2015

Perspectives on the design of resilient systems

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Talking about resilience

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Introduction

Question: how to represent system resilience?

- Different system types
- Varied stakeholders

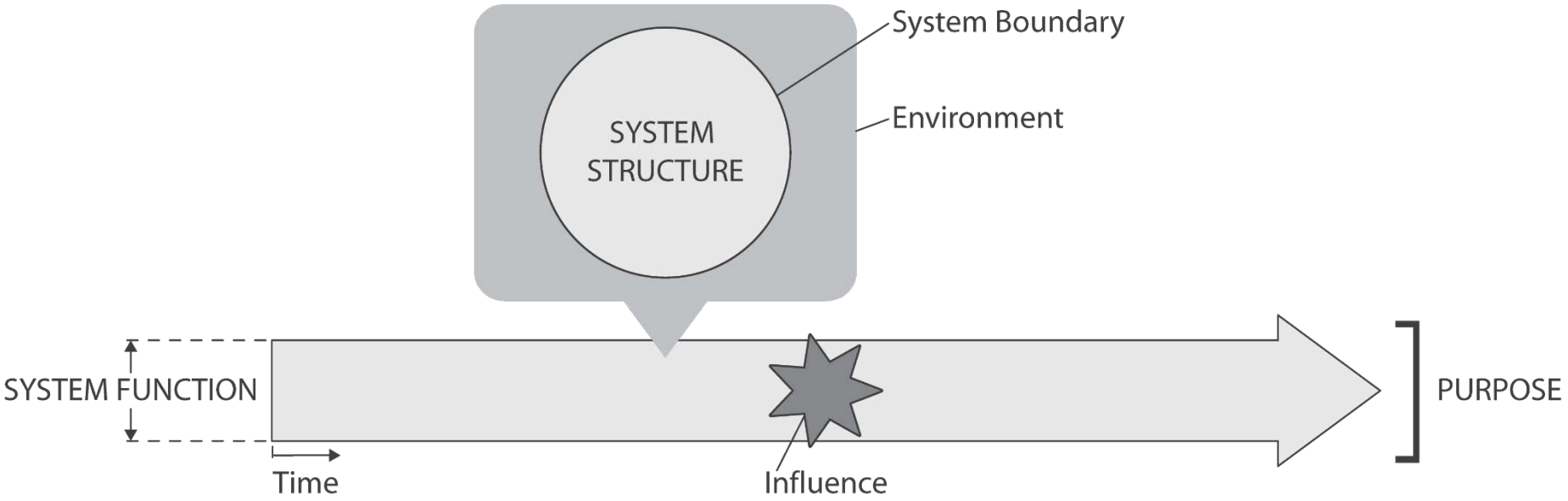
Approach: interdisciplinary workshop

- Varied participants (different systems, different roles)
- Two two-hour sessions
- Recorded for analysis
- Diagrammatic summaries of examples and themes

Workshop participants

Participant ID	Field of Study	Academia	Policy	Industry
P1	Design Engineering	X		
P2	Human Geography	X		
P3	Operations Research	X		
P4	Mechanical Engineering	X		
P5	Psychophysiology	X		
P6	Biological Sciences	X		
P7	National Security	X	X	
P8	Science and Policy	X	X	
P9	International Politics	X	X	
P10	Science and Policy	X	X	
P11	Built Environment	X		X
P12	Architecture	X		X
P13	Telecommunications			X
P14	Architecture			X
P15	Space Systems			X
P16	International Policy		X	X
P17	International Affairs		X	X
P18	Healthcare Strategy		X	
P19	Counter Terrorism		X	
P20	National Security		X	
P21	Science and Policy		X	

