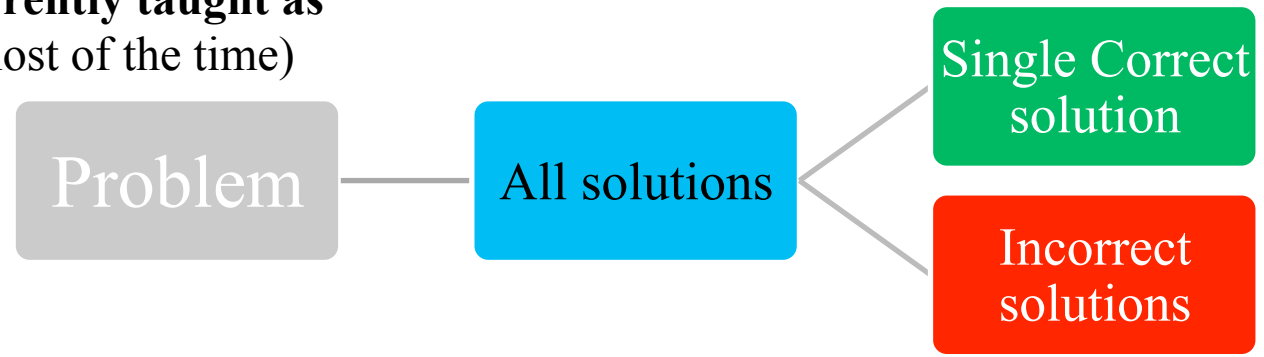
Systems engineering activities* overlap problem solving process



* Hitchins 2007, Figure 6.2 [yellow and pink areas]

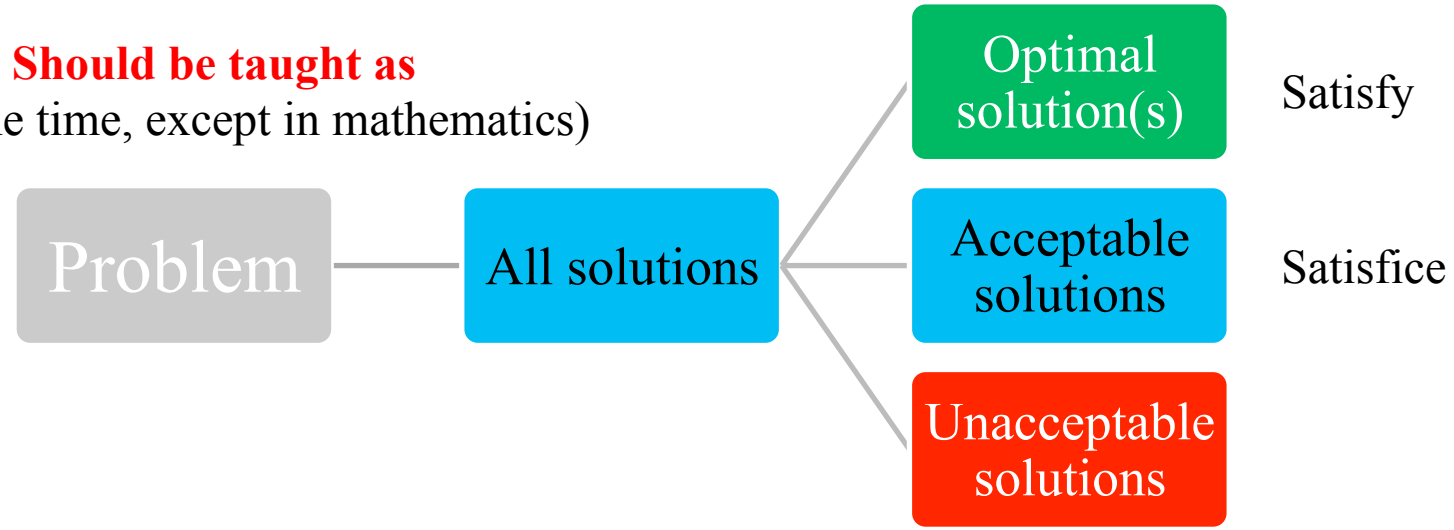
Problems and solutions

Currently taught as
(most of the time)



Should be taught as
(all of the time, except in mathematics)

Who defines the problem?



Classification of problems*

1. Complexity of the problem
   – Objective and subjective
2. Level of difficulty of the problem
3. Research and intervention problems
4. Structure of the problem

- Others

Sorting

Definitions: Dictionary.com (2013)

- ***Complex***
  - Composed of many interconnected parts; compound; composite: [e.g.] a complex highway system.
  - Characterized by a very complicated or involved arrangement of parts, units, etc.: [e.g.] complex machinery.
  - So complicated or intricate as to be hard to understand or deal with: [e.g.] a complex problem.
- ***Complicated***
  - Composed of elaborately interconnected parts; complex: [e.g.] complicated apparatus for measuring brain functions.
  - Difficult to analyze, understand, explain, etc.: [e.g.] a complicated problem.

Need to separate subjective and objective definitions

Complexity (subjective definitions)

- **Complexity** is in the eye of the beholder
  - Jackson, M. C. and Keys, P., "*Towards a System of Systems Methodologies*", Journal of the Operations Research Society, Vol. 35 (1984), no. 6, pages 473-486.
- A **complex** system is an assembly of interacting members that is difficult to understand as a whole
  - Allison, J. T., "Complex System Optimization: A Review of Analytical Target Cascading, Collaborative Optimization, and Other Formulations," The University of Michigan, 2004, page 2

Complexity (objective definition)

- Number of issues, functions, or variables involved in the problem;
- Degree of connectivity among those variables;
- Type of functional relationships among those properties;
- Stability among the properties of the problem over time

Levels of difficulty*

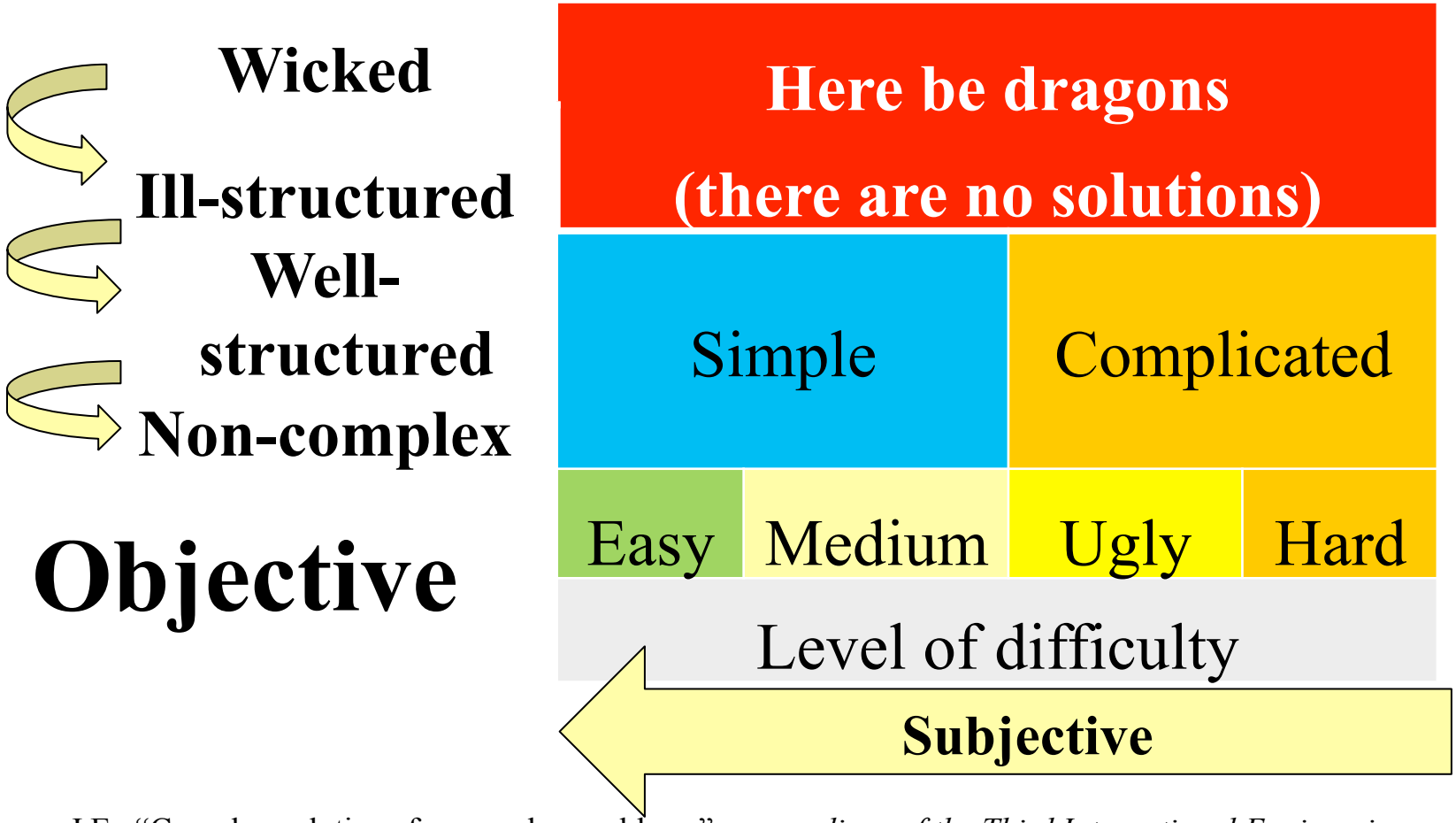
- ***Easy*** - can be solved in a short time with very little thought
- ***Medium*** - can be solved after some thought, may take a few more steps to solve than an easy problem and can probably be solved without too much difficulty, perhaps after some practice
- ***Ugly*** - will take a while to solve. Solving them involves a lot of thought, many steps and may require the use of several different concepts
- ***Hard*** - usually involve dealing with one or more unknowns. Solving them involves a lot of thought and some research and may also require iteration through the problem solving process as learning takes place

* Ford, Whit, "Learning and Teaching Math", http://mathmaine.wordpress.com/2010/01/09/problems-fall-into-four-categories/ (*last accessed 17 March 2014*)

Structure of the problem

- Well-structured
  - The existing undesired situation and the desired future situation are clearly identified.
  - May have a single solution or sometimes more than one correct solution.
- Ill-structured
  - Either or both the existing undesired situation and the desired future situation are unclear
- Wicked
  - Extremely ill-structured problems [situations]
    - E.g. making sense of systems engineering

Problem classification matrix*



* Kasser, J.E., "Complex solutions for complex problems", *proceedings of the Third International Engineering Systems Symposium (CESUN),* Delft, Holland, 2012.

