# The basic principles of safety management

MEC-E3004 Safety management in complex sociotechnical systems

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1. 2.3. Introduction and the basic concepts of safety management
2. 9.3 Basic concepts: Human Factors and Safety Management (Douglas Owen)
3. 16.3 Accident models
4. 23.3 Accident case (BP Texas City refinery explosion in 2005)
   - Mid-term assignment
5. 30.3 Organizational learning

6.4 NO LECTURE

*13.4 Returning the mid-term assignment*

6. 13.4. Safety culture
7. 20.4. Safety leadership
8. **27.4. The basic principles of safety management**
9. 4.5 Safety management systems
10. 11.5. Tools of safety management
11. 17.5 Future challenges and new directions of safety management (TIME!)
12. 25.5 Recap and Q&A
    - Deadline for returning the paper 31.5.2023

# Selected accident cases with good information available and adequate complexity to extract lessons

## Nuclear

- Three Mile Island 1979
- Chernobyl 1986
- Davis Besse NPP reactor head corrosion discovered in 2002
- Fukushima Daiichi nuclear accident 2011

## Petrochemical

- Bhopal chemical accident, India, 1984
- Piper Alpha oil rig disaster, North Sea, 6 July 1988
- BP America's Texas City isomerization unit explosion 23 March 2005 - only with a very good reason
- BP Deepwater Horizon explosion, Gulf of Mexico, 20 April 2010

## Rail

- Clapham Junction railway crash, London, 12 December 1988
- Ladbroke Grove rail crash, London, 5 October 1999
- Amagasaki rail crash, Osaka, 25 April 2005
- Lac-Méqantic oil shipment train derailment, Quebec Canada, July 6, 2013

## Aviation

- Teneriffe airport runway collision 27 March 1977
- Space Shuttle Challenger 1986 – only with a very good reason
- Überlingen mid-air collision, over Germany, 2002
- Space Shuttle Columbia disaster 1 February 2003
- ValuJet Flight 592 DC-9, Everglades, 1996
- Air France Flight 447, 2009
- Boeing 737 Max airplane accidents 2018-2019

## Maritime

- Capsizing of the Herald of Free Enterprise, English Channel, 6 March 1987
- Sinking of MS Estonia in the Baltic Sea 28 September 1994
- Capsizing of Costa Concordia, Italy, 13 January 2012
- Sinking of MV Sewol, South-Korea, 16 April 2014

## Others

- King's Cross London underground fire 18 November 1987

# Learning logs

- “When discussing the differences in leadership styles it’s usually assumed that people should follow someone to begin with. Maybe even more critical to safety is whether they should?”
- “In my opinion, the capacity to connect people and get them to cooperate is what defines leadership.”

- Cultural effects on humble inquiry and the universal nature of leadership?
- How to know what kind of leadership is needed since situations can be complex?
- What are the means that may be used when balancing between constraining and creating leadership?
- Does it have to be a crisis to a good leader to emerge?

# Onagawa nuclear power plant - example of good leadership

- Onagawa nuclear power station survived the 2011 earthquake and tsunami, despite experiencing greater levels of shaking and tsunami waves than Fukushima Daiichi.
- Two leaders are key in this: Takao Watanabe and Yanosuke Hirai

- WANO presented a Nuclear Excellence Award to Watanabe in 2012. They cited the following three reasons for the award.

1. For providing for the safety of many residents of the local community following the earthquake and tsunami.
2. For his inspirational leadership enabling the safe shutdown of three reactors during the largest earthquake and tsunami encountered by any nuclear plant in the world.
3. For his superb leadership in preparing the Onagawa nuclear plant and staff to be ready for emergencies.

Takao Watanabe declared that, prior to and after the 2011 earthquake and tsunami, the mindset of Onagawa NPS was to "Handle normal times with emergencies in mind so that you are able to handle emergencies like normal times".

# Safety leadership - recap

# Key “do nots” of safety leadership

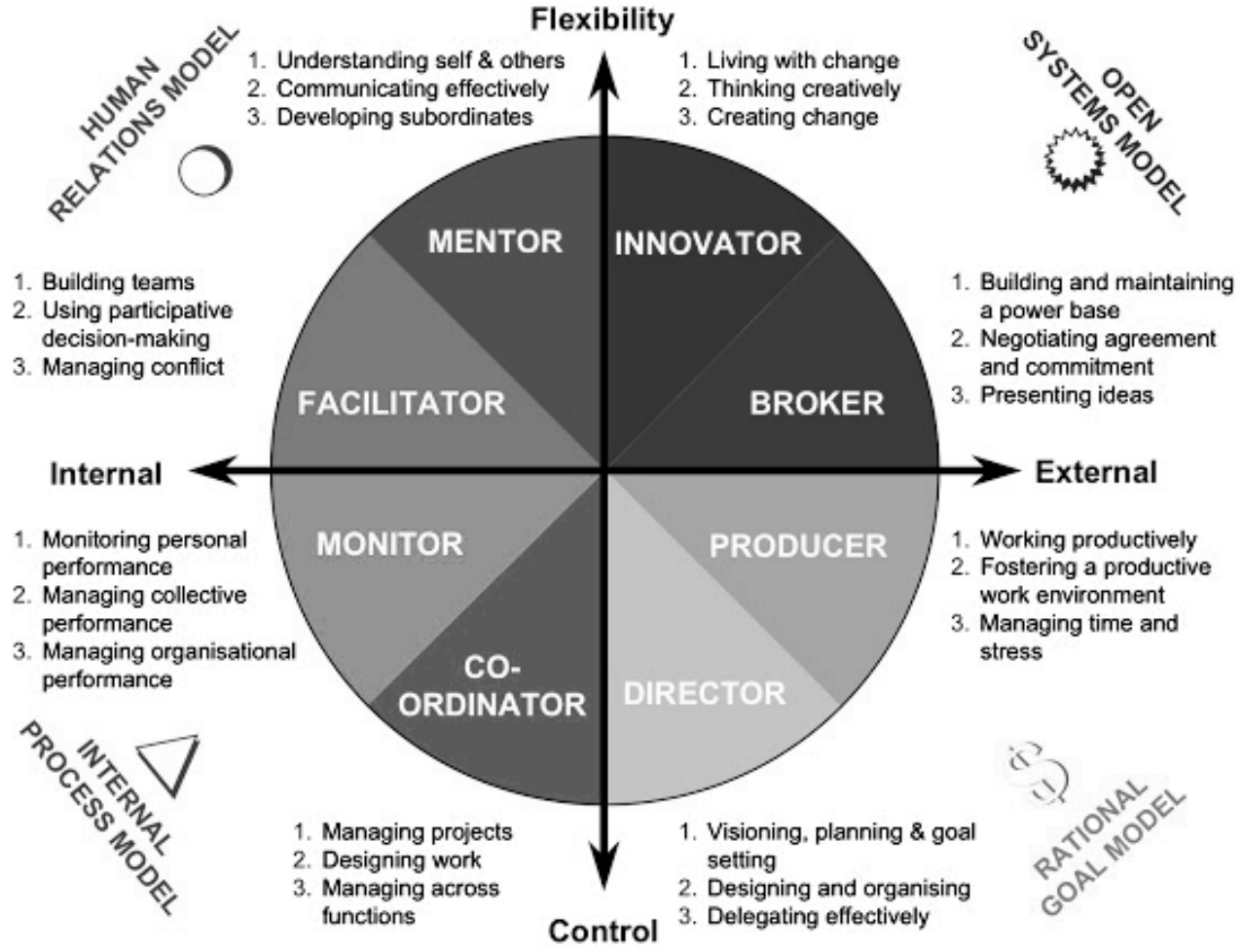
- Intimidate and lead by fear
- Humiliate, blame or bully
- Punish genuine mistakes
- Talk differently than behave
- Use different standards to own behavior
- Micro-manage or seek to control everything
- Tell people the right answers
- Lead by numbers
- Focus on the short term only
- Focus on yourself only
- Think that you already know everything
- Behave erratically

