31st Annual INCOSE international symposium

virtual event

July 17 - 22, 2021

Charlotte Dunford and Richard Beasley present

Social Science Solutions for the Systems Engineer What's Needed

www.incose.org/symp2021

Outline

Section 01 Introduction & Opening Question - Charlotte

Section 02 Problem Context - Richard

Section 03 Case Study - Charlotte

Section 04 Social Science Solutions - Charlotte

Section 05 Next Steps - Charlotte

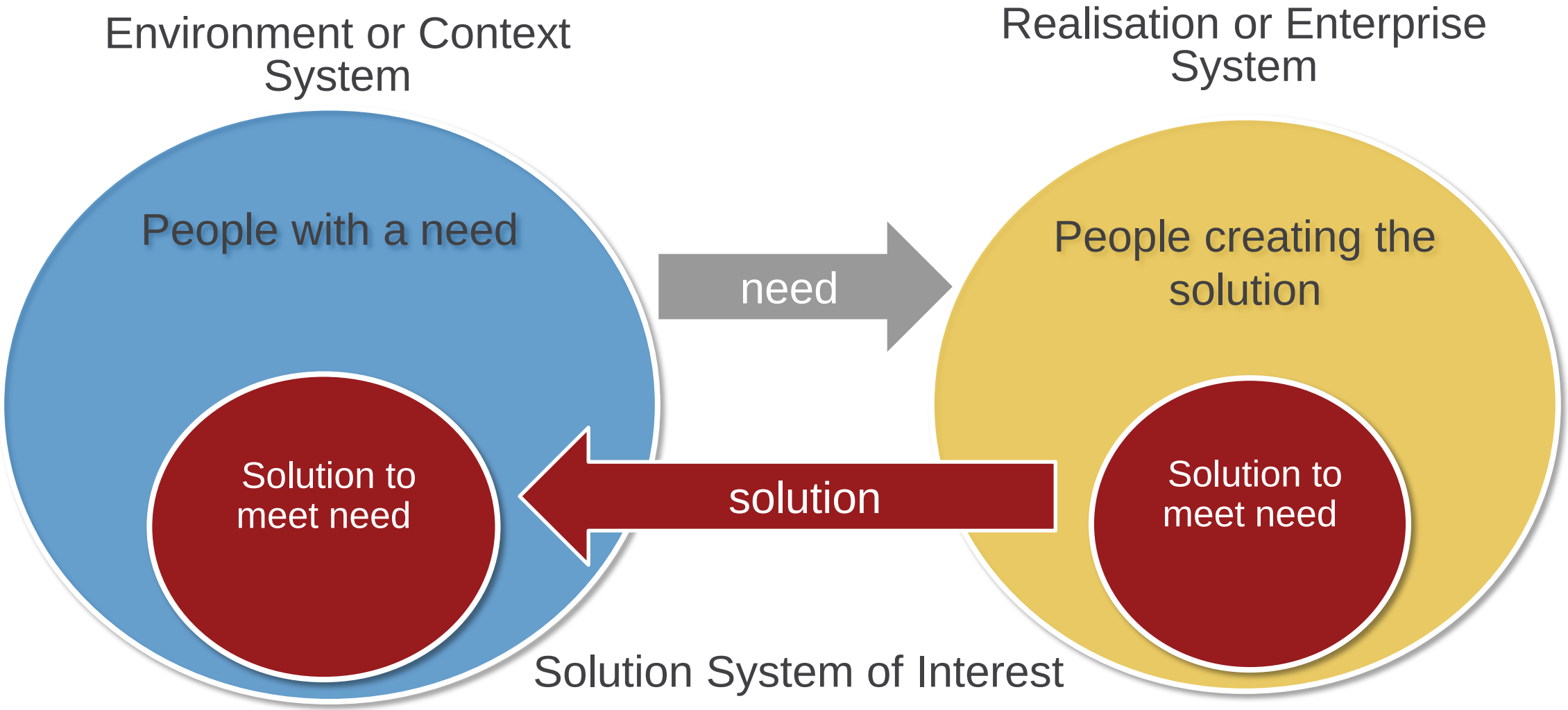
Section 06 Concluding thoughts - Richard

01 Introduction & Opening Question

How can a better understanding of the Social Sciences help us be better engineers?

Answer in the chat please!

Social Systems in Engineering



02 Problem Context

What are the problems with the application of Systems Engineering that social science can help with?