Dealing with complexity

- Try to dissolve the problem
- Formulate the correct undesirable situation and problem(s)
  - System …. parts and their relationships ….
- Distinguish between
  - **Complex** – objective: system in which what happens in one part affects what happens in another part.
  - **Complicated** – subjective: measure of understanding

Topics

- Previous approaches to managing complexity
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Perspectives on dealing with "it"

Engineers focus on

- Making **it** work
- What must be done
- How to do it

Scientists focus on

- Understanding **it**
- Why it works

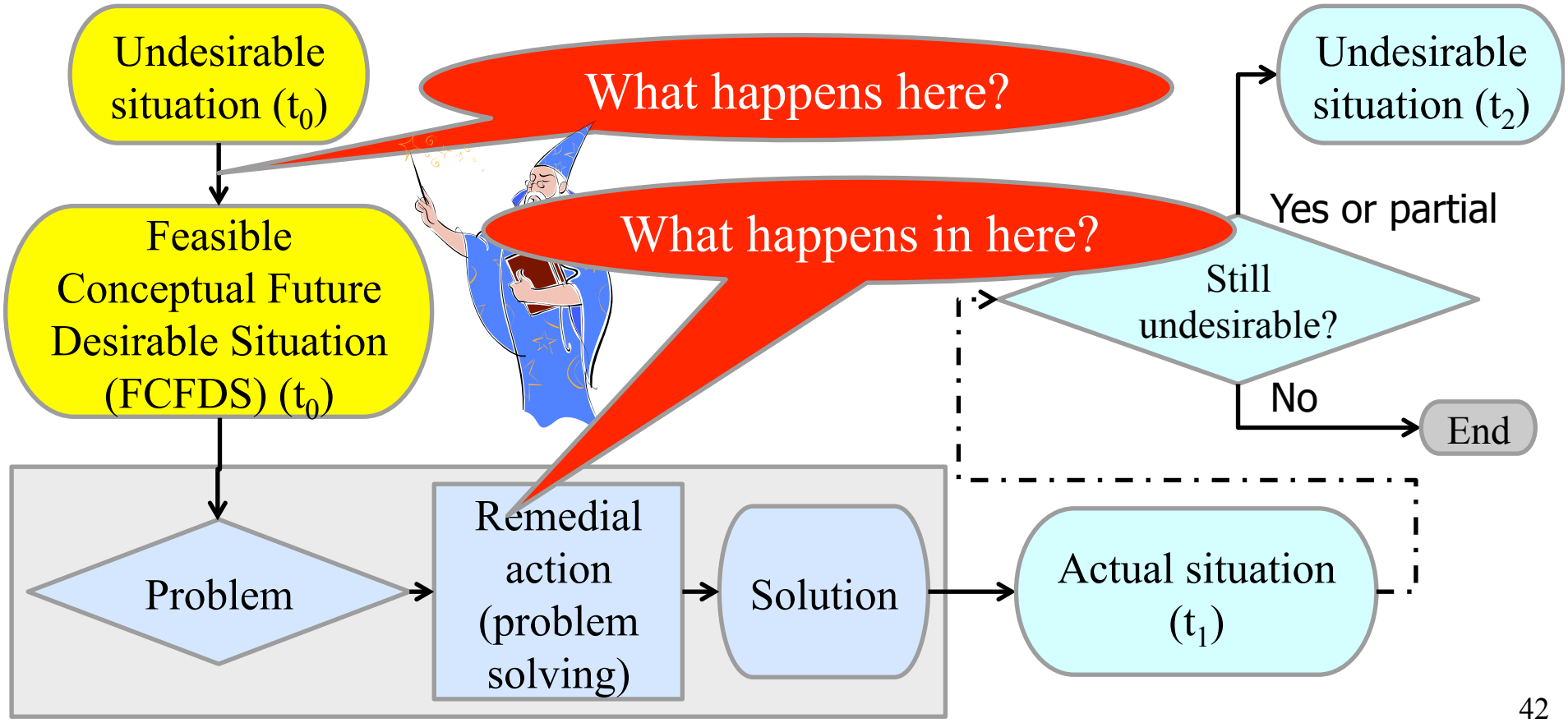
Different perspectives
Different problems

1. Making **it** work
2. Recognizing where **it** is in the system hierarchy
3. Observing behaviour, success and failure
4. Researching "what happens when I change part of **it**"
5. Leads to understanding and theory

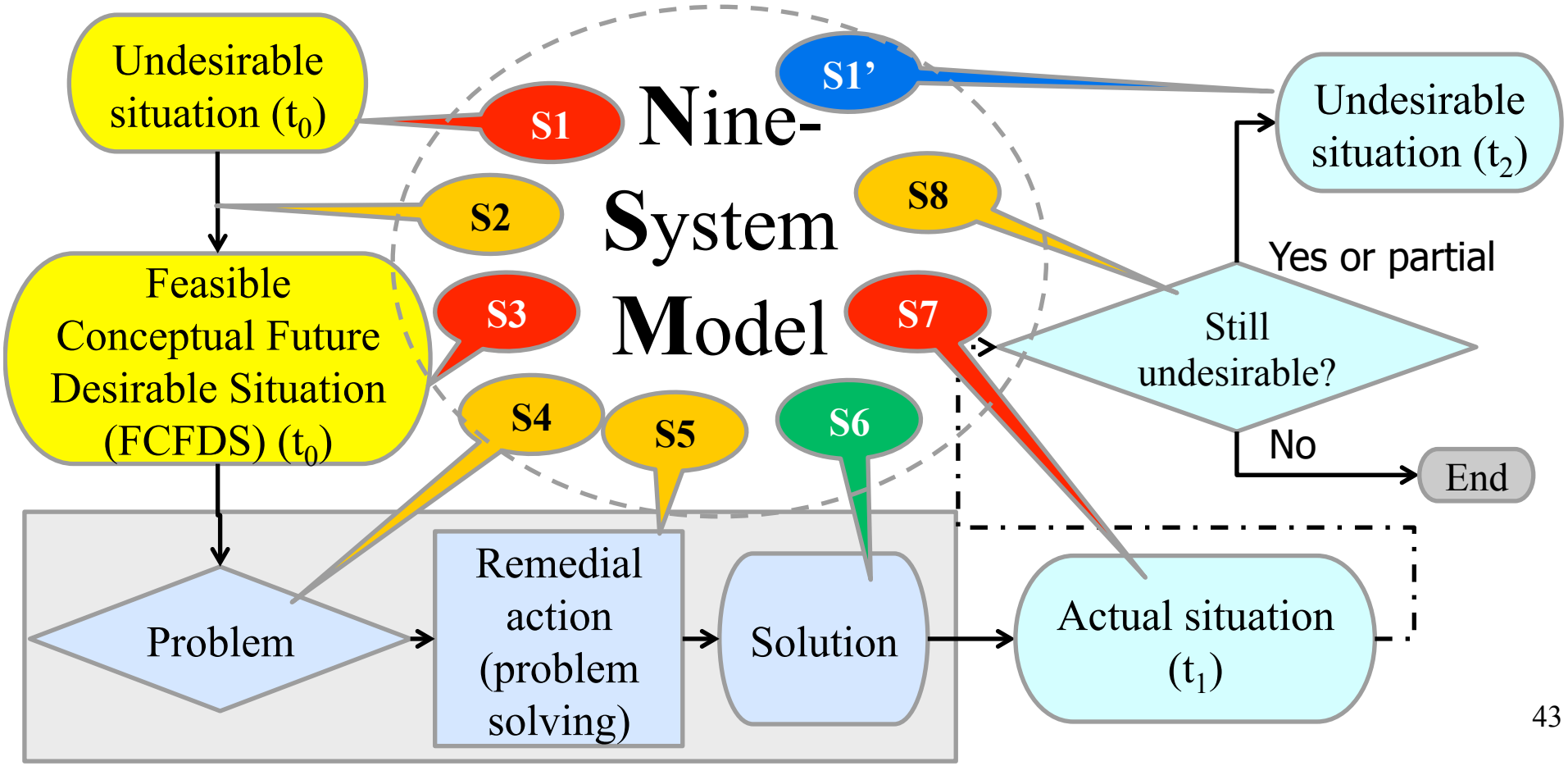
Template for framing the problem

1. The undesirable situation
2. The Feasible Conceptual Future Desirable Situation (FCFDS)
3. The solution
   - Often is a system which will operate in the FCFDS
4. The problems
   1. Determine the cause(s) of undesirability
   2. Create the system that will operate in the FCFDS
   3. Determine how to transition from the undesirable situation to the FCFDS