# Key “do nots” of safety leadership - Instead

| | |
|---|---|
| Intimidate and lead by fear | Build psychological safety, listen |
| Humiliate, blame or bully | Be respectful and fair |
| Punish genuine mistakes | Give constructive feedback, understand errors |
| Talk differently than behave | Align your words and behavior |
| Use different standards to own behavior | Lead by example, expect same from others as from you |
| Micro-manage or seek to control everything | Create conditions for others to work |
| Tell people the right answers | Ask the right questions, tell *what/why*, not how |
| Lead by numbers | Lead by content, using numbers as aid |
| Focus on the short term only | Balance short and long term foci |
| Focus on yourself only | Care about others, create real relationships |
| Think that you already know everything | Be humble, learn from others, and with others |
| Behave erratically | Be consistent and persistent in your message |

**There is no one type of successful leader - success depends on the situation, context (including culture and life cycle of the company) and personality of the leader**

**Leadership roles according to the competing values framework (Quinn 1988, Cameron & Quinn 1999)**



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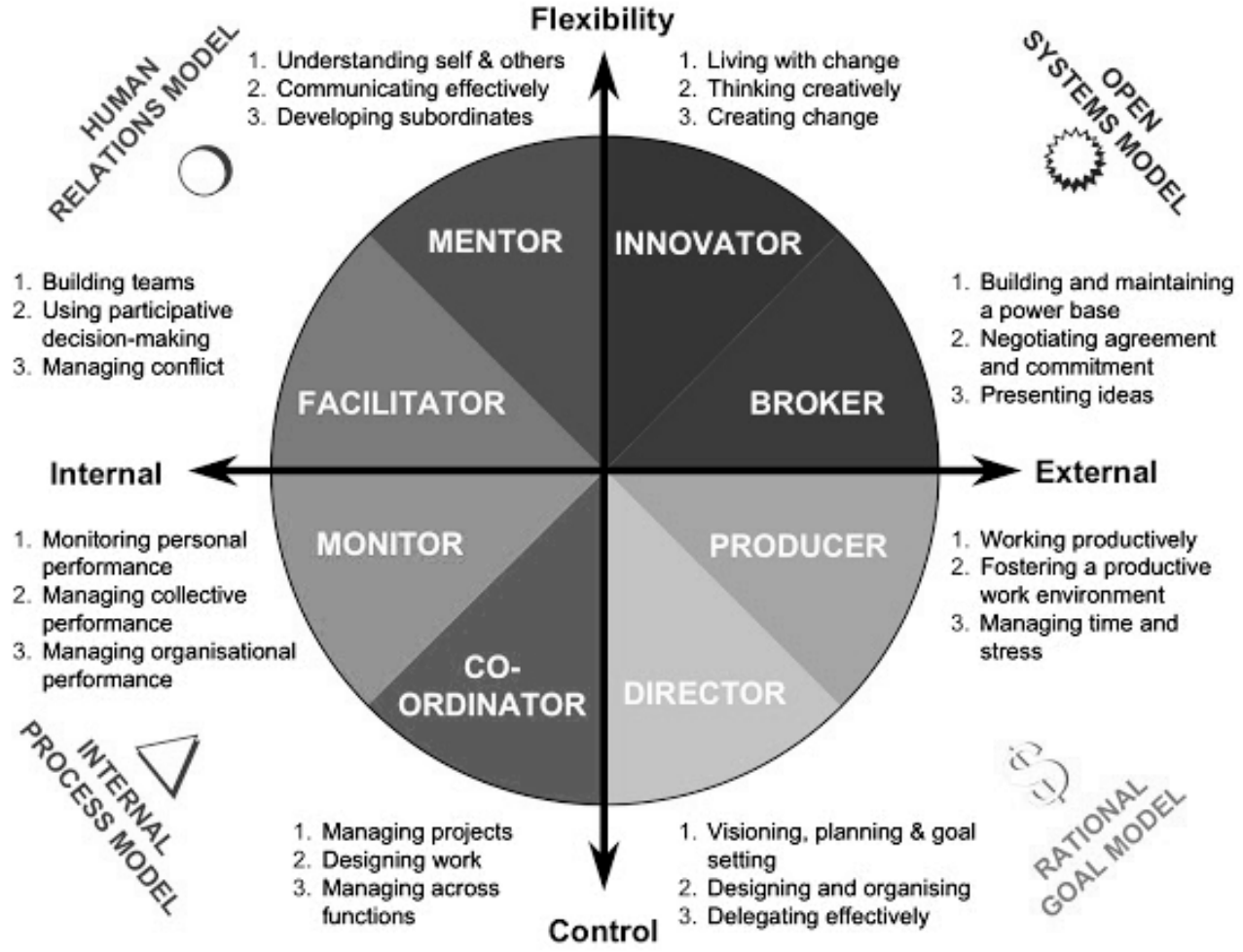