General diagram for resilience



Workshop findings

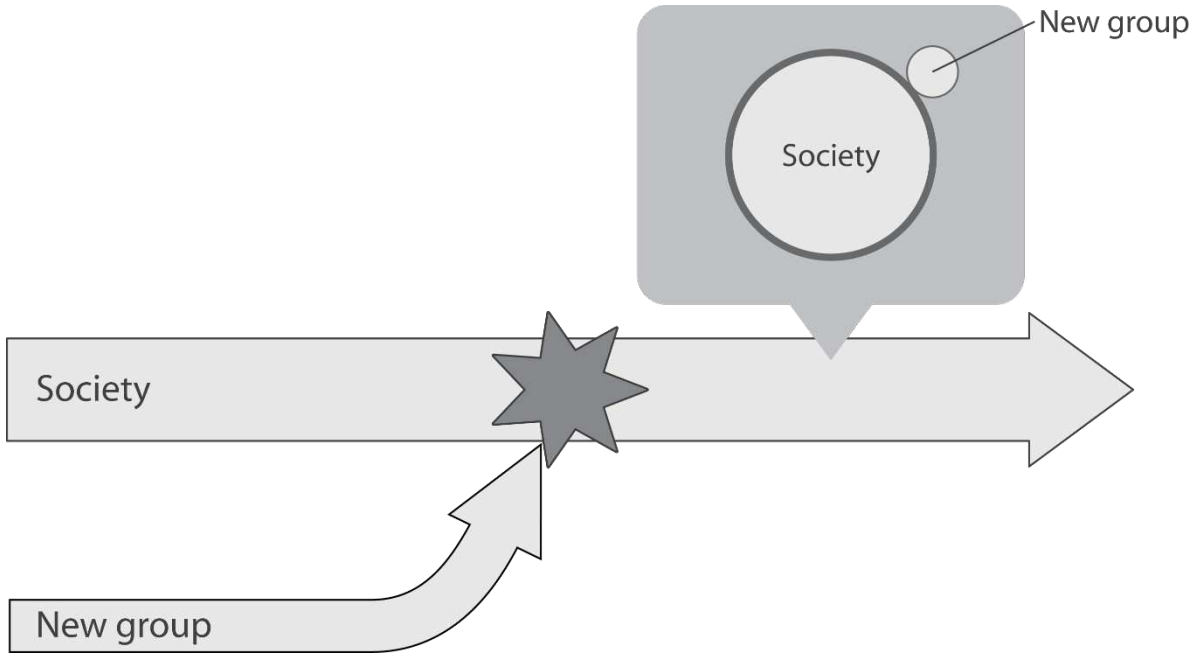
How people talk about resilience

- Resisting
- Recovering
- Changing

Structuring discussions about resilience

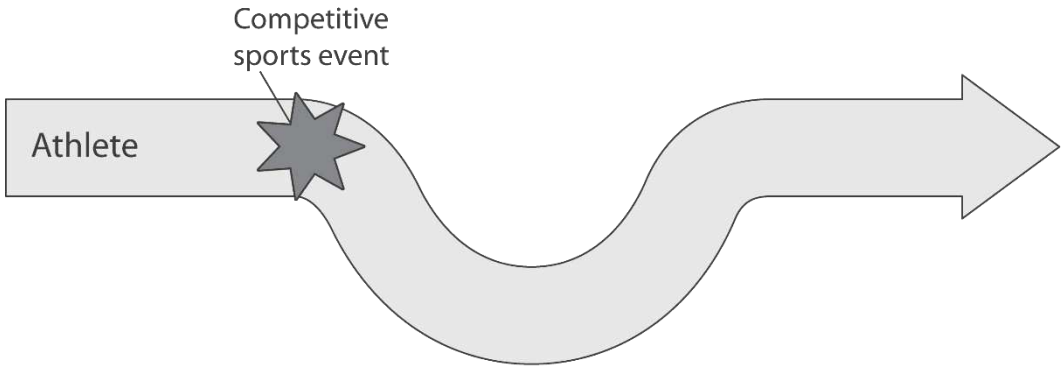
- Boundaries
- Purpose
- Perspective

How people talk: resisting



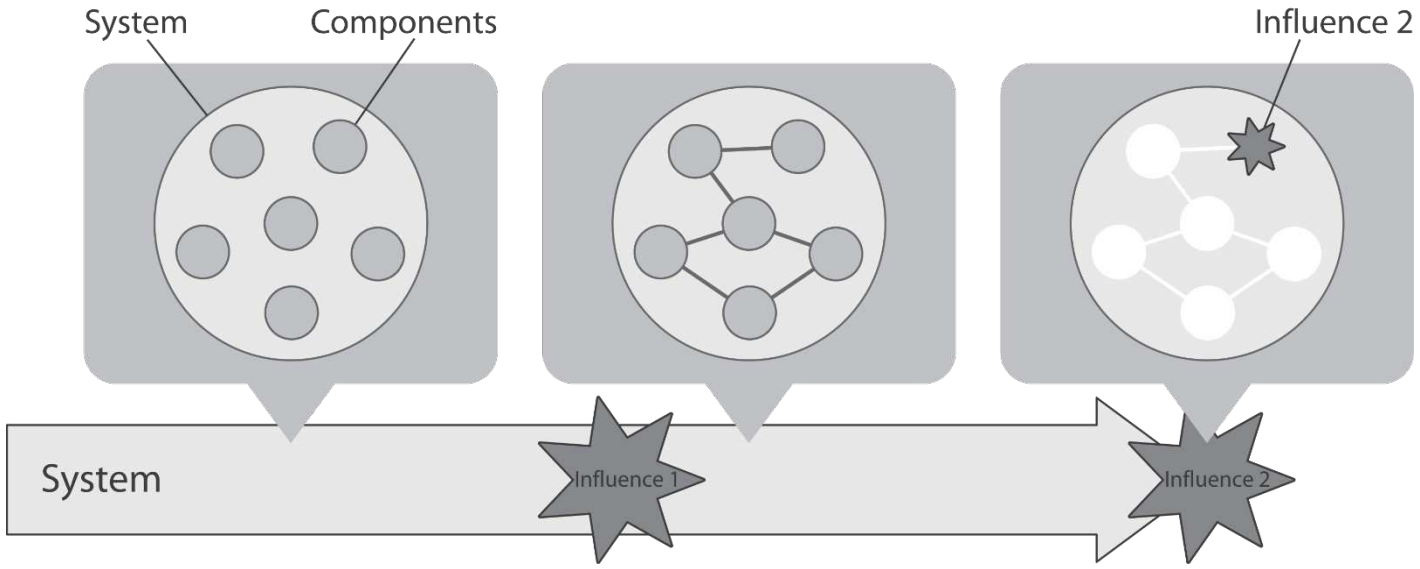
Example 1: A society sees a group of new people as a threat to their collective identity so they protect themselves, refusing to let the group become part of their society and resisting change. Is the society being resilient or are they rigid? (P9)