Holistic systems approach to managing problems and solutions



Holistic systems approach to managing problems and solutions



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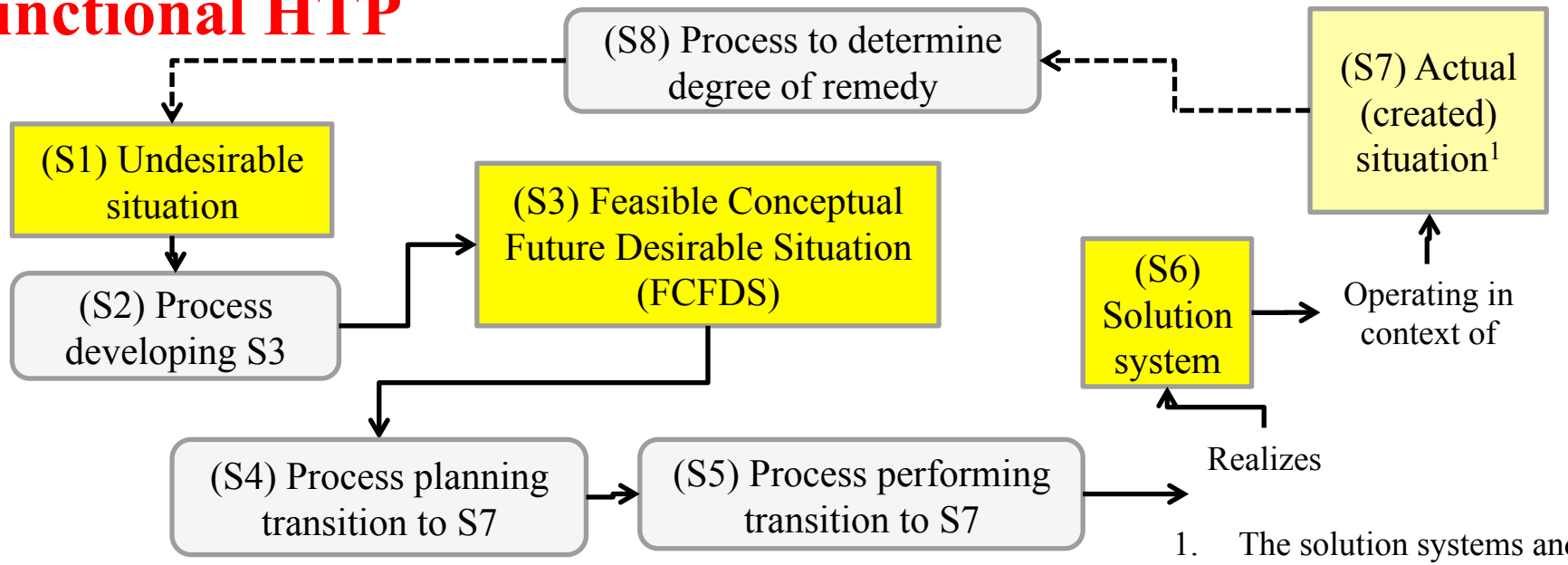
The 9 systems: situations, systems & processes

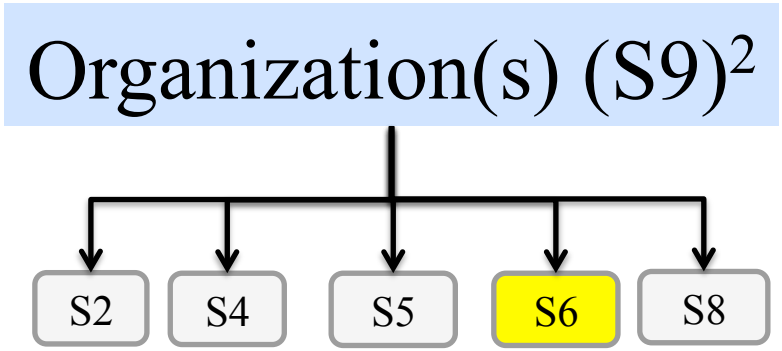
1. Undesirable or problematic **situation**
   - Baselined at t_0, but will evolve during realization of solution system
2. **Process** to develop the FCFDS
3. Future conceptual feasible desirable situation (FCFDS) that remedies the undesirable **situation**
4. **Process** to plan the transition from the undesirable situation to the FCFDS
5. **Process** to realize the transition by providing the solution system
6. Solution **system** that will operate within FCFDS
7. Actual or created **situation** at t_1
8. **Process** to determine that the realized solution remedies the evolved undesirable situation
9. **Organization**(s) containing the **processes**

The Nine-System model

Functional HTP



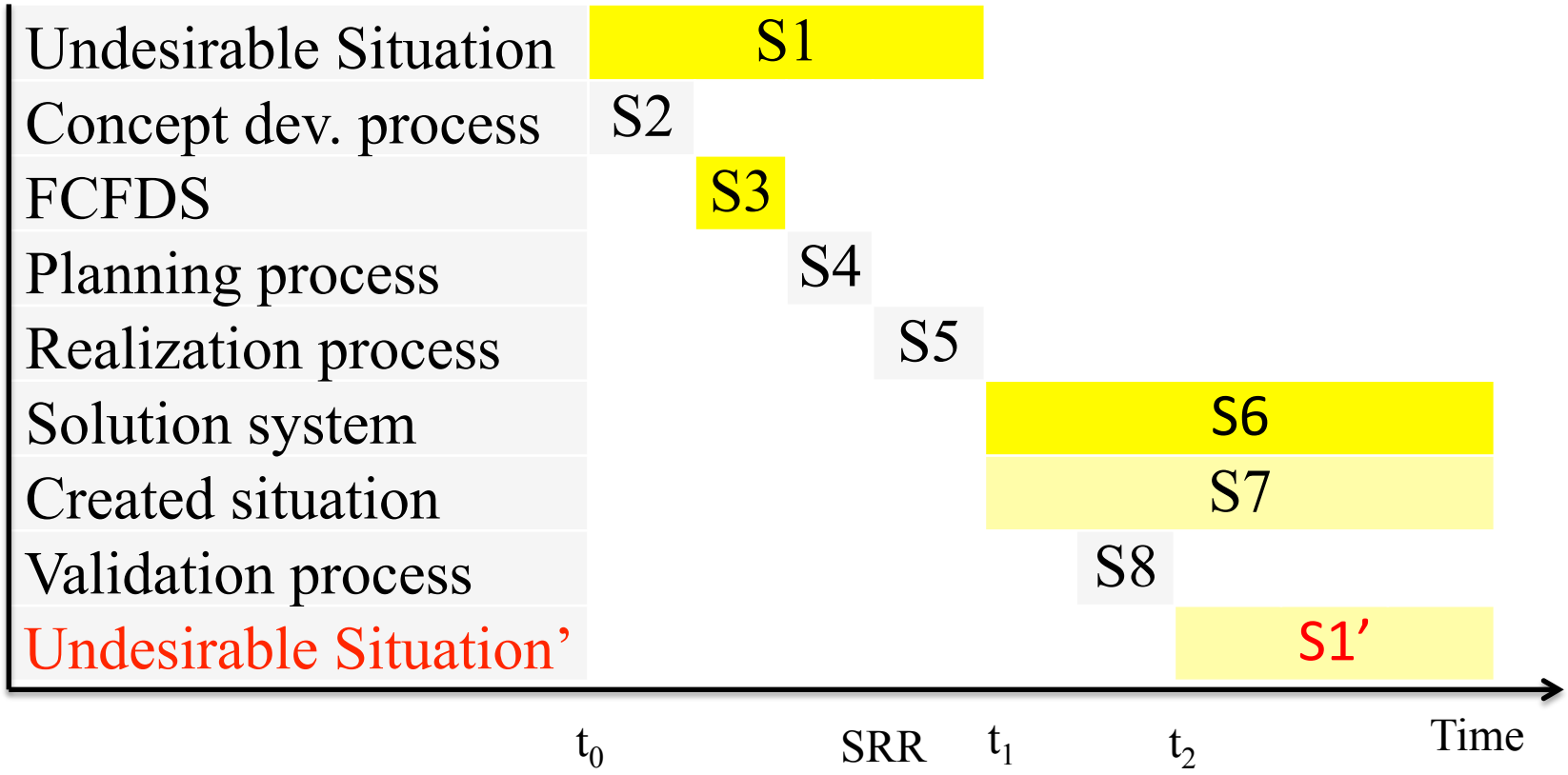
Structural HTP



1. The solution systems and the adjacent systems are subsystems in the actual situation
2. Considered as one [class of] system but generally is at least two organizations

The Nine-System model

Temporal HTP

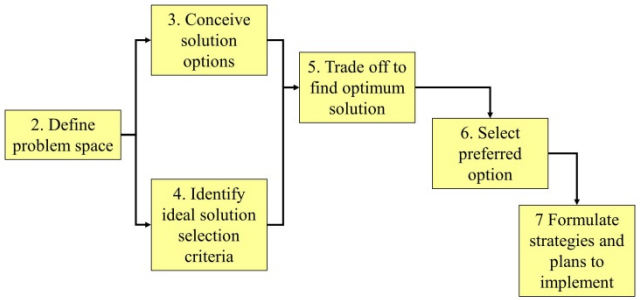


S1. Undesirable situation

- Perceived from Holistic Thinking Perspectives
- As-is
- Baselined at t_0
  - Eight descriptive perspectives
    - Observations
    - Assumptions
  - Scientific perspective
    - Causes of undesirability
      - May be more than one
    - Statement of problems
      - A hypothesis of
        1. cause of undesirability
        2. what it will take to remedy the undesirable situation

S2. Process: early stage

- Develops FCFDS (S3)
- Develops CONOPS of solution system operating (S6) within FCFDS (S3)
  - S3 will evolve to S7 during S4 and S5
- Uses Steps 2-6 in Hitchins' systems engineering approach to problem solving
  - Hitchins, 2007

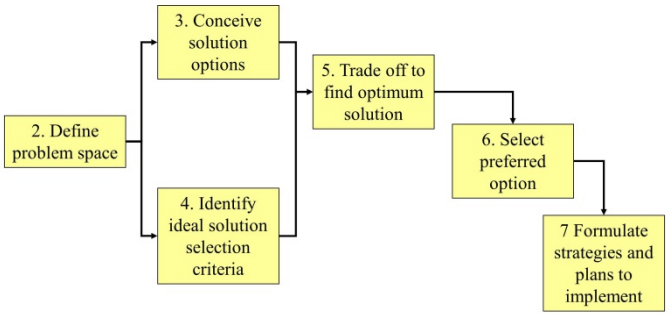


S3. FCFDS

- Begin with the end in mind
  - 7 Habits of …, Covey, 1989
- Work back from the answer
  - Ackoff 1991
- Assumption
  - FCFDS will remedy the undesirable situation
- Sometimes consensus on FCFDS may be achieved without consensus on the underlying cause of the undesirable situation
- Described from eight descriptive HTPs
- Will evolve into S7 during S4 and S5

S4. Process: planning the transition

- Planning/creating the process that will provide the solution system
  - Assembled from activities documented in textbooks, Standards, experience, etc.
  - Build/buy decisions
  - Creates SEMP and TEMP
  - Biemer and Sage, 2009
- Step 7 in Hitchins systems engineering process
- Creating the matched set of specifications for the solution system
- Taught in Project Management classes
- Generally terminates with a SRR



S5. Process: performing the transition

- Commonly known as the
  - 'system development process (SDP)'
  - 'system development lifecycle (SDLC)'
  - "systems engineering process (SEP)"
- Three streams of work
  1. Management
  2. Development/production
  3. Development Test and Evaluation (DT&E)
     - SETA and SETR
- May require several iterations
  - Temporal perspective
- Must be able to cope with changes in need before process terminates

S6. Solution system

- Conceived as part of FCFDS (S3)
- Realized in providing actual situation
- May comprise more than one system
- Contains mission and support functions
- Conforms to 7 principles paper
  - Kasser, J. E. and Hitchins, D. K., "Unifying systems engineering: Seven principles for systems engineered solution systems", *proceedings of the 21st International Symposium of the INCOSE*, Denver, 2011.
- May be provided in stages or Builds
- Contains a mixture of technology and people

S6: solution system

- Big Picture perspective
  - Subsystem of S7
- Operational perspective
  - Interactions with adjacent systems
  - What the system does (Scenarios)
- Functional perspective
  - Internal Mission and Support functions
- Structural perspective
  - Technology and physical components
- Quantitative perspective
  - Numbers associated with functions and other aspects
    - costs, reliability, etc.