About Systems Engineering

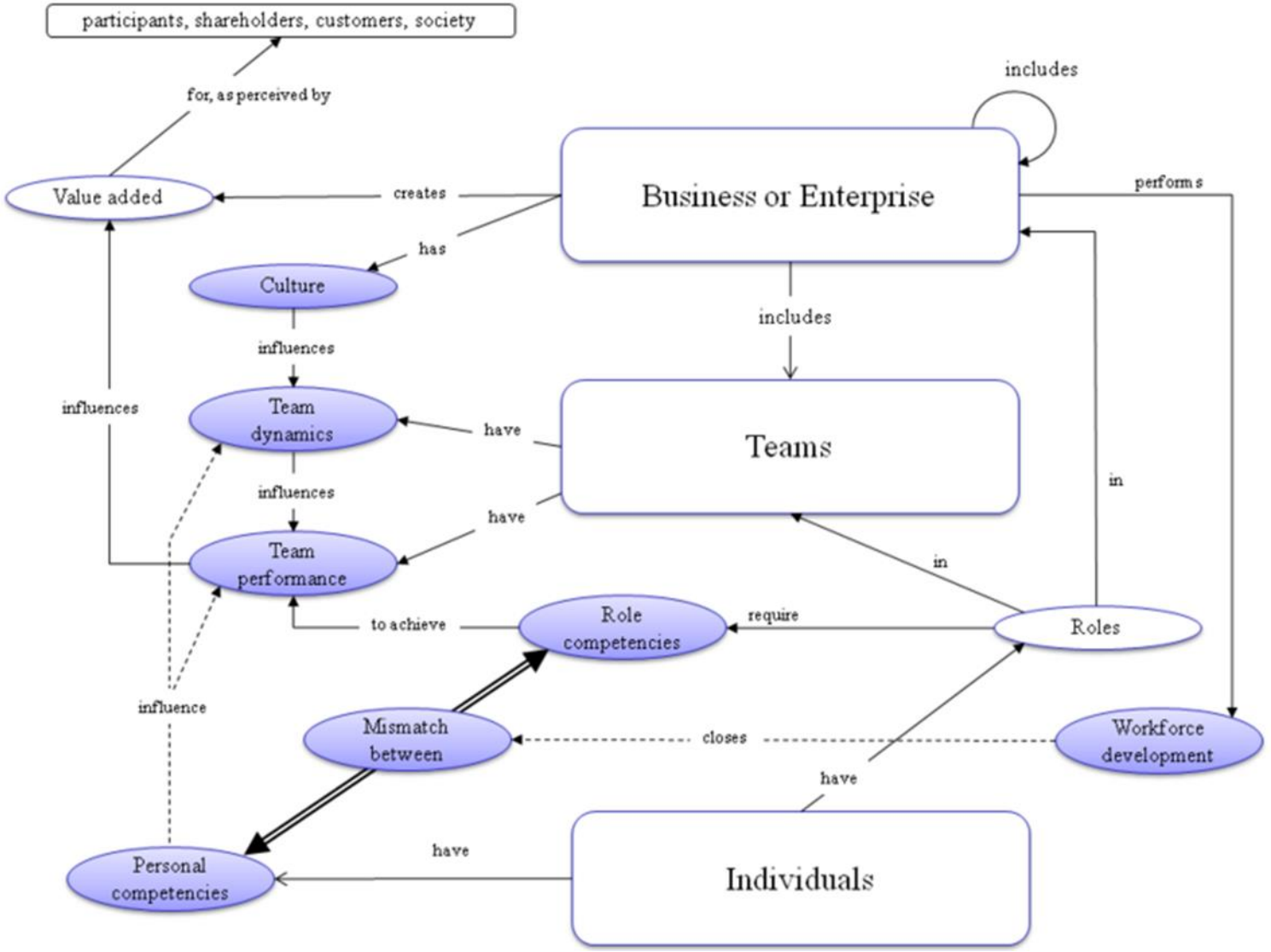
Systems engineering is defined as

- “a trans-disciplinary and integrative approach to the successful realization, use, and retirement of engineered systems using systems principles and concepts, and scientific, technological and management methods” *(INCOSE definition of SE)*
- Practicing this approach presents a number of challenges working
  - within their organizations
  - with other engineering and non-engineering disciplines

Lets outline those challenges

Systems Engineering Capabilities in Businesses and Enterprises

Start with what SE capability needed



This is Figure 1 in SEBoK, section 5, article on Determining Needed Systems Engineering Capabilities in Businesses and Enterprises https://sebokwiki.org/wiki/Determining_Needed_Systems_Engineering_Capabilities_in_Businesses_and_Enterprises

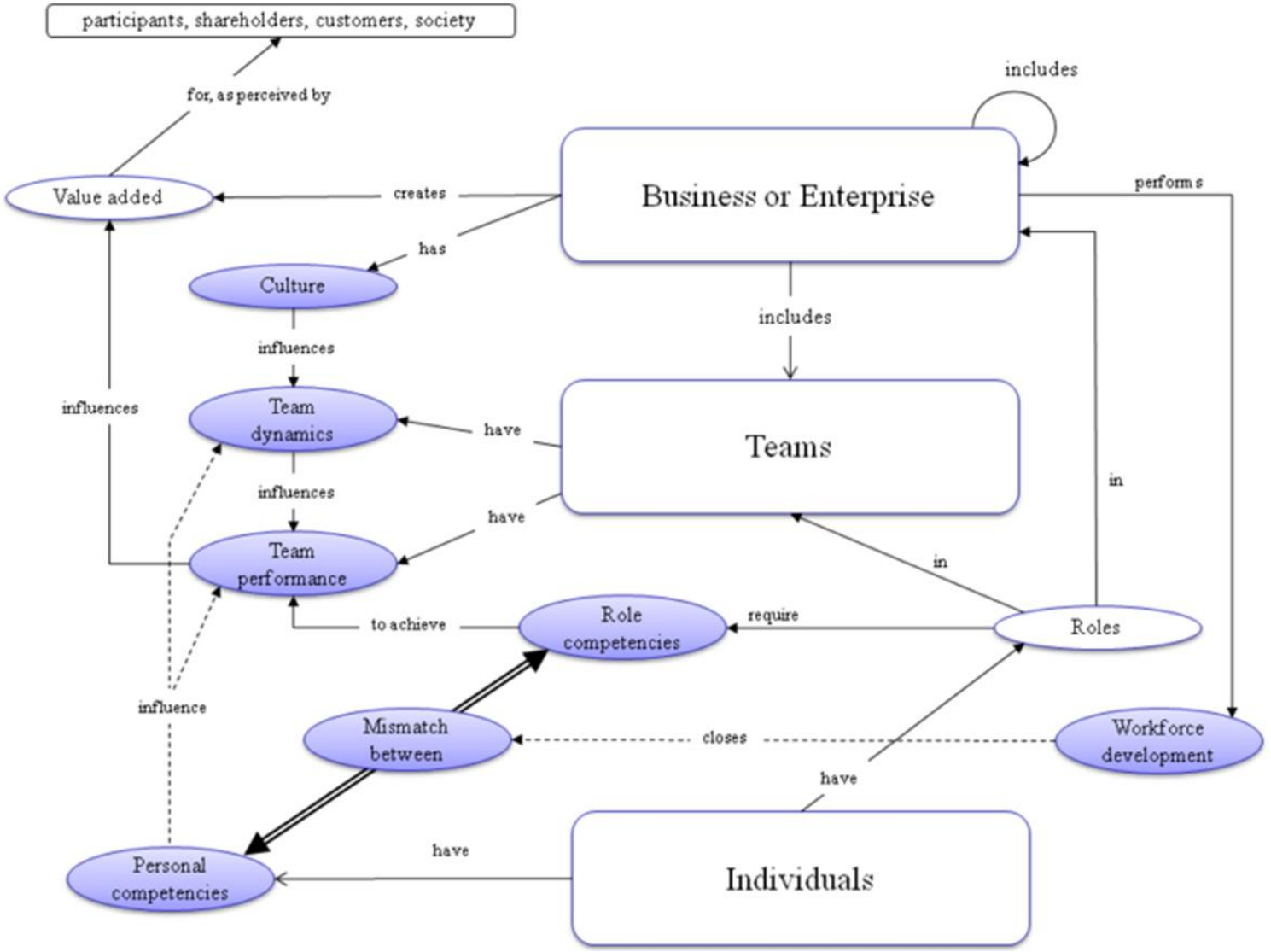
Systems Engineering Capabilities in Businesses and Enterprises