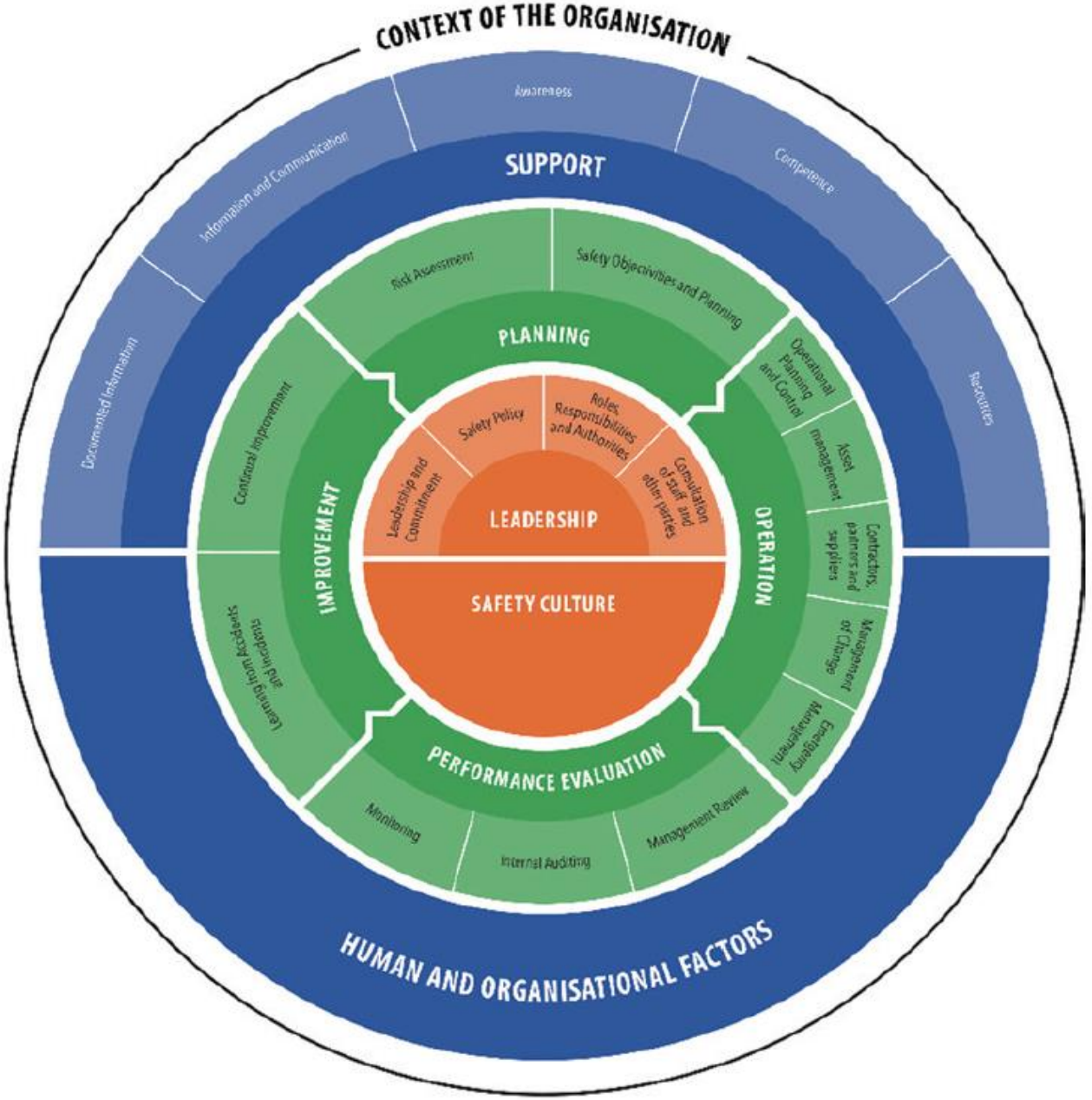

Today we introduce a model for safety management inspired by the competing values framework.

Safety management system requirements for safety certification or safety authorisation by the European Union Agency for Railways – leadership and safety culture are at the center of attention

Next lecture takes a closer look at the typical elements of safety management systems (in addition to leadership and safety culture)

However, safety management systems were created during the "management system age" (1980-2000) of safety management (see Lecture 1) and sometimes they (or their users) embed quite a mechanistic view of humans and organization, when a systems view would be needed

Figure 2: Railway safety management system



Safety management system requirements for safety certification or safety authorisation by the European Union Agency for Railways – leadership and safety culture are at the center of attention

Most safety culture models of today emphasize the need for a systems view on safety. In the ERA model one the dimensions of safety culture is called "system complexity":