S7. Actual (created) situation

- Realization of the original FCFDS (S3)
  - Situation at time solution system (S6) is realized
- Contains solution system (S6) and adjacent systems operating interdependently
- May only partially remedy original undesirable situation
- May not remedy new undesirable aspects that show up during time taken by realization process
- May contain unanticipated undesirable emergent properties from solution system (S6) and its interactions with adjacent systems in the situation
- May be realized in partial remedies

S8. Process closing stage

- Determines if the solution system (S6), operating in its context, remedies the new evolved undesirable situation at t_1(S7)
- System qualification
- Operational Test and Evaluation (OT&E)
- Acceptance test at end of first iteration
- Evolves into change management process
  - Triggers new iteration via change process to modify/ upgrade solution system
  - May lead to disposal phase

S9. System containing processes

- Organizations
  - Generally at least two organizations
    - Customer and contractor
  - Grouped as one system because of common features
    - Each organization is an instance of a class of systems
- Provides personnel and other resources to process systems

Example: The 9 systems of the Apollo program

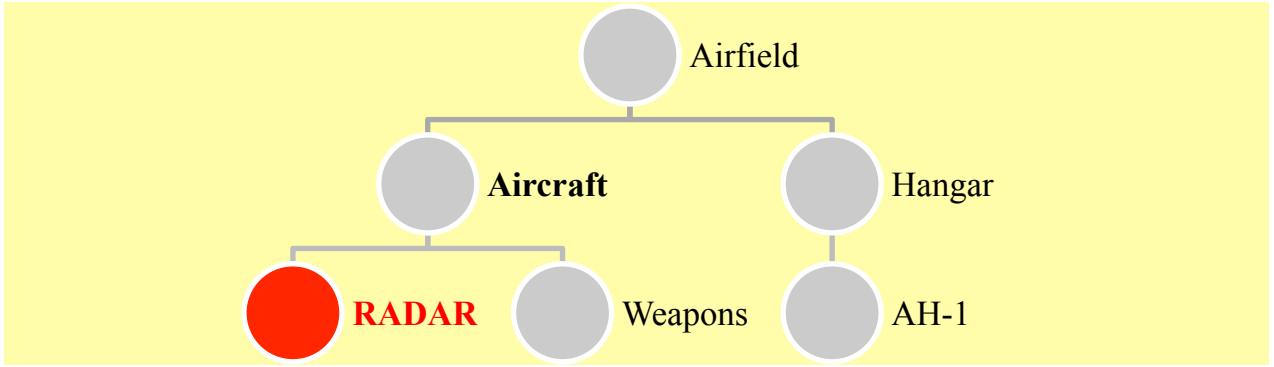
1. Undesirable or problematic situation
   - Perception that Soviet Union is ahead of US in space
2. Process to develop the FCFDS – NASA's early stage systems engineering
3. Future FCFDS that remedies the undesirable situation
   - Perception that US is ahead of Soviet Union in space
4. Process to plan the transition from the undesirable situation to the FCFDS (in NASA)
5. Process Realize the transition by providing the solution system (in Contractors, NASA and DCAS*)
6. Solution system that will operate within FCFDS
   - Ground, space and lunar systems
7. Actual or created situation
   - APOLLO landings
8. Process to determine that the realized solution remedies the evolved undesirable situation
   - US publicly lands on the moon before Soviet Union
9. Organization(s) containing the processes
   - NASA orchestrating situation and systems
   - Contractors producing systems and subsystems
     - DCAS performing Quality Control on products

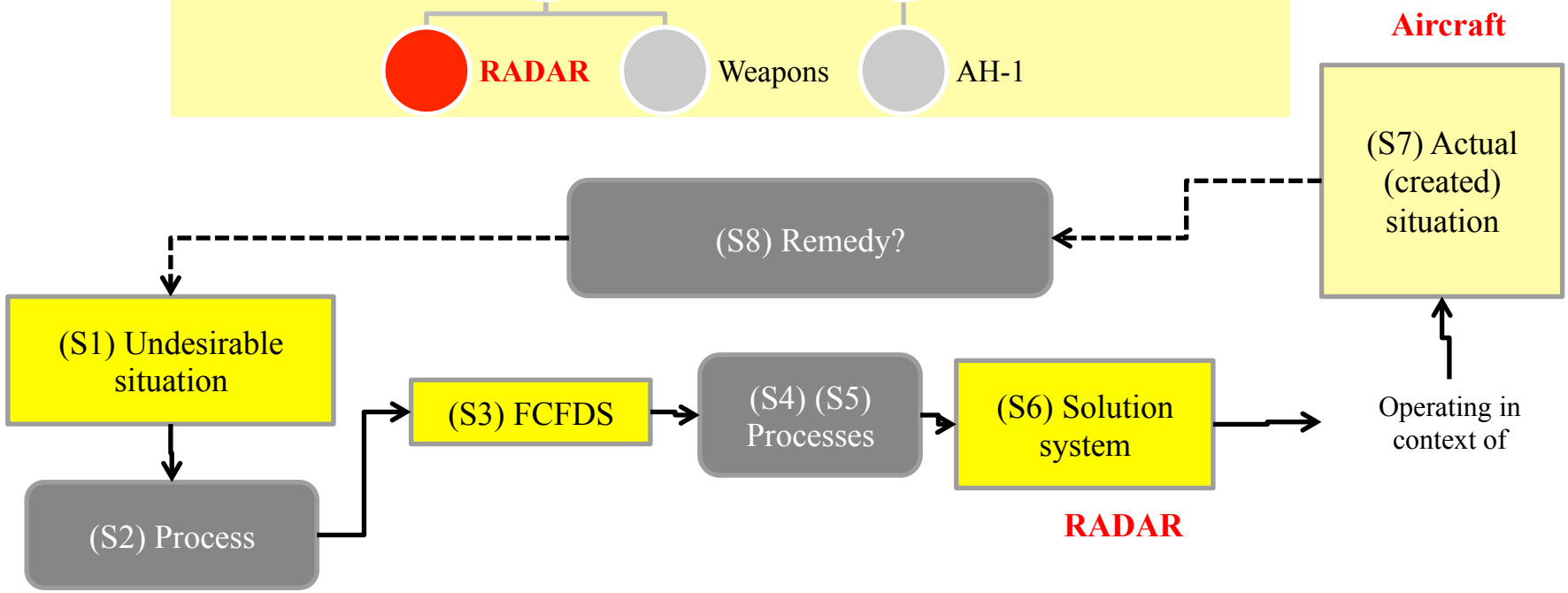
* DCAS Defense Contract Administration Services

Example: The 9 systems in aerial reconnaissance

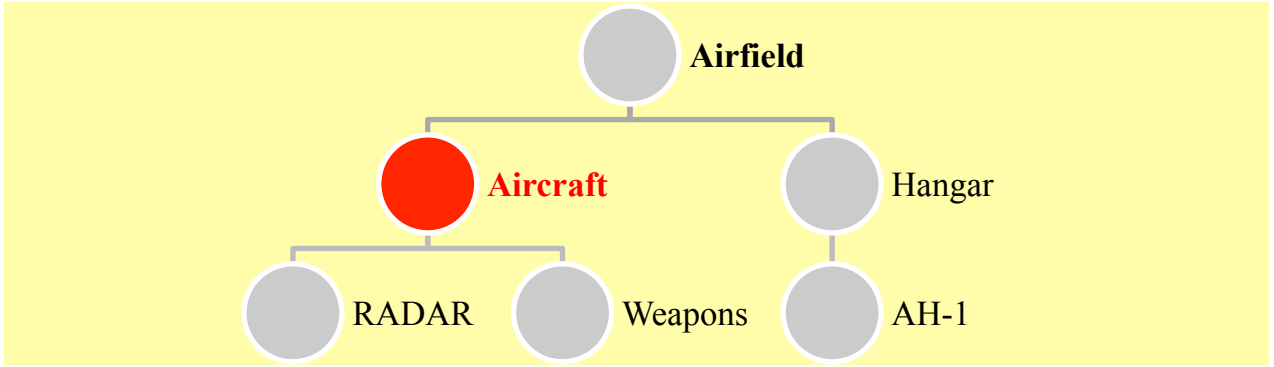
1. Undesirable situation
   - Need for accurate and timely information about something happening in a remote location
2. Process to develop the FCFDS
3. Future FCFDS that remedies the undesirable situation
   - Accurate and timely information is being provided
4. Process to plan the transformation from the undesirable situation to the FCFDS
5. Process to realize the transformation from the undesirable situation to the FCFDS by providing the solution system (purchase COTS or develop)
6. Solution system
   - UAV and associated ground support equipment
7. Actual or created situation
   - UAV operational returning accurate and timely information to personnel
8. Process to compare actual or created system with the FCFDS
9. Organization(s) containing the processes
   a) Defence force
   b) Contractor or vendor