How people talk: recovering



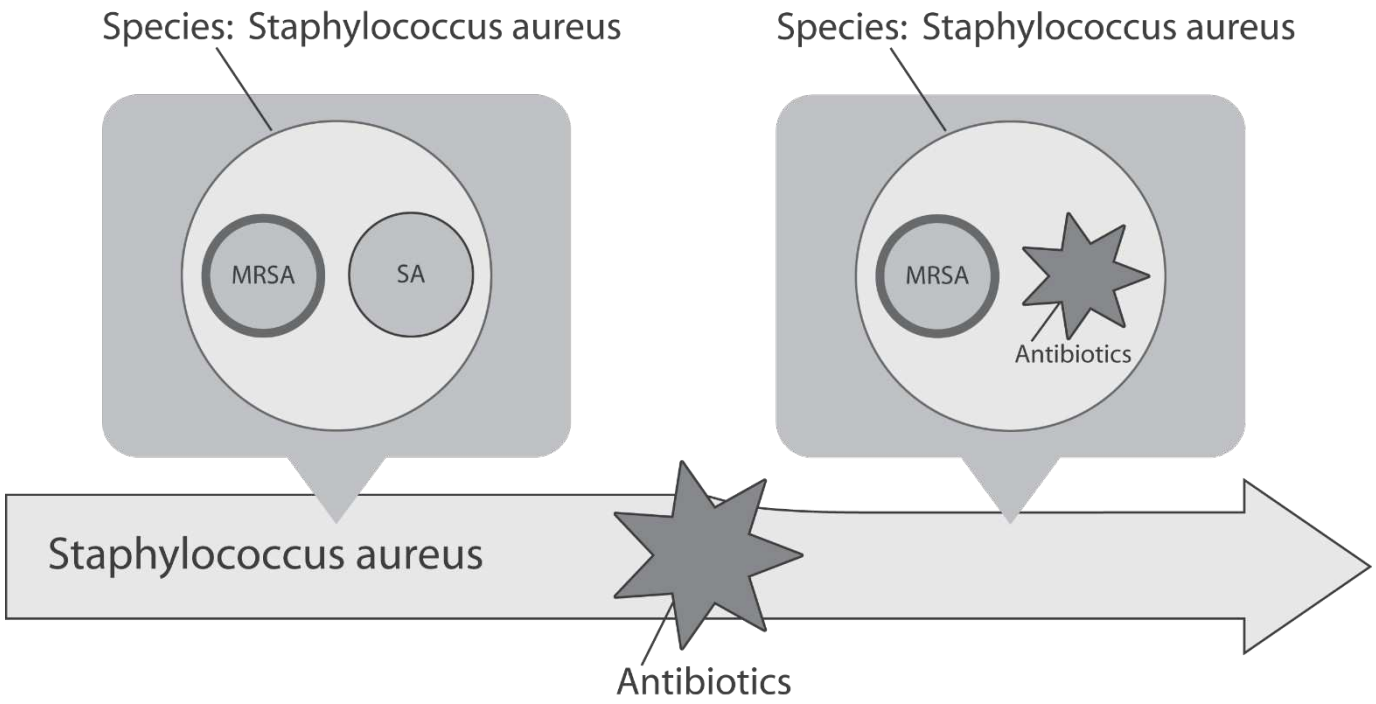
Example 2: The "emotional resilience of an athlete" could refer to at least two different things: (a) the way a person maintains high levels of physical performance despite setbacks to their mental wellbeing; or (b) the way a person maintains high levels of mental wellbeing despite setbacks to their physical performance. Maintaining mental wellbeing may conflict with maintaining extreme levels of physical performance. When someone says that an athlete is resilient, do they mean resilient in terms of performance or wellbeing? (P5)