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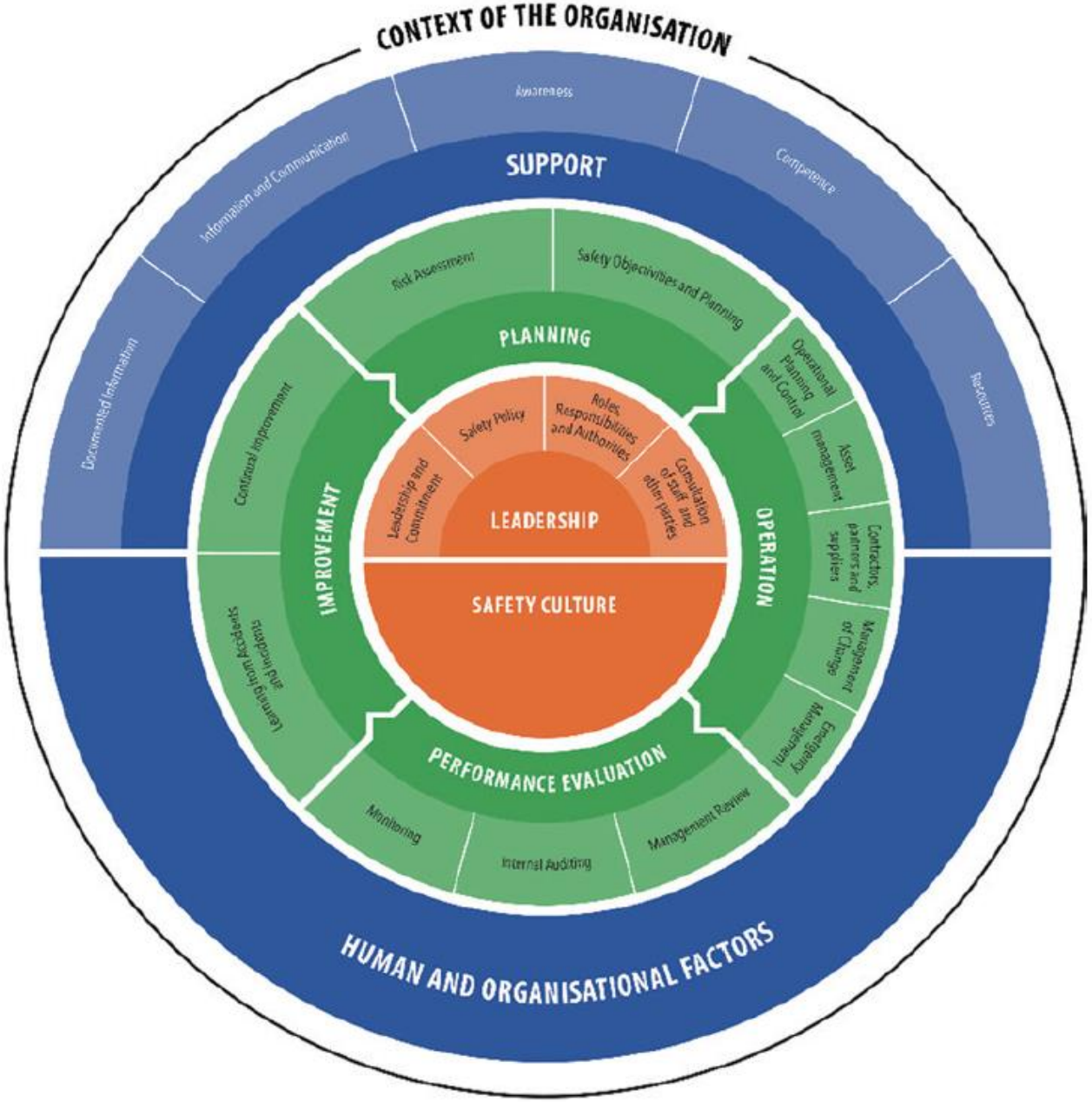

Safety management system requirements for safety certification or safety authorisation by the European Union Agency for Railways – leadership and safety culture are at the center of attention

Most safety culture models of today emphasize the need for a systems view on safety. In the ERA model one the dimensions of safety culture is called "system complexity":

The organisation recognises that its technologies and systems are complex and can fail in unpredictable ways

Safety is considered within the perspective of the overall system. The organisation recognises that human, organisational, technical and external factors can influence safety at a system level and analyses the interactions between system components. Safety is managed in a proactive away. The organisation acknowledges that the workplace reality is dynamic and continually scans and interprets threats to safety.

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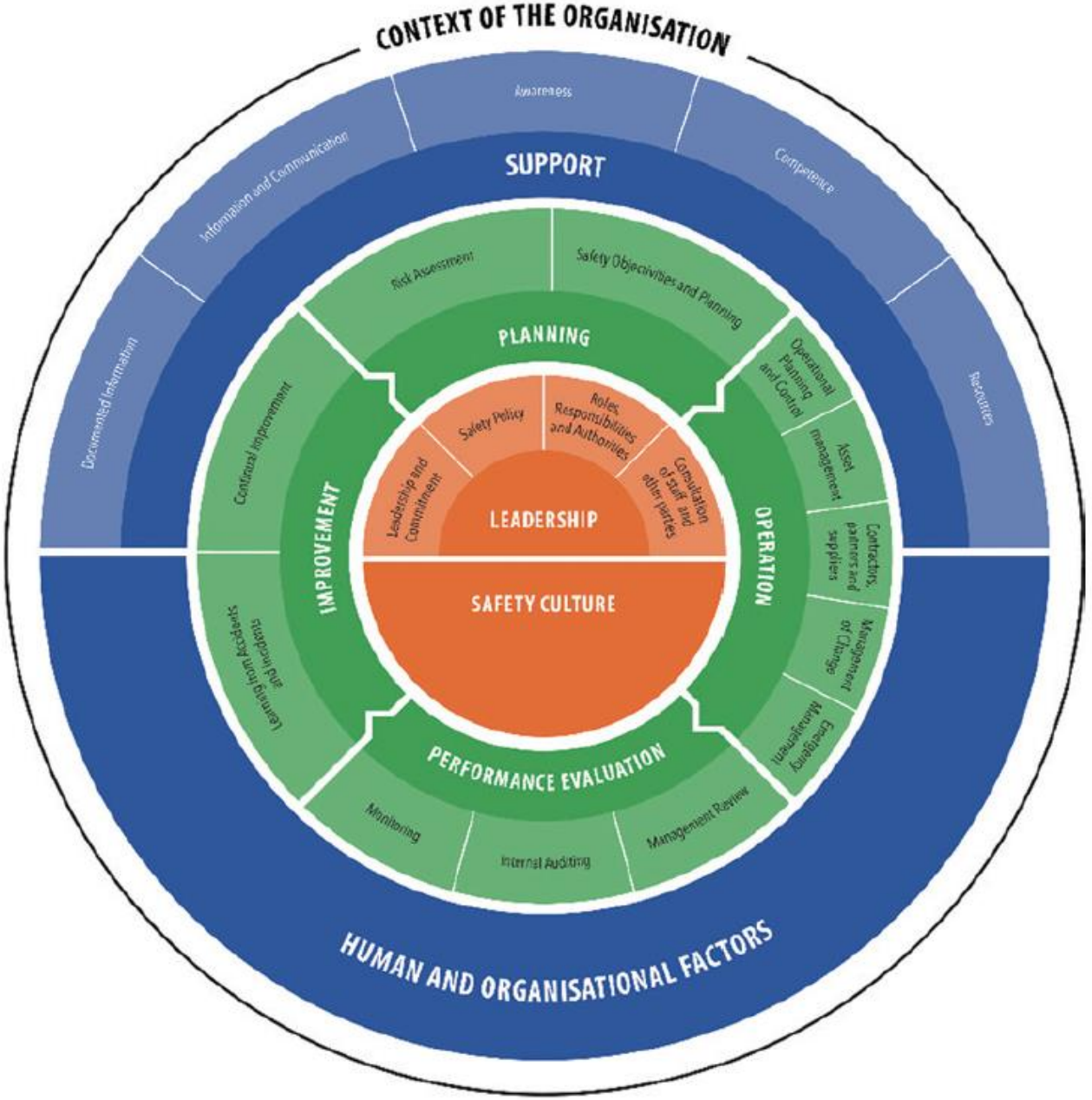