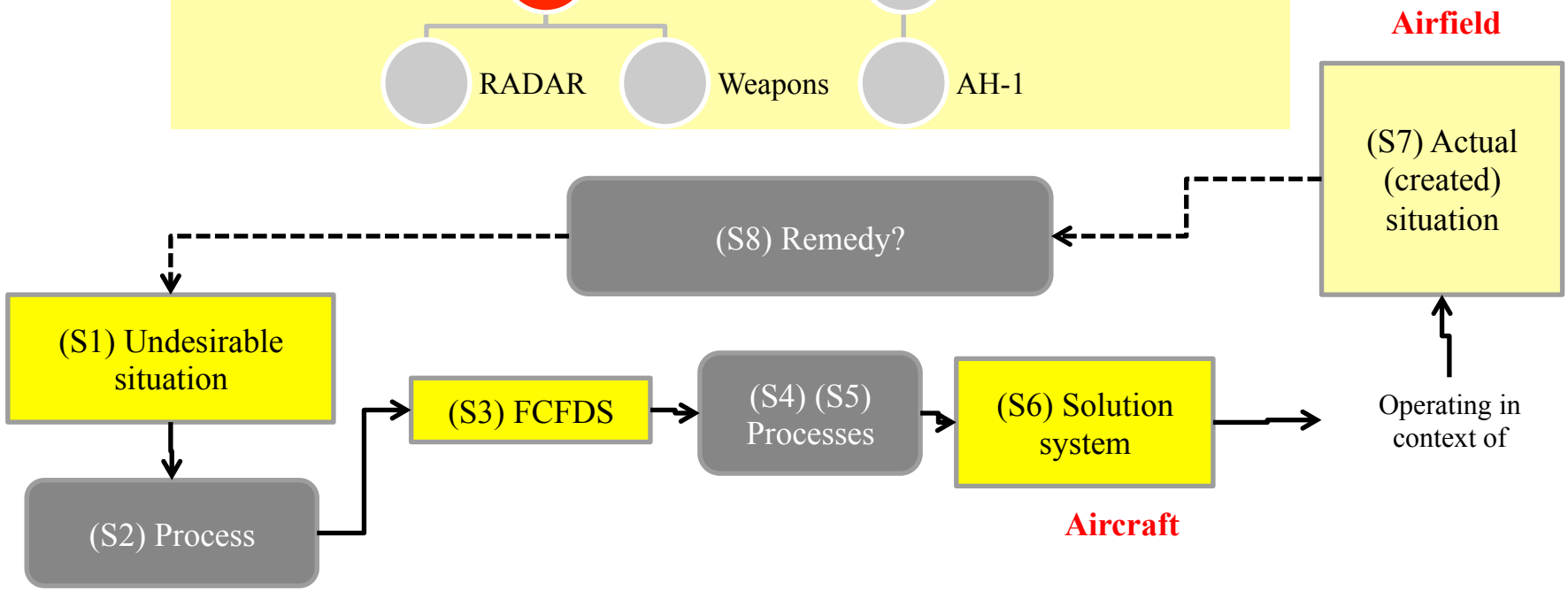
Applies in each level of hierarchy



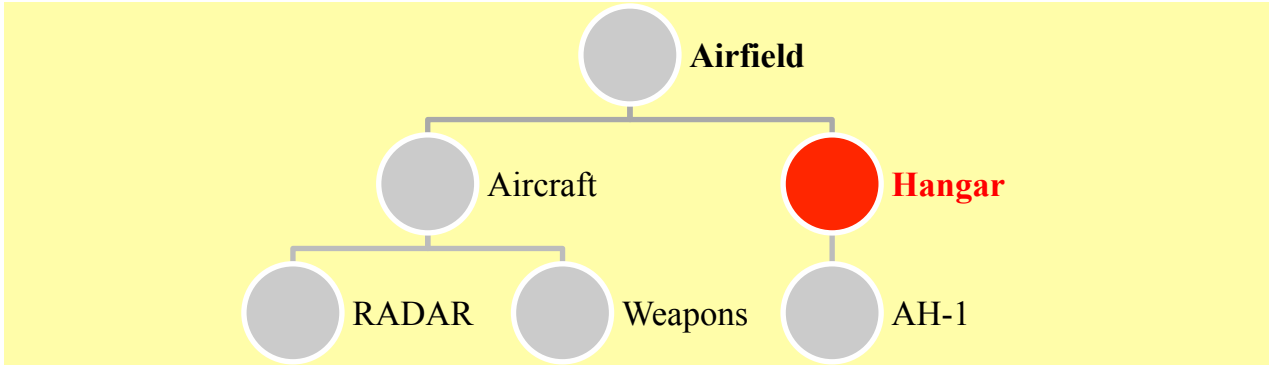


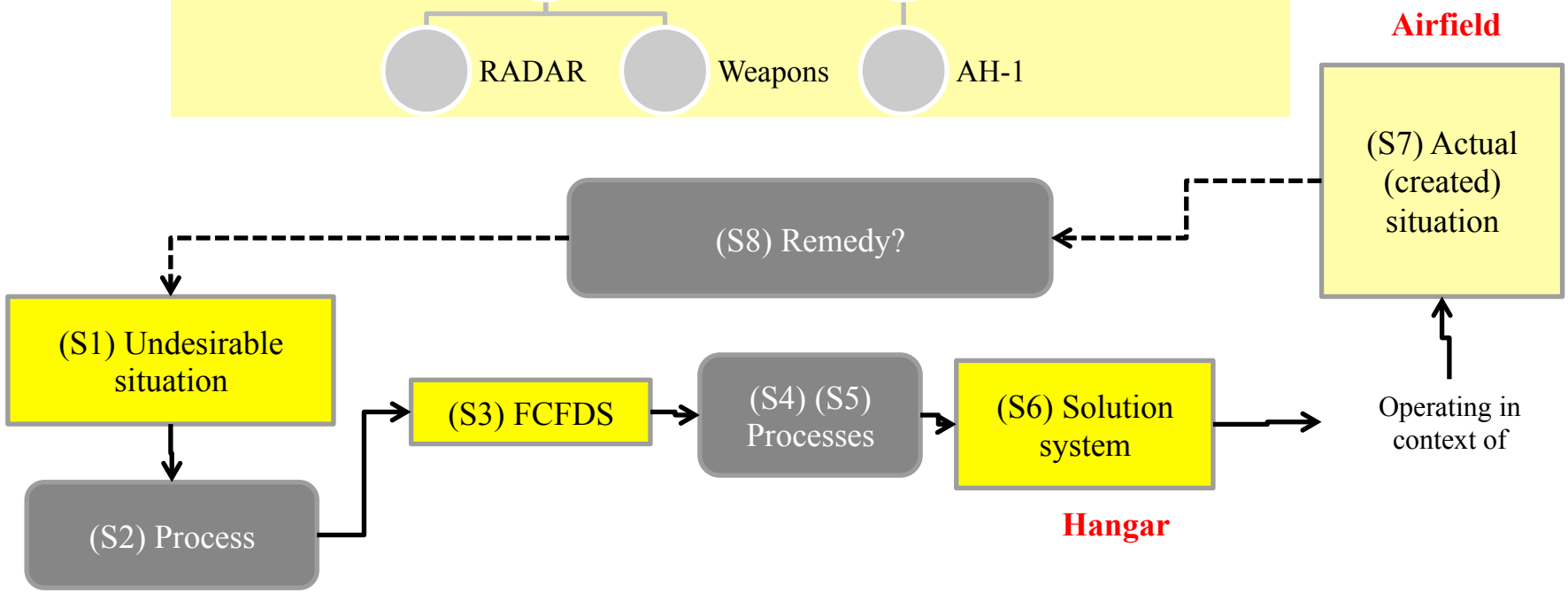
Applies in each level of hierarchy



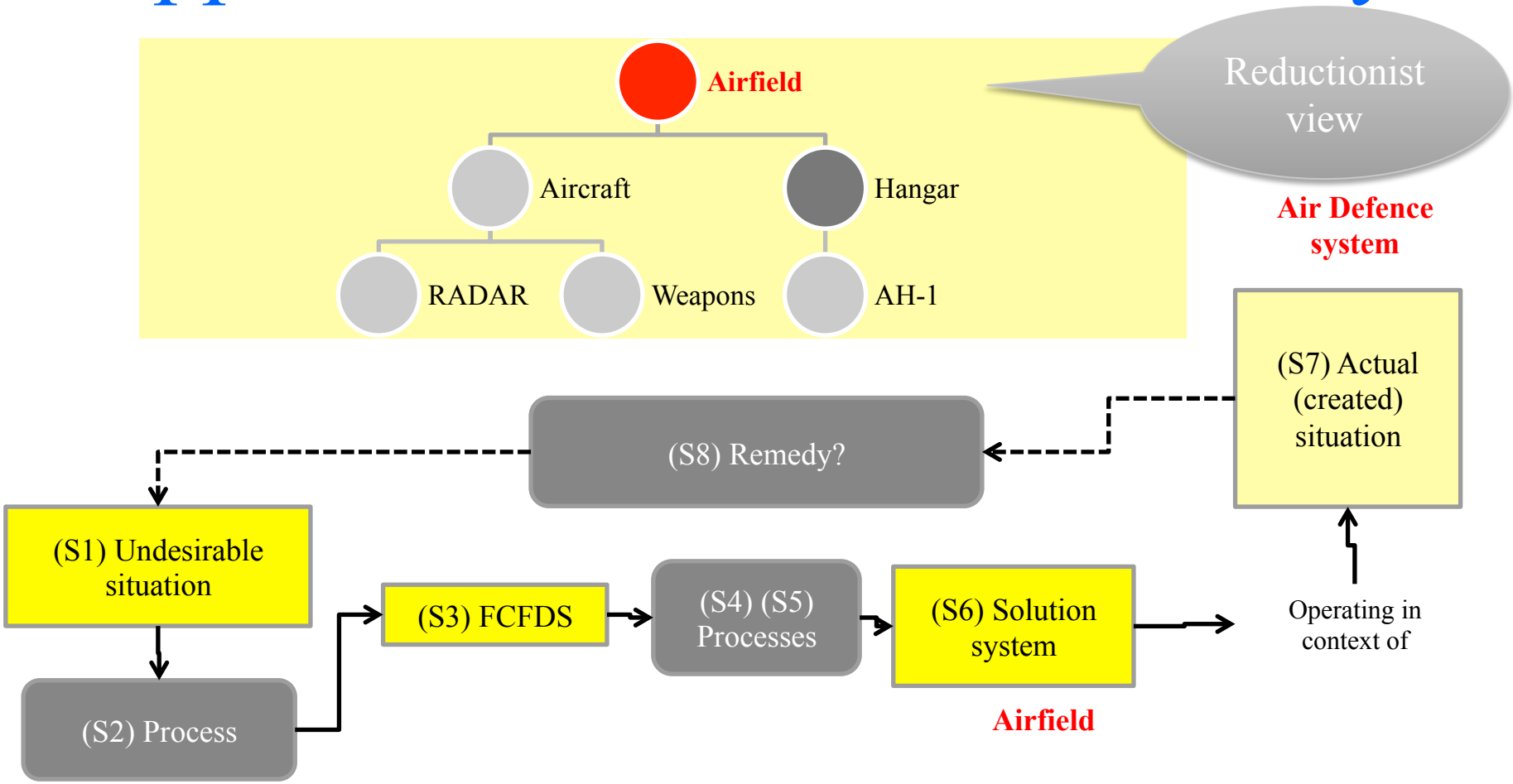


Applies in each level of hierarchy



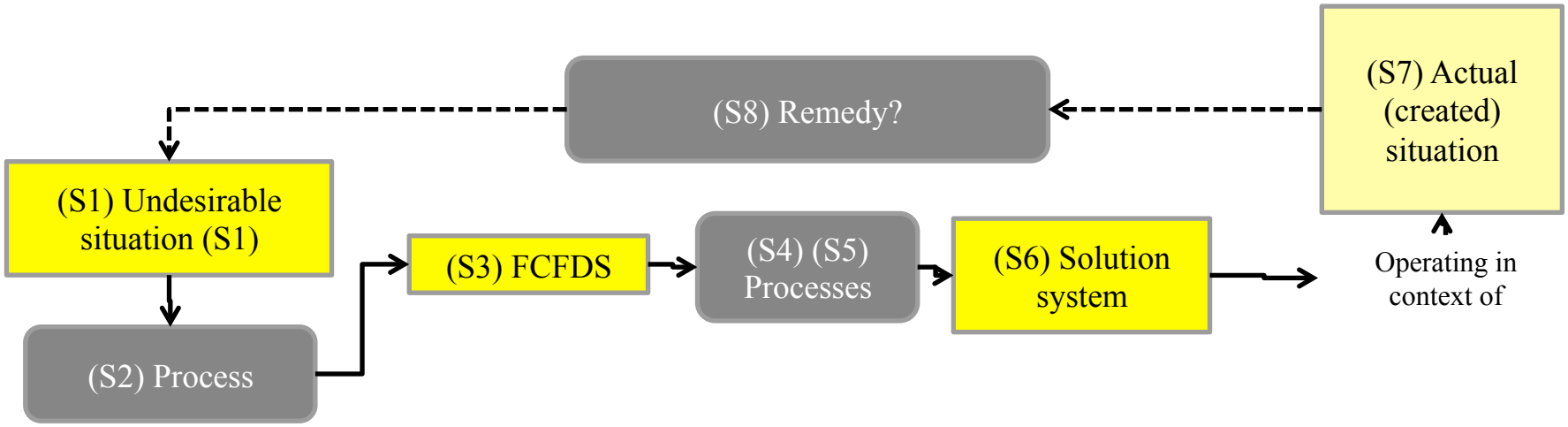


Applies in each level of hierarchy



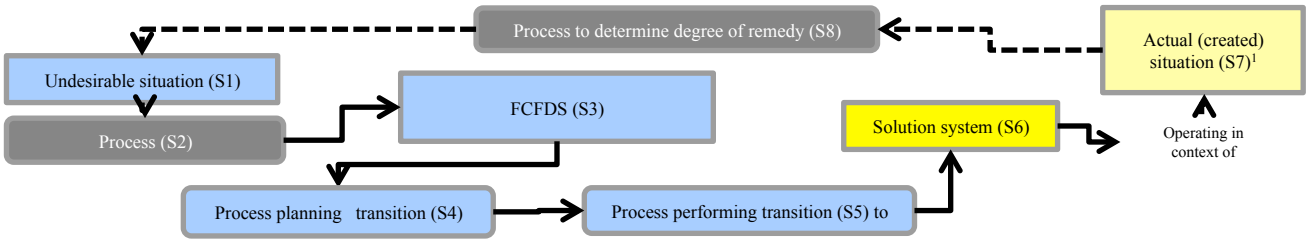
It depends

- Each system has its own 9 systems
- S6 and its adjacent systems are subsystems of S7
- S7 perceived from this view is an S6 to the systems engineers working on it
- Each systems engineer needs to be concerned with their subsystems, S6 and S7, and abstract out rest of complexity



Ill-structured situations

- Tend to be due to plurality on "problem", could be:
  1. Undesirable situation (S1)
     - May be subjective
  2. Causes of undesirability
     - May be several causes (Continuum HTP)
     - Well-structured problems
  3. Undetermined processes
     - Solution system (S6) realized by (S5) and planned in (S4)



Topics

- Previous approaches to managing complexity
- Systems thinking
- Gaining an understanding
- Holistic thinking
- Active brainstorming
- Classifications of problems
- Holistic problem-solving
- The Nine-Systems Model
- **The MSOCC Data Switch Replacement Project**
- Questions and comments

The MSOCC Data Switch Replacement Project

- The MSOCC Replacement Project
- Stakeholder management in the literature
- Managing stakeholder expectations using
  - the Holistic Thinking Perspectives