Start with what SE capability needed

Two classes of problem

Individual issues

Org issues



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Systems Engineering Capabilities in Businesses and Enterprises

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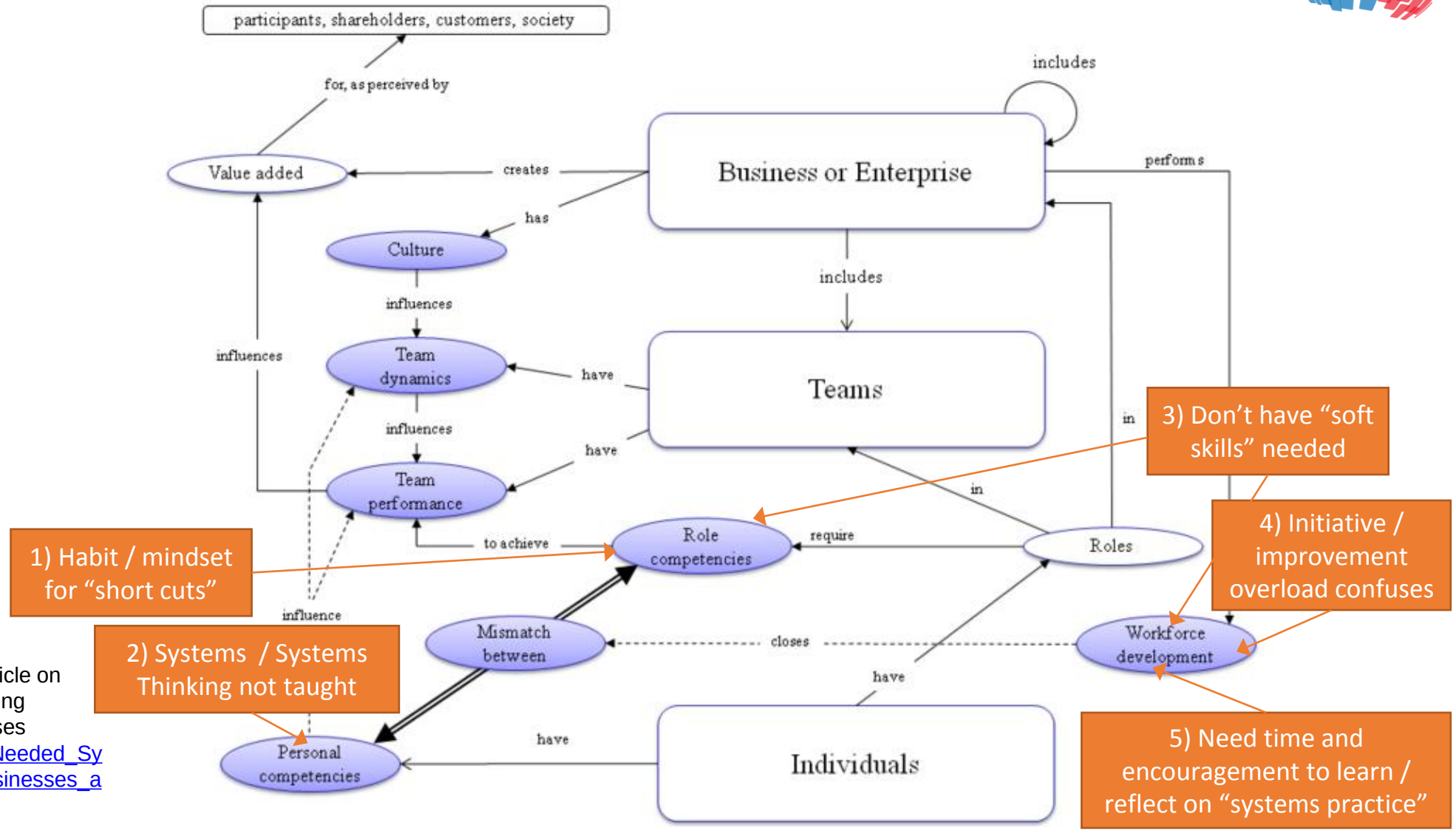