**During the course we have already looked at many systems phenomena affecting safety**

# System phenomena in sociotechnical systems

**(Vaughan 1996, Snook 2000, Dekker 2011, Leveson 2011; see also Reiman et al. 2015)**

Normalization of deviance

- Deviation from acceptable level of risk becomes the new norm because it appears to (still) result in successes
- Produces a disregard for potential danger signals, e.g. warnings that recur often

Structural secrecy

- Organizational structures, division of labor (including specialization), the hierarchy and the geographical dispersion segregate knowledge about tasks and goals
- Networks, supply chains and organizational borders are natural habitats for structural secrecy

Organizational drift

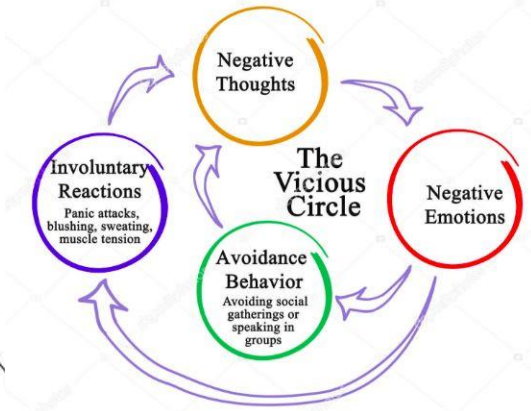
- Actual behavior slowly drifts away from written procedures as locally efficient behavior is favored over written procedures that do not appear to be applicable
- Since drift takes place locally, it poses a challenge for the overall management

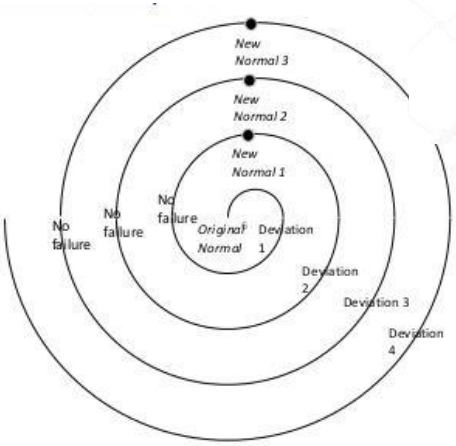
Conflicting goals

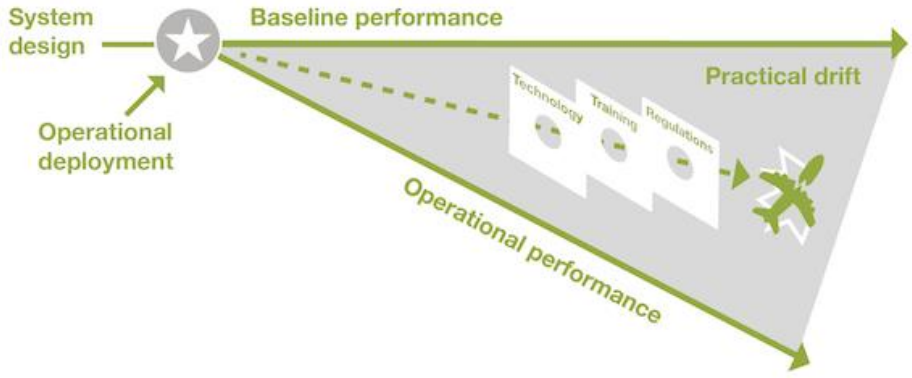
- Safety-critical organizations inherently exhibit a variety of goals

Vicious circle

- A self-reinforcing feedback loop that feeds on itself.



**To understand and manage these system phenomena, we need to understand organizations as complex systems – and when we are talking about safety critical systems with a high degree of technology we can talk about *complex sociotechnical systems***

**There is an emerging discipline in organization studies that applies complexity theory to organizations – they conceptualize organizations as *complex adaptive systems***

***In this course, we use the terms complex sociotechnical systems and complex adaptive systems interchangeably***

# Organizations can be conceptualized as Complex Adaptive Systems (CAS)

## Non-linearity

Systems are (composed of) highly responsive and interconnected feedback loops that can reinforce or attenuate inputs. There is no linear relation between a cause and an effect (cf. domino models).

## Self-organization

New structures, patterns and new forms of behaviour form in the system as a consequence of agent interaction and connections during the system life cycle.

## Emergent properties

As a consequence of the interactions between the diverse agents in CAS, new higher level structures, such as culture, emerge.

## Far-from-equilibrium conditions

CAS exists in a balance between order and disorder, stability and instability, equilibrium and non-equilibrium. CAS is in a continuous process of flux and change.

## History-dependence

A CAS cannot be rewind back to its earlier form and state. Actions are thus irreversible, and the past helps to shape present behaviour.