  - the Nine-System Model

MCSS Replacement Project

- ***The undesirable situation***
  - The perception that the MSOCC will not be able to cope with its anticipated future switching requirements
  - Some undesirable aspects of the current switching system need to be eliminated.
- ***The Feasible Conceptual Future Desirable Situation*** (FCFDS)
  - An MSOCC that will be able to cope with its anticipated future switching requirements.
- ***The solution***
  - An upgraded higher performance switch operating within the context of the FCFDS.
- ***The problem***
  - How to gain consensus on the plan to transition from the undesirable situation to the FCFDS.

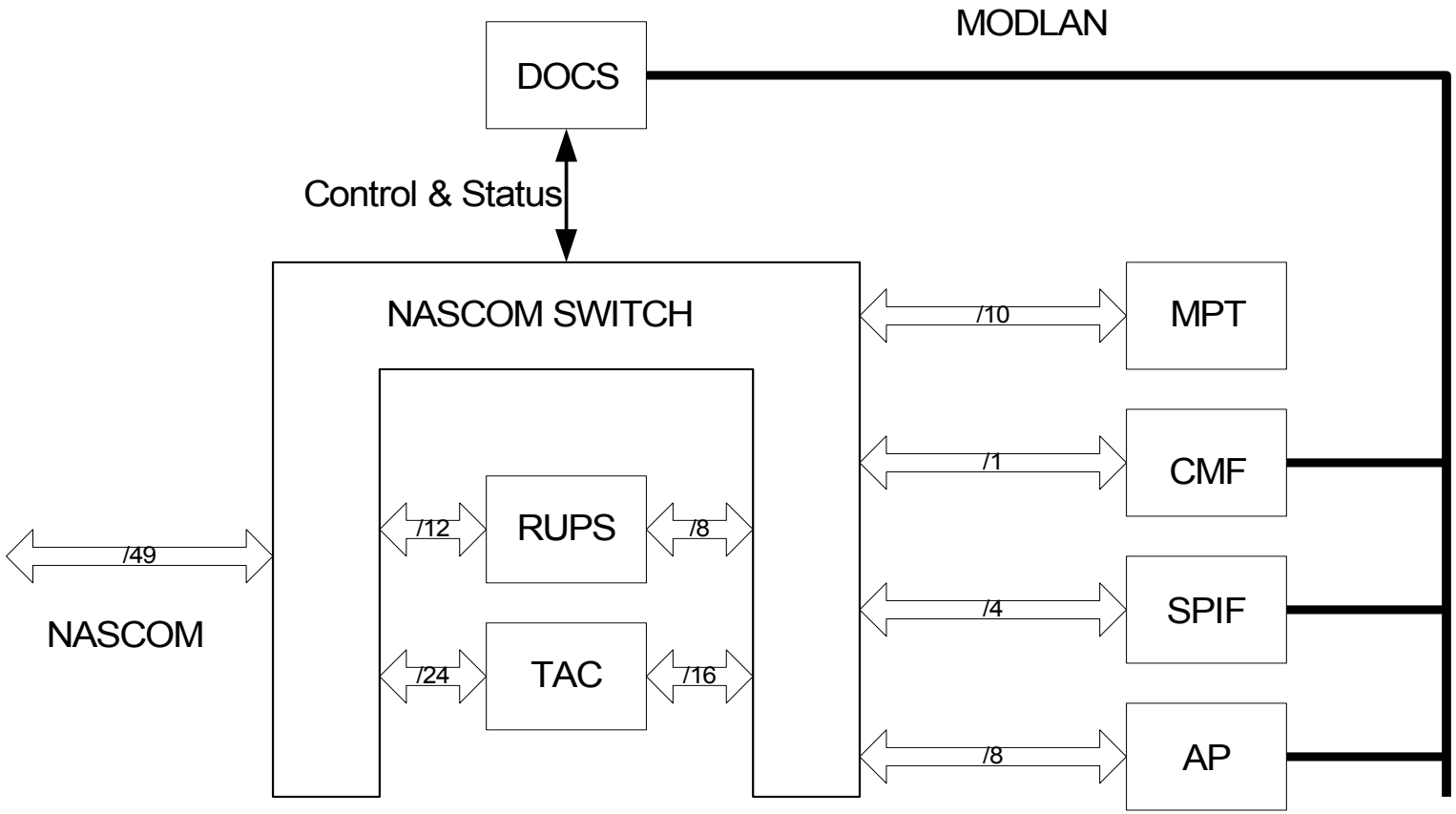
MSOCC Big picture perspective

- In 1989, the Goddard Space Flight Center (GSFC) Multi-Satellite Operations Control Center (MSOCC) was facing the problem of replacing the data switch that routed signals from multiple low earth orbit (LEO) satellites to data processing computers
- The MSOCC was the major interface between the LEO data streams from the global tracking network (Nascom) and the Telemetry Tracking and Control system at NASA's GSFC
- Loss of LEO satellite scientific data could not be tolerated
- Principle Investigators (PI) would be very upset if they lost scientific data
- There were a plurality of stakeholders in the MSOCC
- There was minimal data capture and storage functionality in the ground stations and Nascom
- The MSOCC was supported by two somewhat overlapping contracts, SEAS and NMOS