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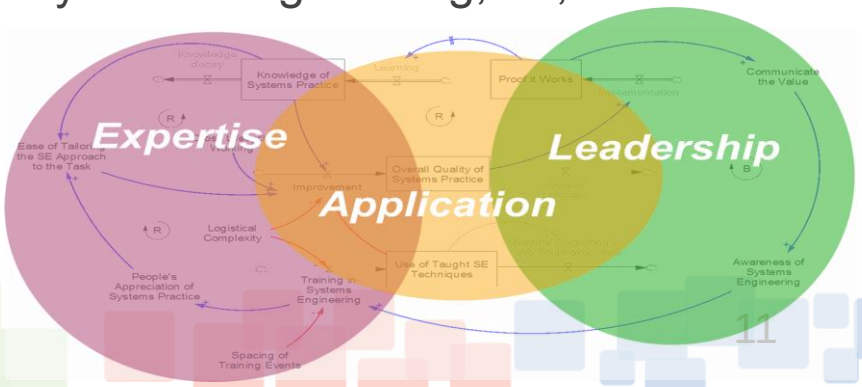
Some sources / detail for the “individual problems”

1. Taking short cuts
   - See Kahneman, D, 2011, *Thinking, Fast and Slow*. Note his slow thinking is not the same as Systems Thinking (which takes even more effort)
2. System / Systems Thinking not taught
   - Dunford, C, 2015, *Making Systems Thinking Routine - Systems Engineering Capability Improvement in Rolls-Royce plc*. Doctorate Thesis explored this issue
3. Don’t have “soft skills” needed
   - See Beasley, R, Gelosh, D and Pickard, A, 2019, ‘Professional competencies – the soft skills to give Systems Engineers a hard edge’, *INCOSE International Symposium* for description of the “professional competencies – a key section of the INCOSE SE competency framework
4. Initiative Overload (and SE seen as another) and need for leadership “encouragement to practice
   - See C Dunford Theses, and SE journal paper Dunford, CN, Yearworth, M, York, DM and Godfrey, P, 2013, ‘*A view of Systems Practice: Enabling quality in design*.’ Systems Engineering, 16, 134–151
   - Especially see System Dynamics model of quality of SE



Systems Engineering Capabilities in Businesses and Enterprises

5) Existing value add "threatened" by SE (as its different)

2) Varying history / culture

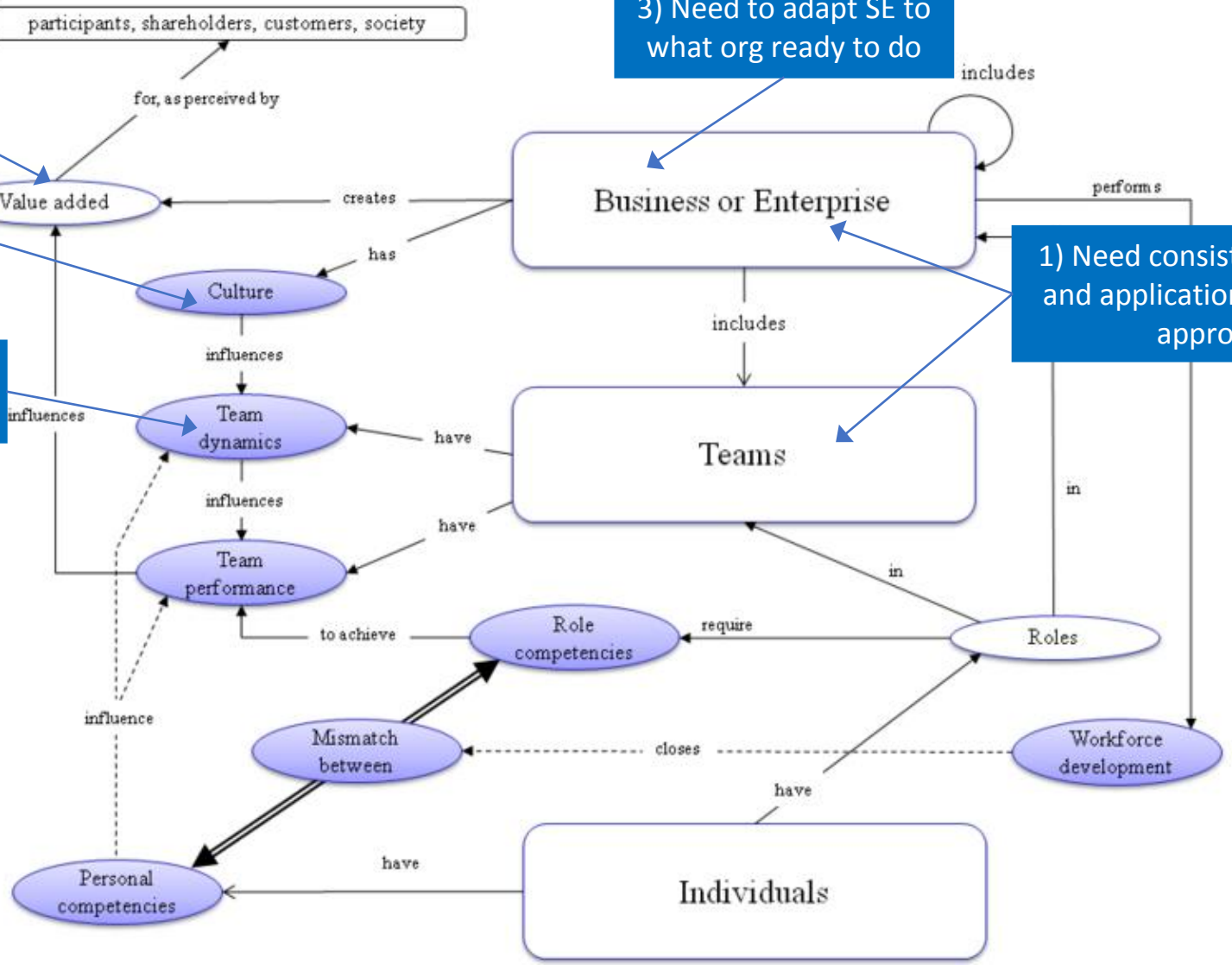
Individual issues

4) Firefighters valued (and team copy)