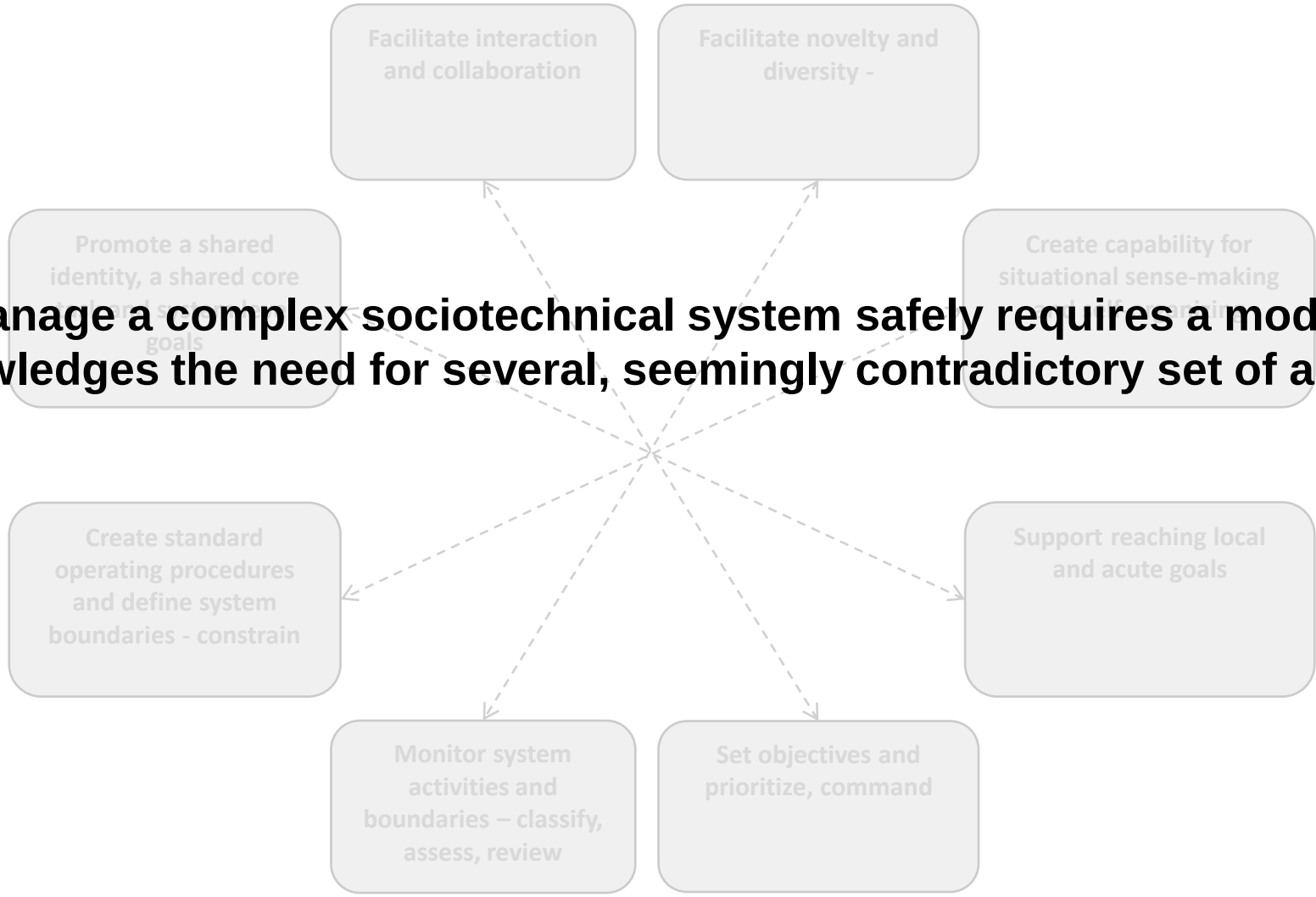
## Coevolution and nested systems

CAS exists within its environment, but it is also part of that environment. CAS can be called ‘systems within systems’.

# Implications for leadership

- A need to avoid oversimplifying reality
  - In a complex system no one can understand all the interconnections and all the consequences of actions – applies to both managers and experts
  - Avoiding treating problems and their solutions as obvious – do not settle for the first explanation
  - Adopting a no-blame (or "just culture") approach
- A need to improve the entire system, not only parts of it
  - Technology, management system, personnel, organizational structure are all part of the system – cannot be looked at in isolation
  - Actions have multiple effects, many of which manifest gradually
  - Most actions have both "positive" and "negative" effects
- A need to realize one's own role as part of the system
  - With ability to change the system to better or worse
  - But also with the same constraints and limitations as any other actor
  - A need to consider the influence of the higher levels of the system on one's own behavior (e.g. top management, regulators, politicians)

# Model of safety management principles (revised from Reiman et al. 2015, Provan et al. 2020)




**To manage a complex sociotechnical system safely requires a model that acknowledges the need for several, seemingly contradictory set of activities**

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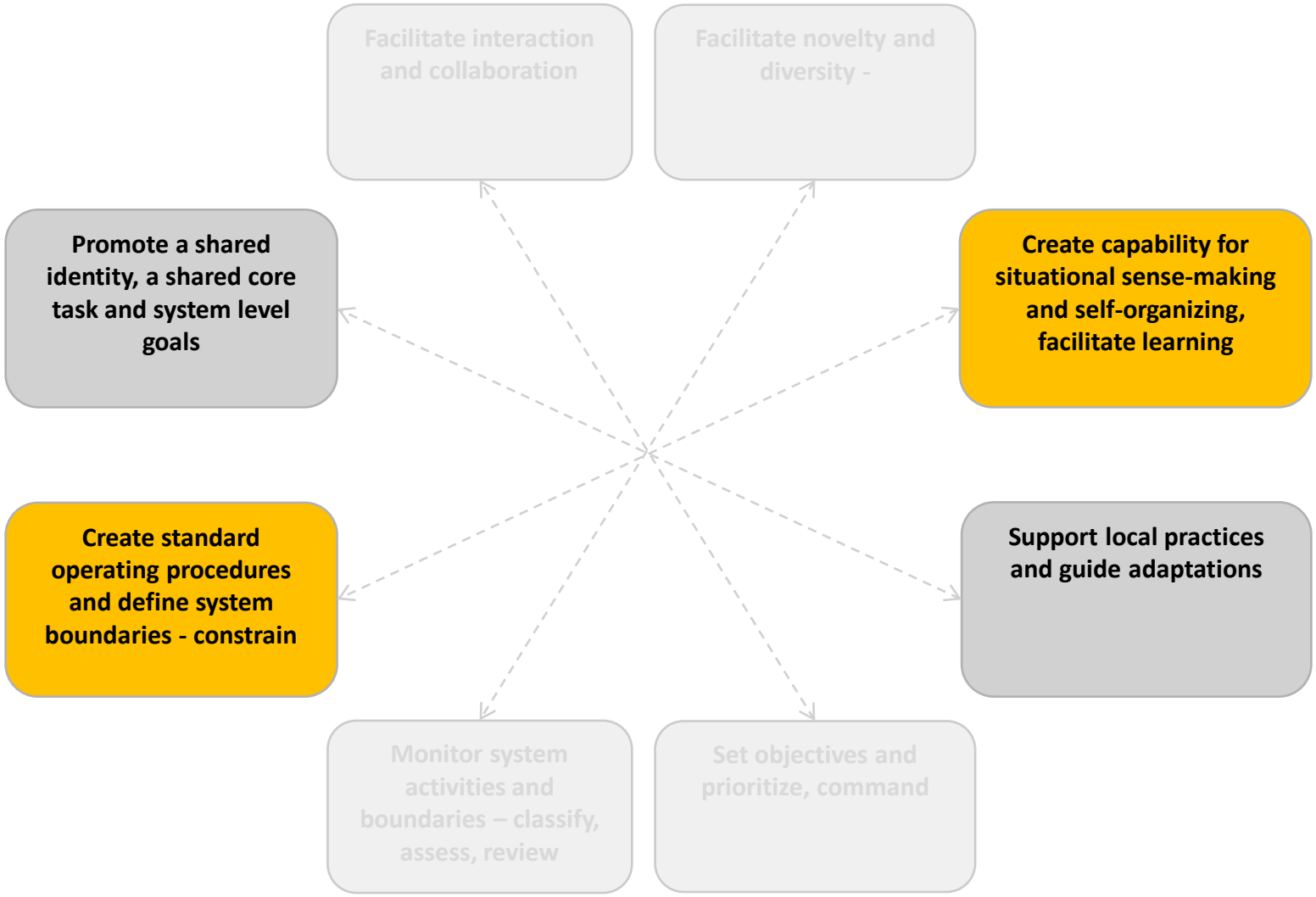