MSOCC Operational perspective

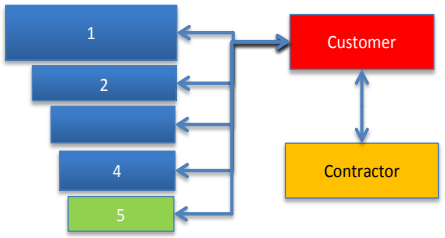
- Various data routing scenarios documented in the CONOPS
- The data streams from the satellites could not be switched off
- Data could arrive at any time without warning

Structural Perspective



Continuum perspective

- Differences between
  1. Stakeholder interests.
  2. Stakeholders and customers.
  3. “No loss of data” and “no downtime” (during the transition)
  4. Stakeholder communications and control (contractual) interfaces

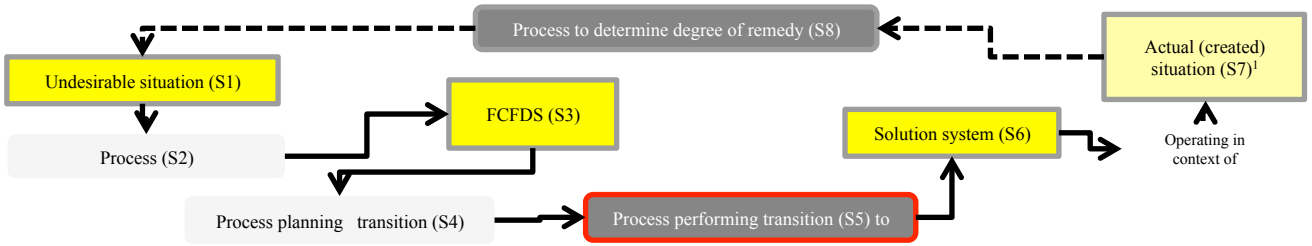


Scientific Perspective

- Two well-structured problems
  1. Determine the requirements for the MCSS.
  2. Convert the stakeholder plurality of opinions on the transition from the existing switch to the replacement switch into a consensus on an approach.
- Each problem has its own and shared stakeholders
  - Expectations that need to be managed

Well-structured problematic situation (MCSS)

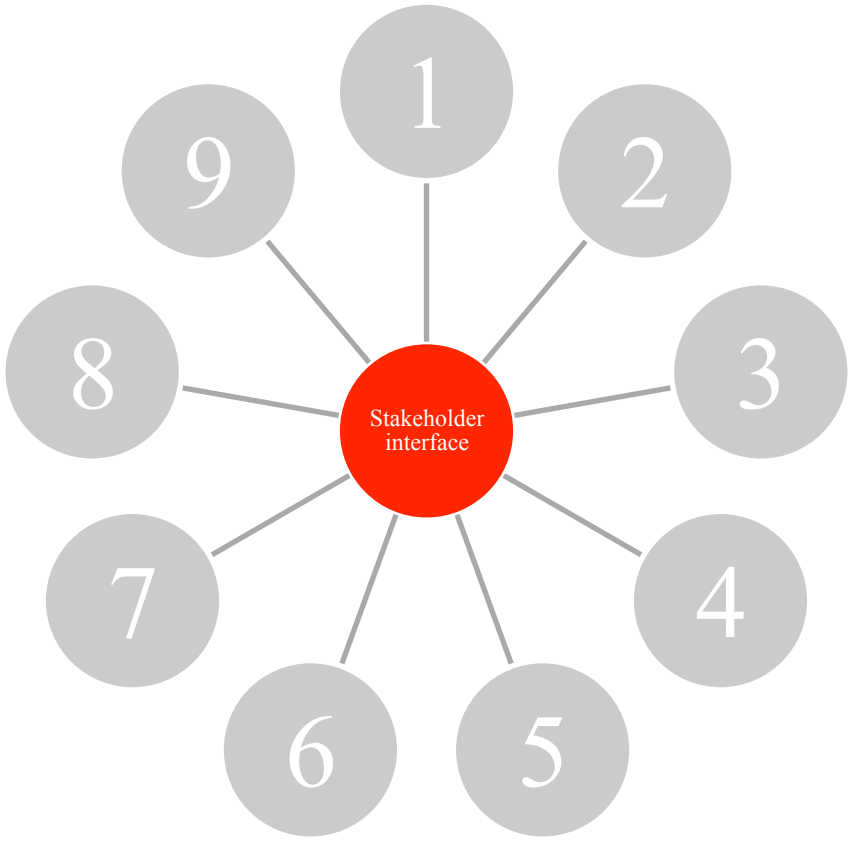
- Seven pertinent systems
- CONOPS in S3 almost identical to CONOPS in S1
  - Standard situation for upgrade/replacement project (Generic HTP)
  - Requirements for MCSS (S6) are based on anticipated number of input data streams and data processing equipment in future
  - Quick check identified COTS switches that could meet the requirements for numbers of inputs and outputs
- **Uncertainty restricted to S5**
  - Remaining complexity can be abstracted out
  - Stakeholder plurality on transition of MCSS into the MSOCC (S5)



Stakeholder management in the literature

- Communicate with stakeholders
- Subset of an undefined list
- Which are relevant?
- How to manage conflicting concerns?
  - QFD?
- No systemic and systematic way of managing stakeholder expectations

Traditional complex view of stakeholders



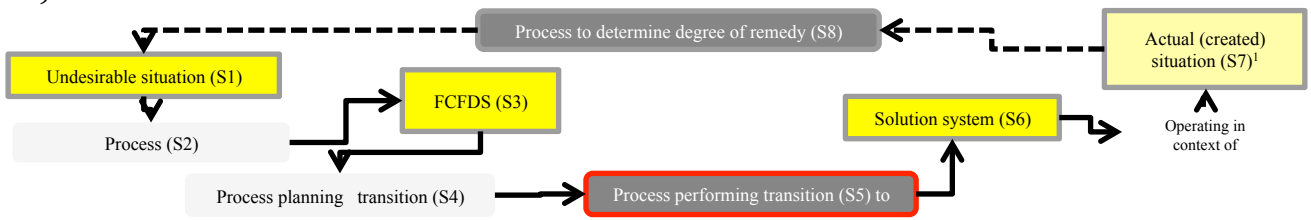
- Need to manage stakeholders in the NASA MSOCC MCSS Replacement project
- Traditional view of stakeholders does not provide any guidance

Stakeholder Management process

1. **Identifying the stakeholders.**
2. **Identifying the areas of concern of each stakeholder.**
3. Addressing the areas of concern of each stakeholder.
4. Informing the stakeholders how their areas of concern were considered.
5. Gaining stakeholder consensus on the outcome.

MCSS Nine systems

1. The undesirable situation
   a. NASCOM data switch would not be able to cope with future anticipated needs
   b. Deficiencies and irritancies in existing switches
2. Most of Hitchins' systems engineering process (Hitchins, 2007)
3. FCFDS: MSOCC data switch coping with future anticipated needs without deficiencies and irritancies in existing switches
4. Transition planning task in SEAS contract, ended at SRR
   – Last part of Hitchins' systems engineering process (Hitchins, 2007)
5. Transition realization task to be assigned after SRR
6. MCSS
7. MSOCC in its upgraded situation
8. MCSS Acceptance test
9. SEAS, NMOS and NASA



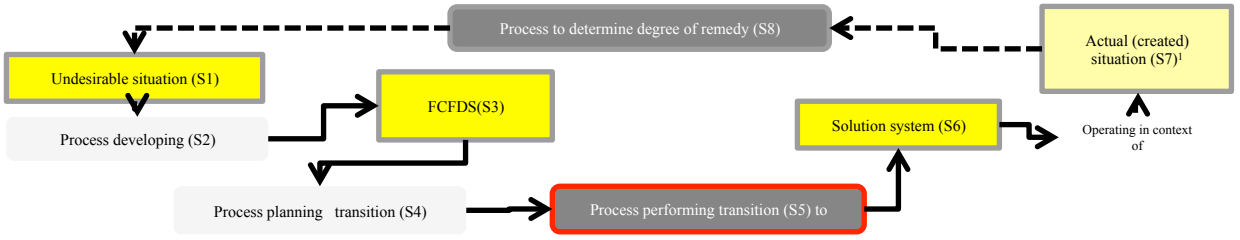
The MCSS Stakeholders

- MSOCC Operators
- NASA Managers
- SEAS and NMOS managers
- Hardware and Software Developers and testers
- NASCOM personnel
- Experiment PIs

Stakeholder concern matrix [typical] at SRR time

Stakeholder	S1	S2	S3	S4	S5	S6	S7	S8	S9
Dr Principle Investigator							O		
Oswald Operator	X		X		X	X	X		
Ollie Operator	X		X		X	X	X		
Danny Developer		X			X	X	X		
Debora Developer					X				
Development manager		X		X	X		X		X
Tammy Tester	X		X						
Thomas Tester								X	