Org issues

3) Need to adapt SE to what org ready to do

1) Need consistent purpose and application of Systems approach



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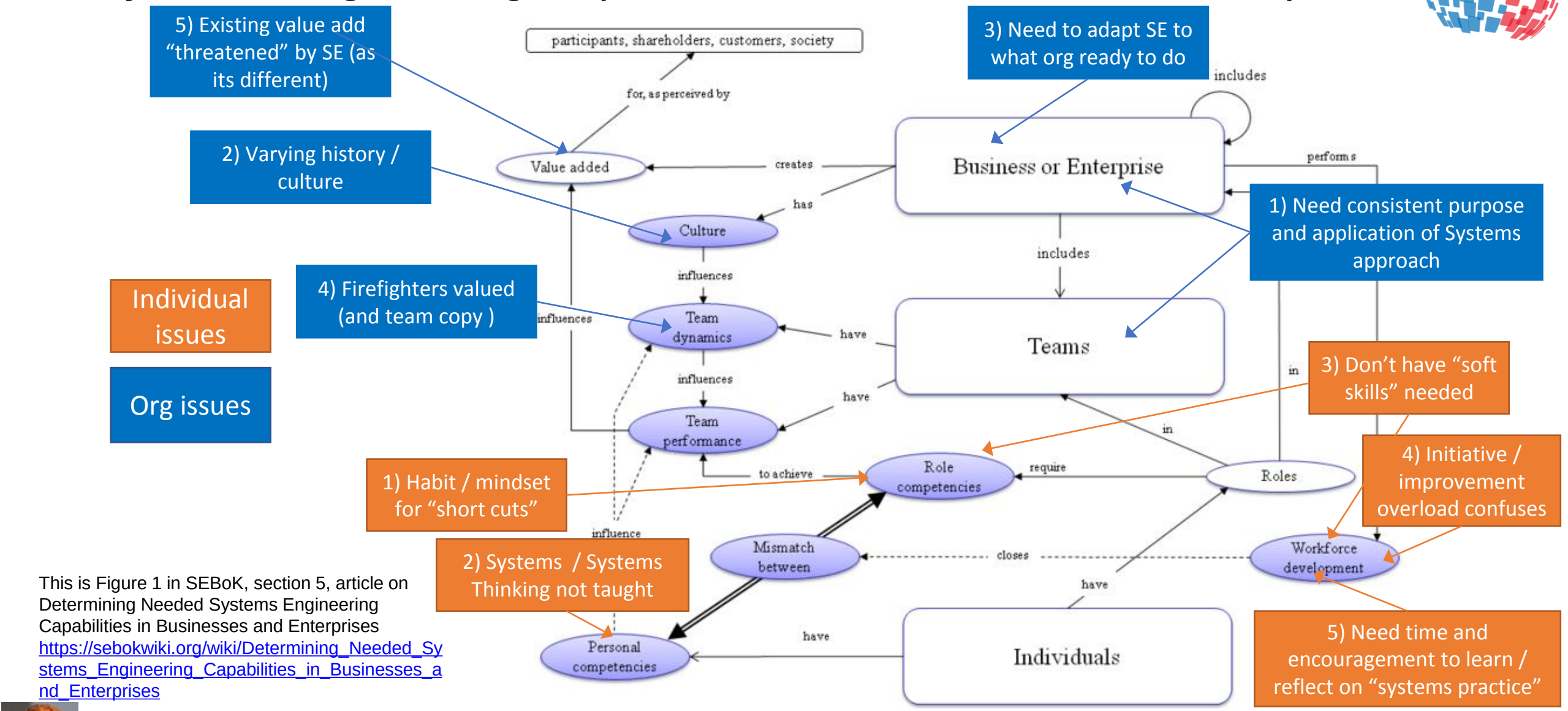
Some sources for the organisation problems

1. Need consistent purpose in the organisation – see
   - SE Bok section 5 on organisation to do SE
   - Fasser, Y and Brettner, D, 2002, *Management for Quality in High-Technology Enterprises*.
2. Varying history / culture in organisations
   - Jack Ring "value cycle" explains different organization "purposes", Ring, J, 1998, "*Value-seeking approach to the engineering of systems'*, Proceedings of the IEEE International Conference on Systems, Man and Cybernetics. 3 (3), 2704-2708
3. Organization history / culture – see (for example)
   - Checkland, P, 1981, *Systems Thinking, Systems Practice*
   - Beasley, R and O'Neil, A, 2016, 'Selling Systems Engineering by Searching for the Sweet Spot', *INCOSE International Symposium*
4. Firefighting culture
   - Beasley, R, Nolan, A and Pickard, A, 2014, 'When "yes" is the Wrong Answer', *INCOSE International Symposium* includes description of the "hero culture"
   - See also and beware of the Graves Level 3, a characteristic (anti-SE) leadership type - Nielsen, N and Nielsen, K, 2007, '*The Graves Model and its Application to Coaching'*, NLP & Coaching Institute Berlin, http://www.nlp-nielsen.de/Graves-Coaching-20071219-englisch.pdf
5. Need to adapt SE to the organisation
   - Beasley, R, 2012, 'The Barriers to Systems Thinking,' *INCOSE International Symposium*

Systems Engineering Capabilities in Businesses and Enterprises



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03 Case Study

Case Study – Rolls-Royce plc

- International company making very complicated system, often as part of joint venture, as a second tier supplier means diverse and relevant perspectives could be gathered
- Question posed on company internal social media platform on company wide channel (yammer).