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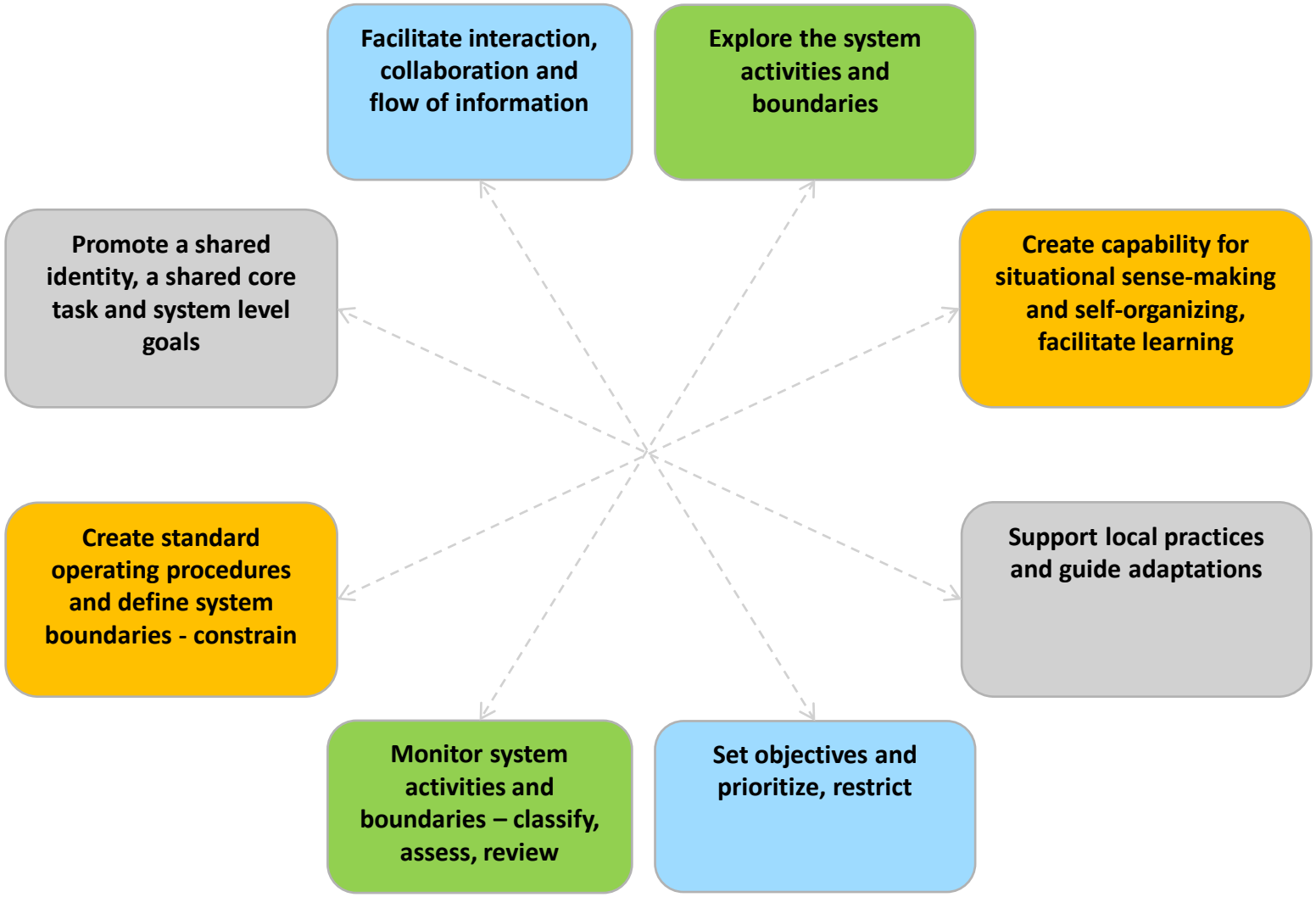