O: Only concerned if data not forthcoming
X: Concerned and Needs information



Stakeholder Management process

1. Identifying the stakeholders.
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3. **Addressing the areas of concern of each stakeholder.**
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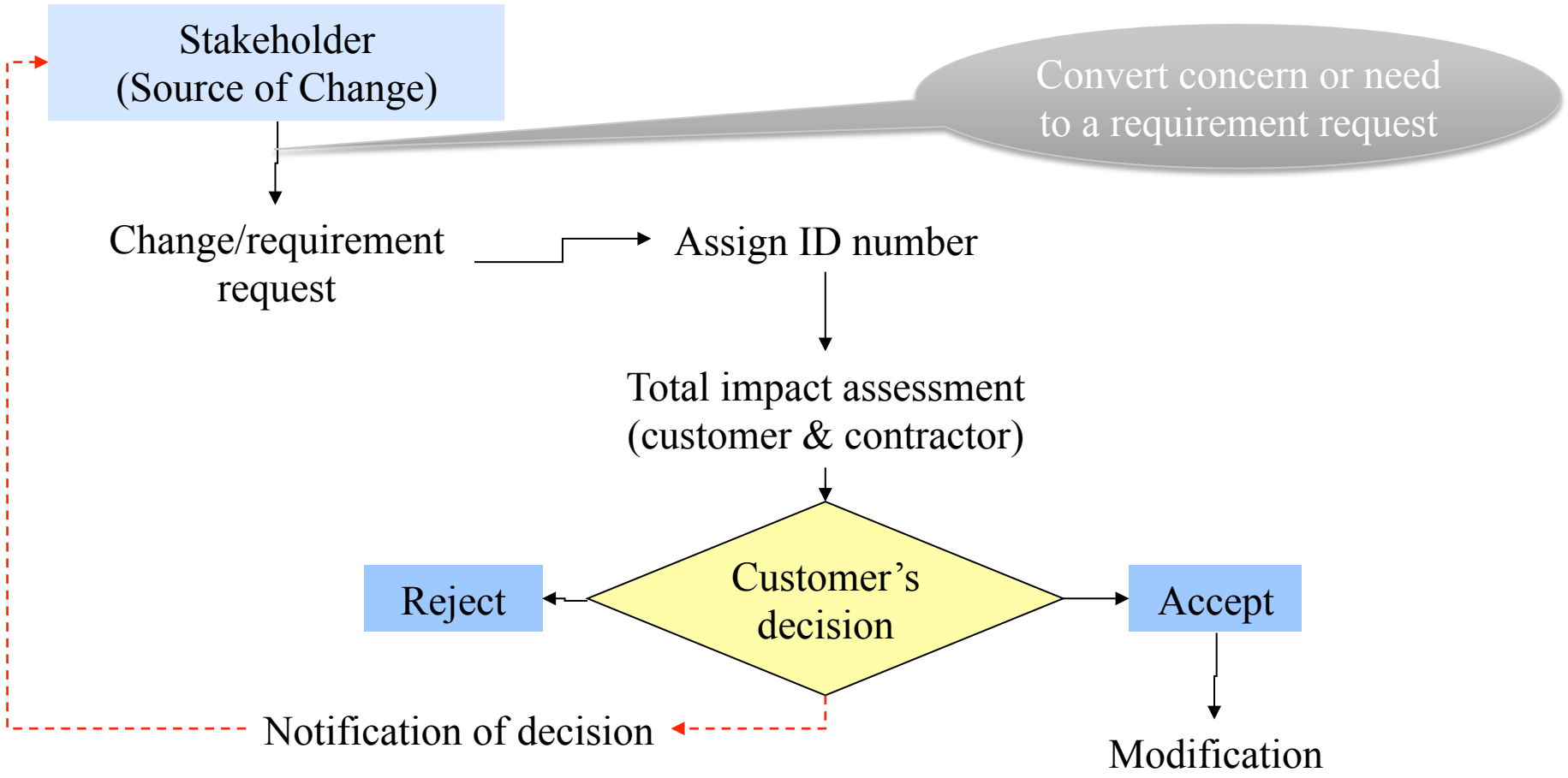
5. Gaining stakeholder consensus on the outcome.

Generic perspective

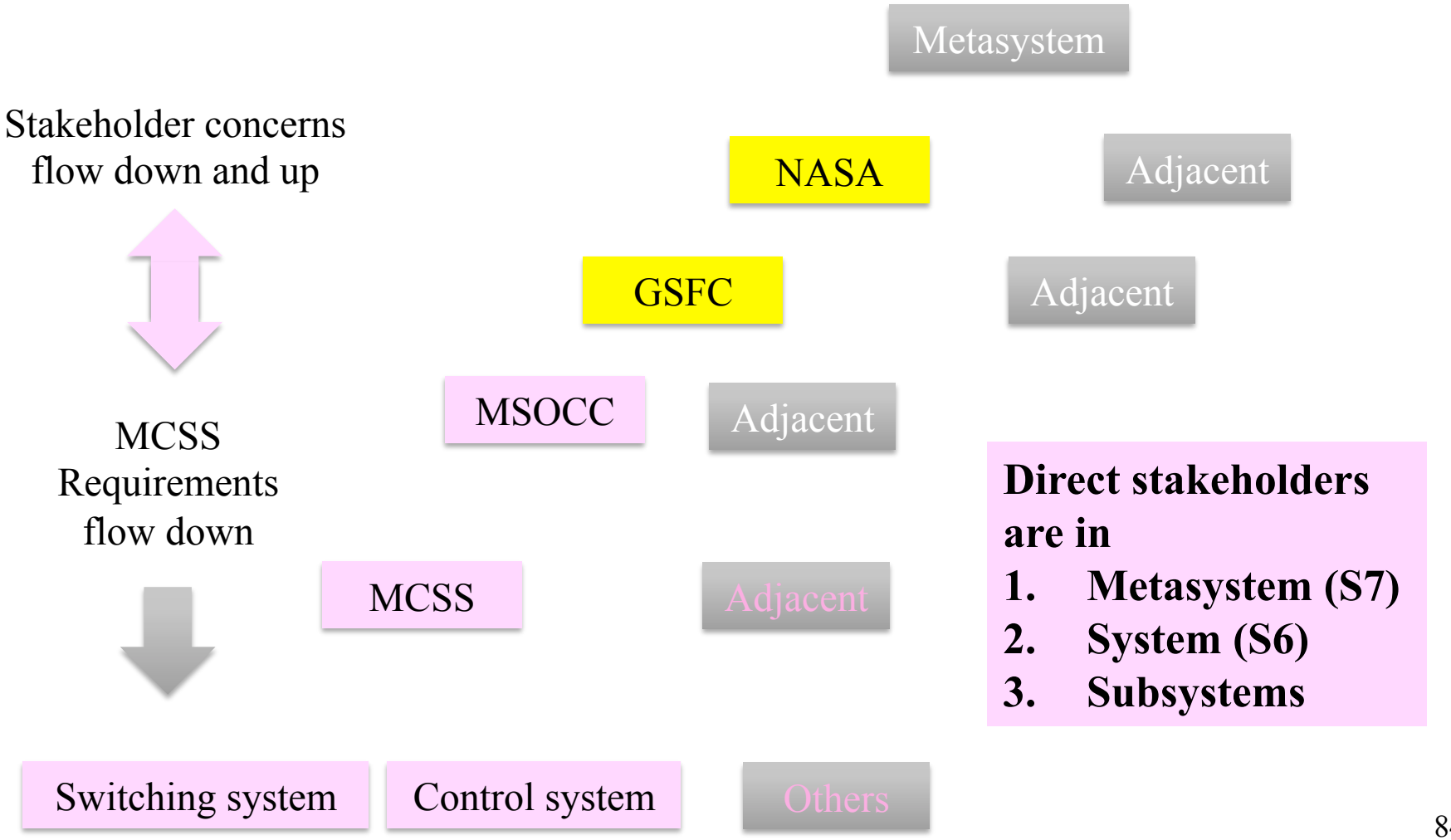
- Instance of generic ‘change management process’
- Requests for changes due to
  1. Not doing what it should be doing, because
     a. Something is broken
     b. Something does not have capability any more (it is overloaded)
  2. Not doing something it could be doing
     a. From requester’s perspective
  3. Doing something, but not as well as it could be doing it.
  4. Doing something it should not be doing.

Functional perspective of change management process



Done in S4 for all pertinent stakeholders in S5 and S6

Direct/indirect stakeholders



Direct stakeholders are in

1. **Metasystem (S7)**
2. **System (S6)**
3. **Subsystems**

Applying the Nine-system Model

- Start with S1
- Perceive it from the HTPs
- Identify other systems
- Perceive them from HTPs in an iterative manner
- Use active brainstorming to generate ideas
- Store ideas in HTPs

Examples of managing complexity

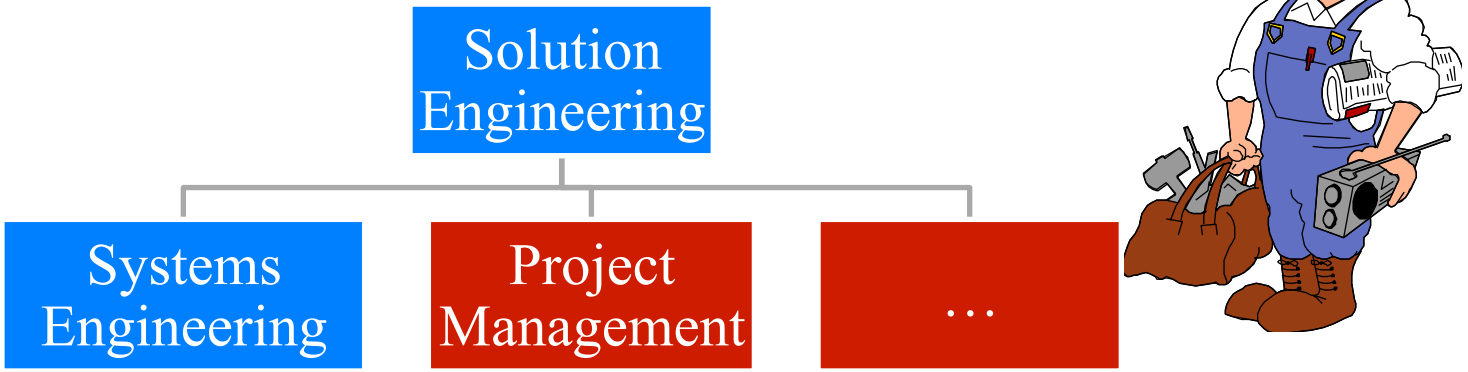
- Cruise ships (fleets)
- Airlines
- International air freight forwarding companies
- Automated rapid transit systems
- Banking via Internet and ATMs
- Hospitals
- Oil rigs

Summary-1

- Previous approaches to managing complexity
- Systems thinking
- Gaining an understanding
- Holistic thinking
- Active brainstorming
- Classifications of problems
- Holistic problem-solving
- The Nine-Systems Model
- The MSOCC Data Switch Replacement Project

Systems engineering

- Systems engineering is a part of the application of a systemic and systematic holistic approach to remedying complex problems



Questions and comments?