Engagement Statistics

	Views	Emoticons	Text
Individual Engagement	1,928	18	12

What did they say is needed?

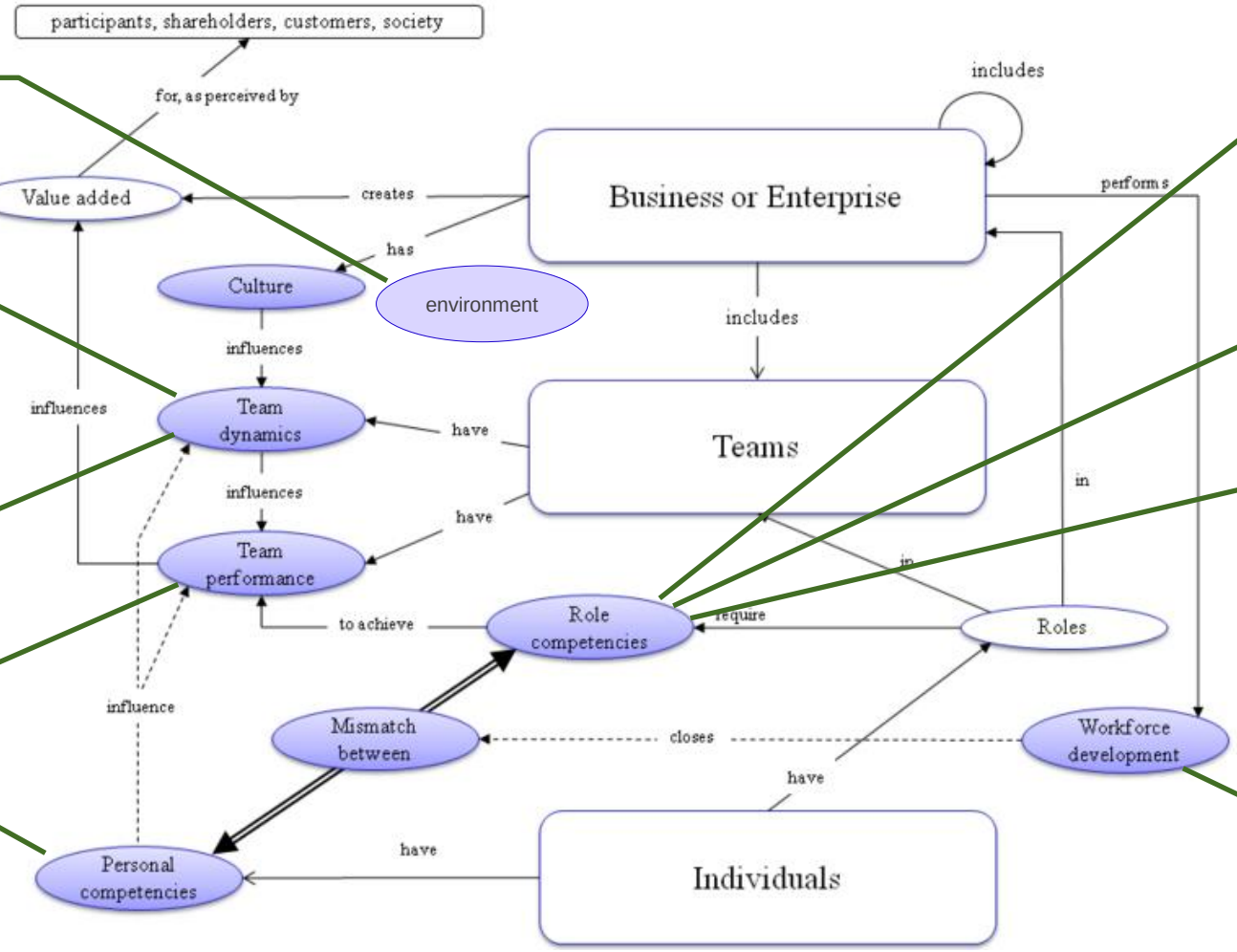
hot desking…Some people need an allocated desk so that their work environment does not change day-to-day and they can therefore switch off from their surroundings and concentrate on their work

How to negotiate with the manager how long something will take; the argument the chief engineer has with the captain in most episodes of Star Trek! Setting a target that the engineer sees as achievable is so important, otherwise engagement falls off.

What can be done to improve feeling part of a team if you do not physically sit with them or work on the same stuff?

How to align work type with mood to improve productivity. How to manage that against demand. How to increase inspiration and reduce perspiration.

*the standard engineer's reaction to pushback: use whatever techniques you can to get your way, because your way is right, dammit



How to summarise deeply technical information in a way that will sell the idea to someone who doesn't want to dive in too far, but in a way that they get the essential details and don't feel like someone is pulling the wool over their eyes.