How people talk: changing



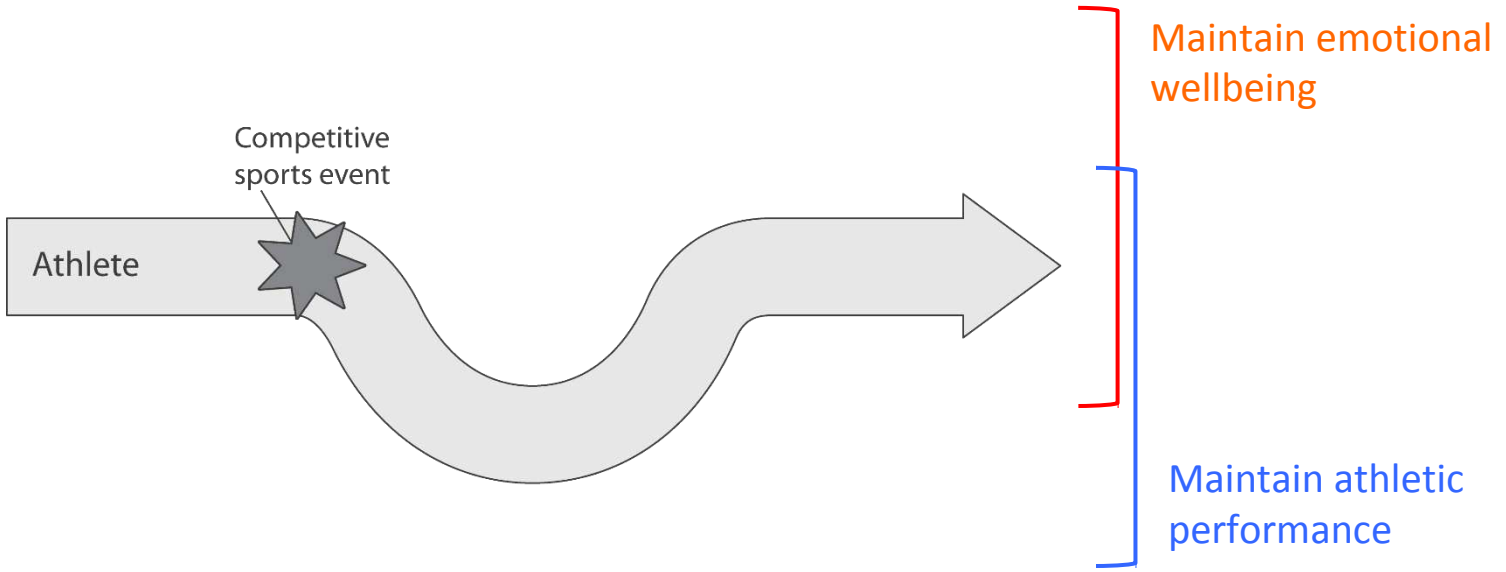
Example 3: Engineering systems are more robust and the performance is getting better and better but eventually they get to the point where they might fall over. As engineers we counter this by creating more and more systems to try and control the performance. How do you avoid encrusting the system with constraints and making it fragile? (P4)