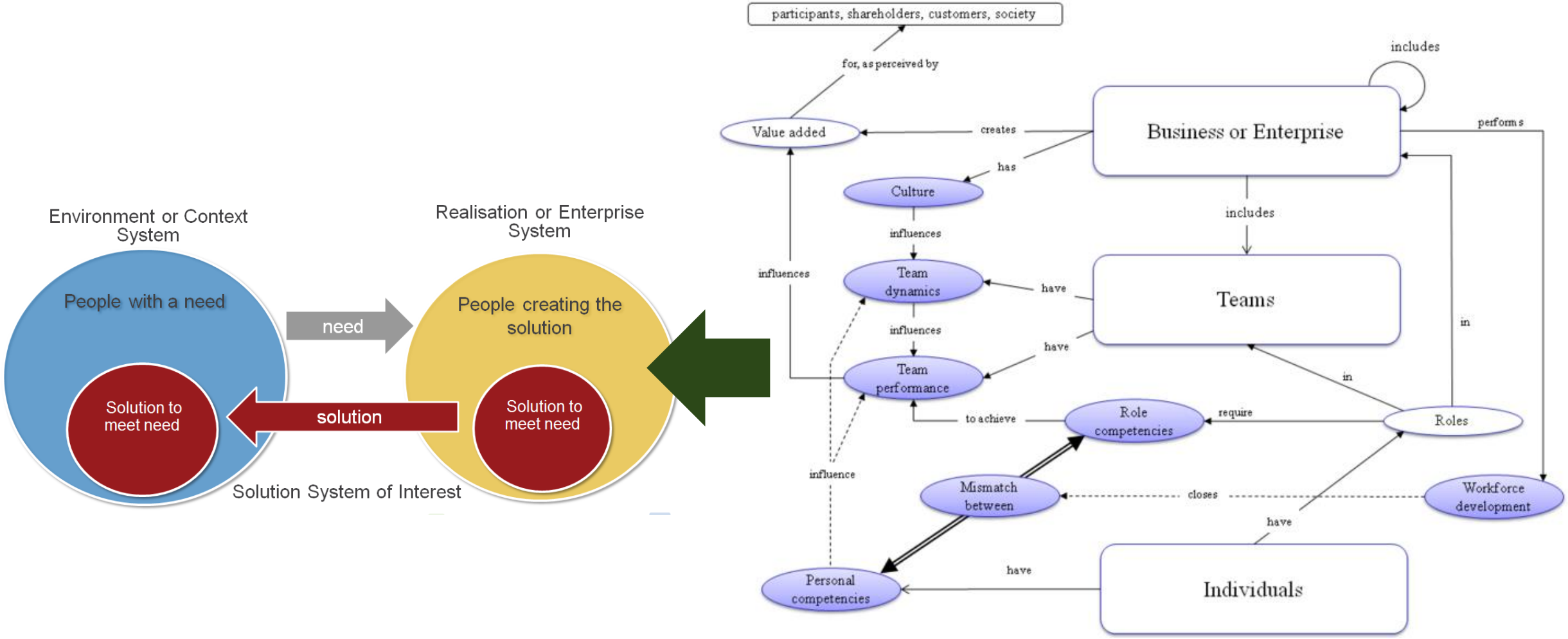
Finding how to align with another person to maximise the efficiency of communication, avoiding misinterpretation

*it would be good to promote a focus on other people as valuable sources of insight and information, leading to better solutions - not necessarily the one you already came up with

How to guide others to do things correctly, and even precisely, without crushing them if they show a large learning gap.

04 Social Science Solutions

A Social System



Social Systems Are Different

Engineers designing something is a social system. A social science framework is needed to study it.

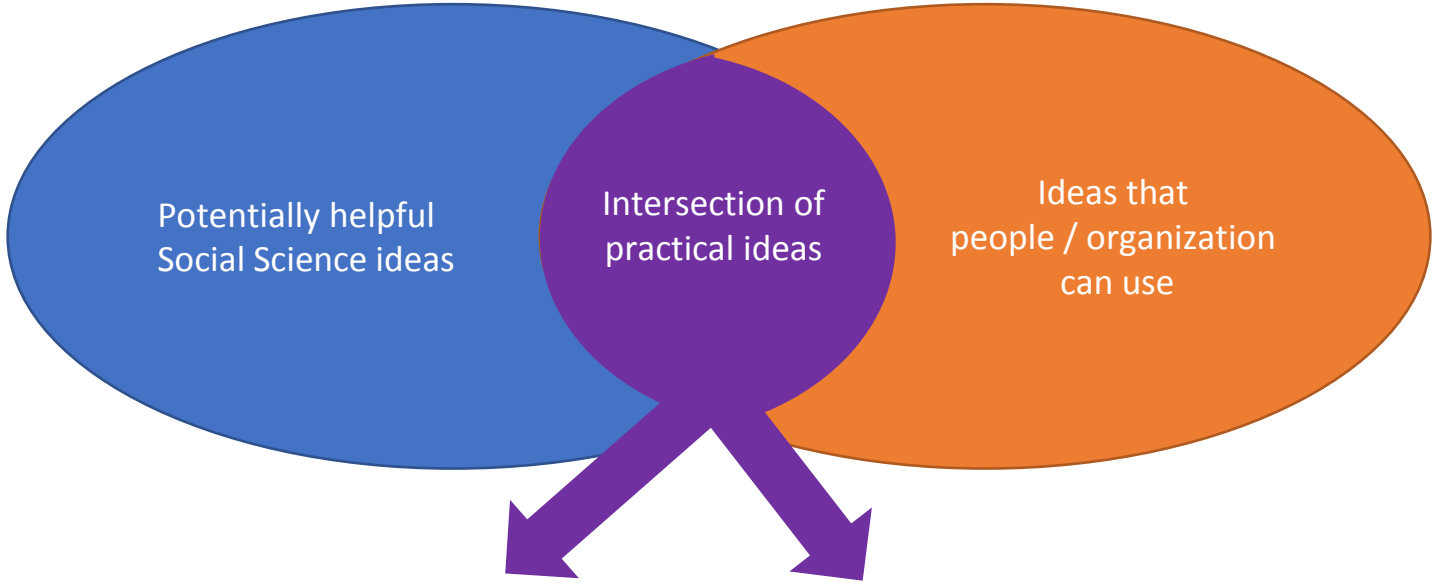
Social System

- Phenomenology
- Multiple valid truths
- Understanding rationale

Technological System

- Positivism
- A single truth
- Repeatability

Social Science Methods and Theories



Social Psychology

Organizational Sociology

What did they say is needed?

Conceptual Models and knowing when to use them

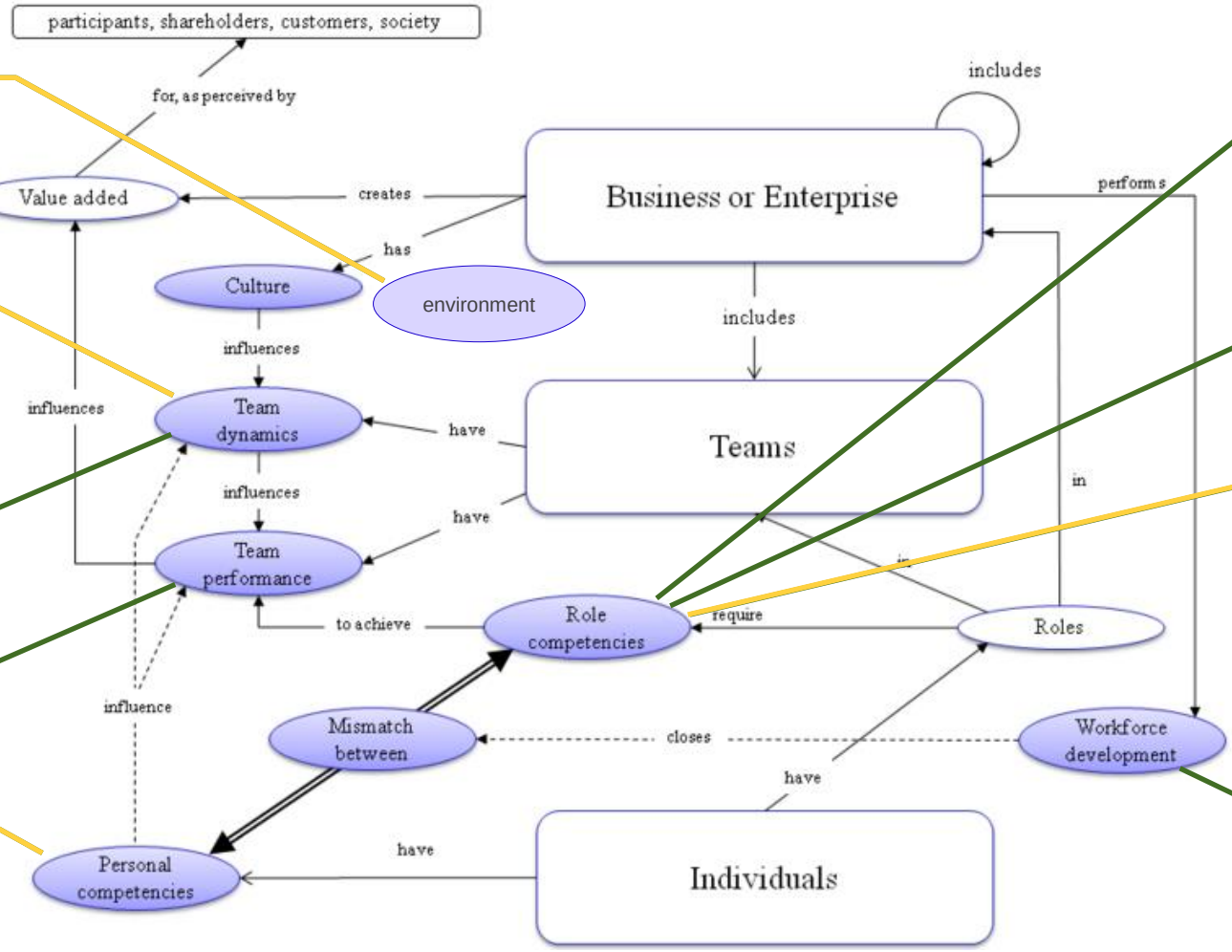
Collective Learning

Social Network Analysis

What can be done to improve feeling part of a team if you do not physically sit with them or work on the same stuff?

How to align work type with mood to improve productivity. How to manage that against demand. How to increase inspiration and reduce perspiration.

Non-Violent Communication



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Collective Learning

Social Systems are Different

How to guide others to do things correctly, and even precisely, without crushing them if they show a large learning gap.

05 Next Steps

Social Systems Primer for Systems Engineers

Guidance on these topics are currently being worked as part of the development of the Social Systems Primer. Publication planned ahead of IS 2022.

Want to get involved?

Get in touch!

Productivity

- Optimise enthusiasm and creativity at work
- Different environments suit different ways of working

Communicating

- Listening to learn
- Communication method based on audience

Conceptual Models and knowing when to use them

06 Concluding Thoughts

Summary

There are problems with the implementation and execution of systems engineering to which social sciences can provide potential solutions.

The key questions are:

- What are, from a human point of view, the difficulties in the implementation and execution of systems engineering?
- How are social systems are different from technological systems?
- How social science can help tailor systems engineering to different circumstances?
- How social science findings can help engineers be more effective in their work?

How can a better understanding of the Social Sciences help us be better engineers?

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