Structuring discussions: boundaries



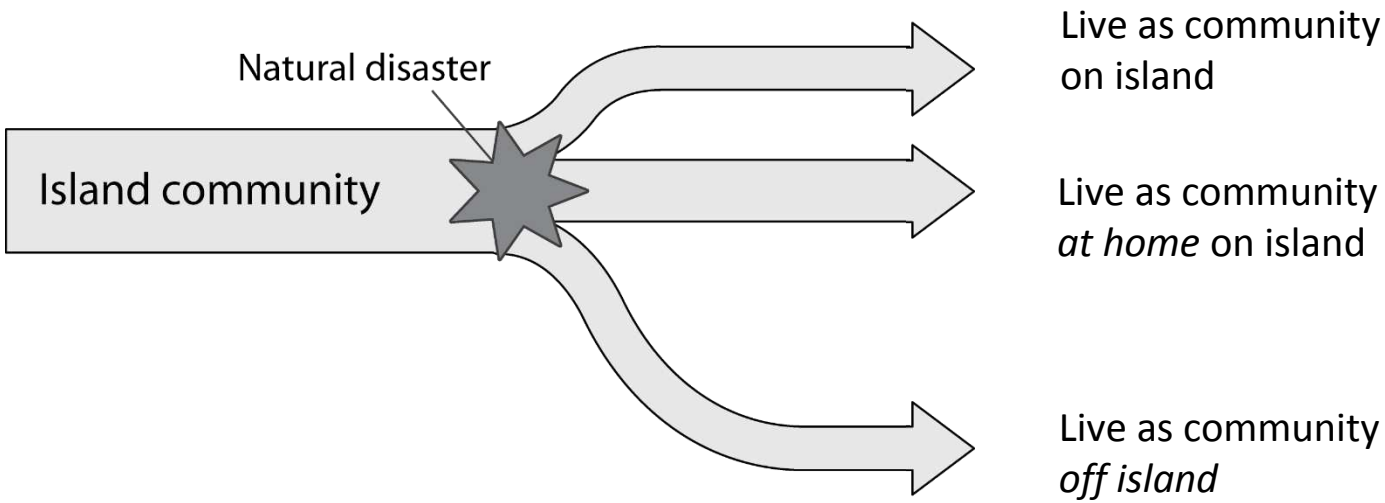
Example 4: Staphylococcus aureus is a type of bacteria that is a common cause of infection and can be treated with penicillin. However, over time some of these organisms have developed into Methicillin-resistant Staphylococcus aureus (MRSA). MRSA is not any more virulent but is resistant to antibiotics such as penicillin. Can you say that Staphylococcus aureus is resilient or only that the subset of MRSA organisms is resilient? (P6)

Structuring discussions: purpose



Example 2 also highlights how different stakeholders may define the boundary and purpose of the system differently. The athlete might have a personal trainer who is trying to increase their physical resilience by controlling their exercise and nutrition. Whereas a psychologist might prescribe rest and social interaction to improve the athlete's emotional resilience. If the purpose of the athlete is defined as maintaining a high level of performance over 6 months for a particular event, then the emotional wellbeing of the person is likely to receive less investment than their physical health. If the athlete's purpose is to maintain their performance over a period of 20 years then it is more likely that the available resources will be distributed more evenly to achieve both physical and mental resilience.

Structuring discussions: perspective



Example 5: An island community was facing environmental threats in the area where they lived. Some of the people stayed in the area, some moved to a new area of the island and others left to live in a new country. Which group of people are most resilient? (P2)

When asking about system resilience…

What system?

What disturbance?

Originating from what source?

Maintaining what?

From whose perspective?

For better or worse?

Further reading

Taysom, E. & Crilly, N. (2014). “Diagrammatic Representation of System Lifecycle Properties.” In 4th International Engineering Systems Symposium. Hoboken, NJ.

Also see:

Chen, C.-C., & Crilly, N. (2014). Towards a framework of design principles: Classifying system features, behaviours and types. In *DRS2014*. Umeå, Sweden.

de Weck, O. L., Roos, D., & Magee, C. L. (2011). *Engineering Systems: Meeting Human Needs in a Complex Technological World*. MIT Press.

Talking about resilience

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