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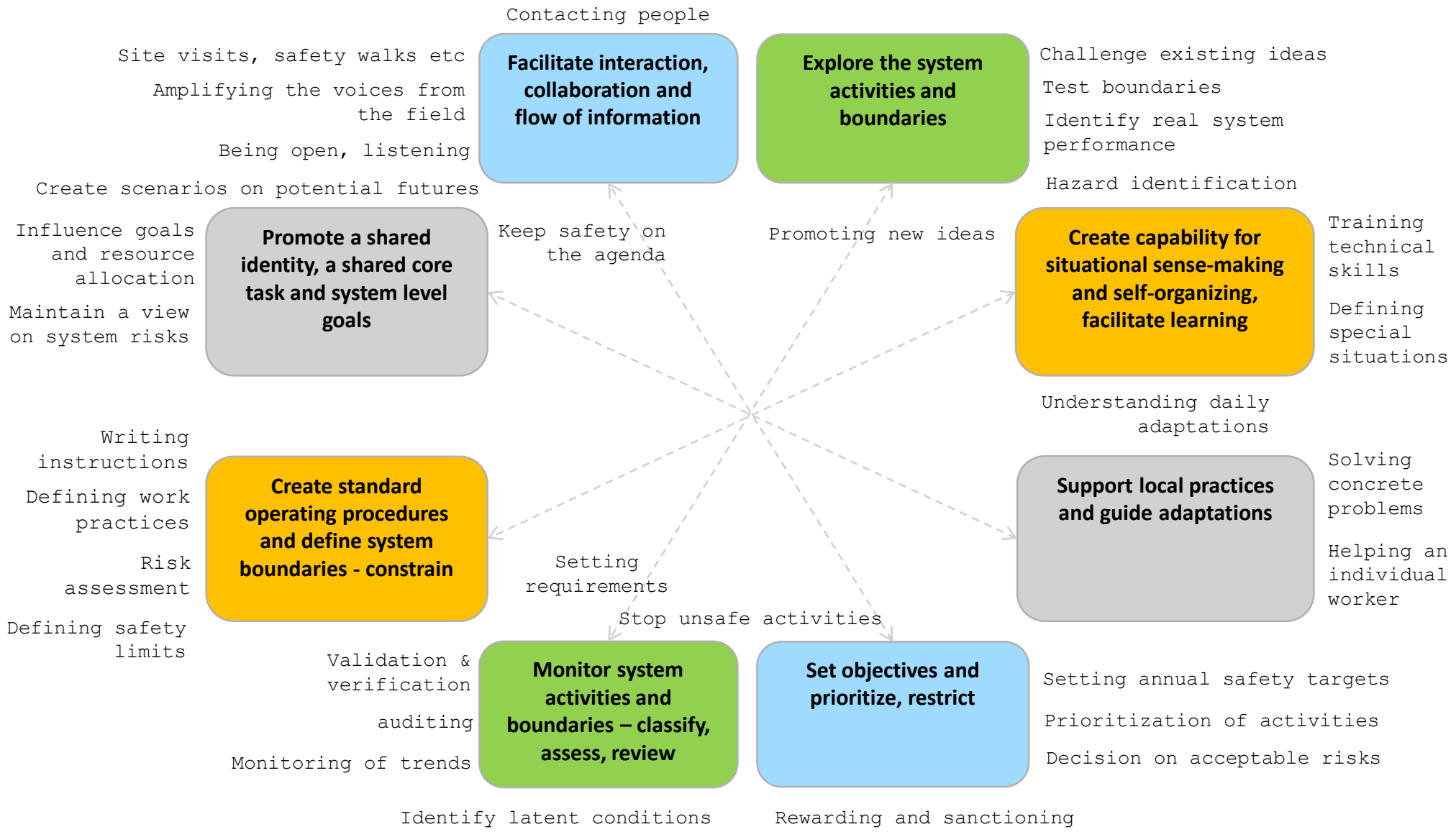

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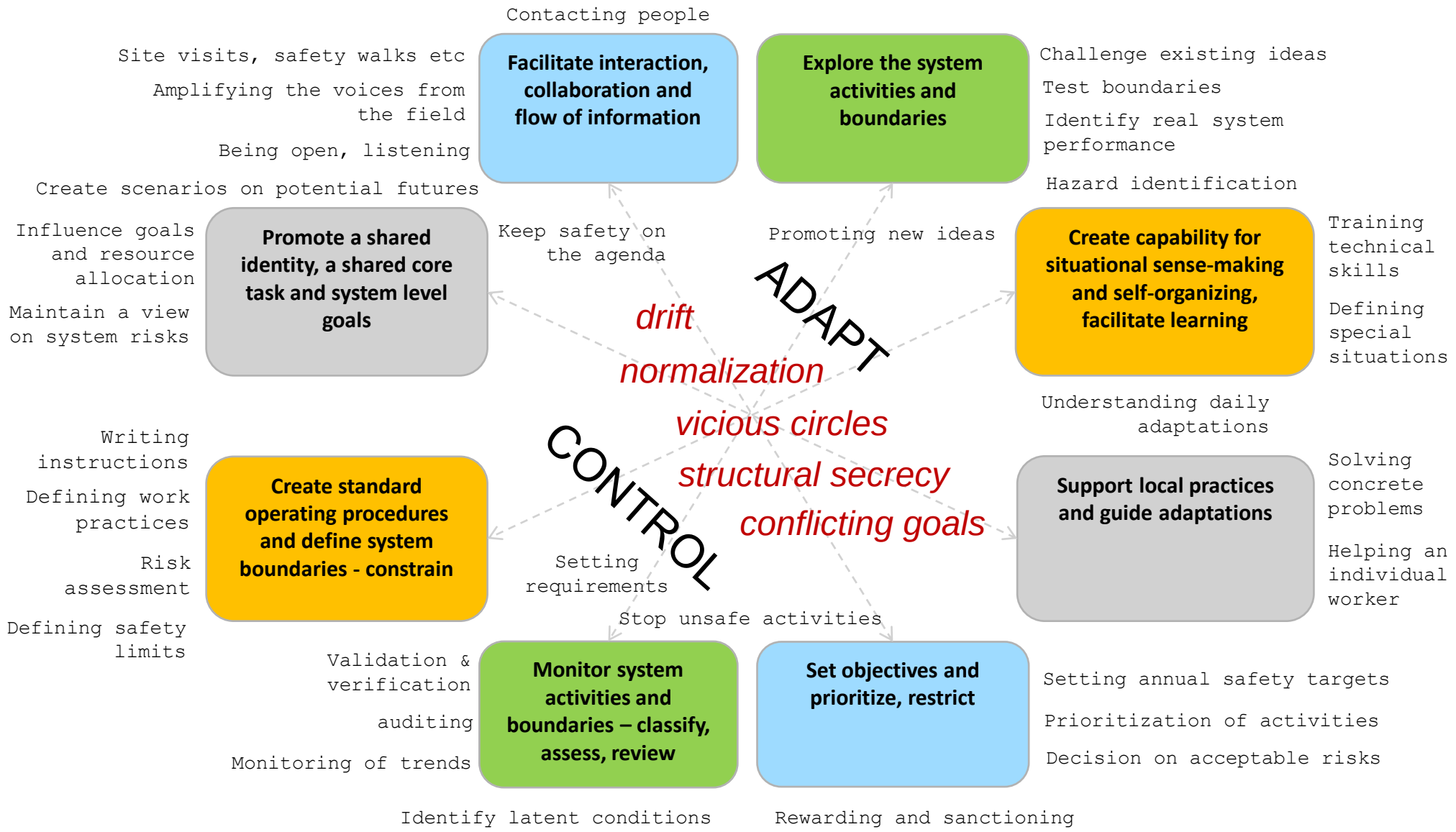

# Managing complex sociotechnical systems requires different types of management principles, combined with leadership skills

Build psychological safety, listen
Be respectful and fair
Give constructive feedback, understand errors
Align your words and behavior
Lead by example, expect same from others as from you
Create conditions for others to work
Ask the right questions, tell *what/why*, not how
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Balance short and long term foci
Care about others, create real relationships
Be humble, learn from others, and with others
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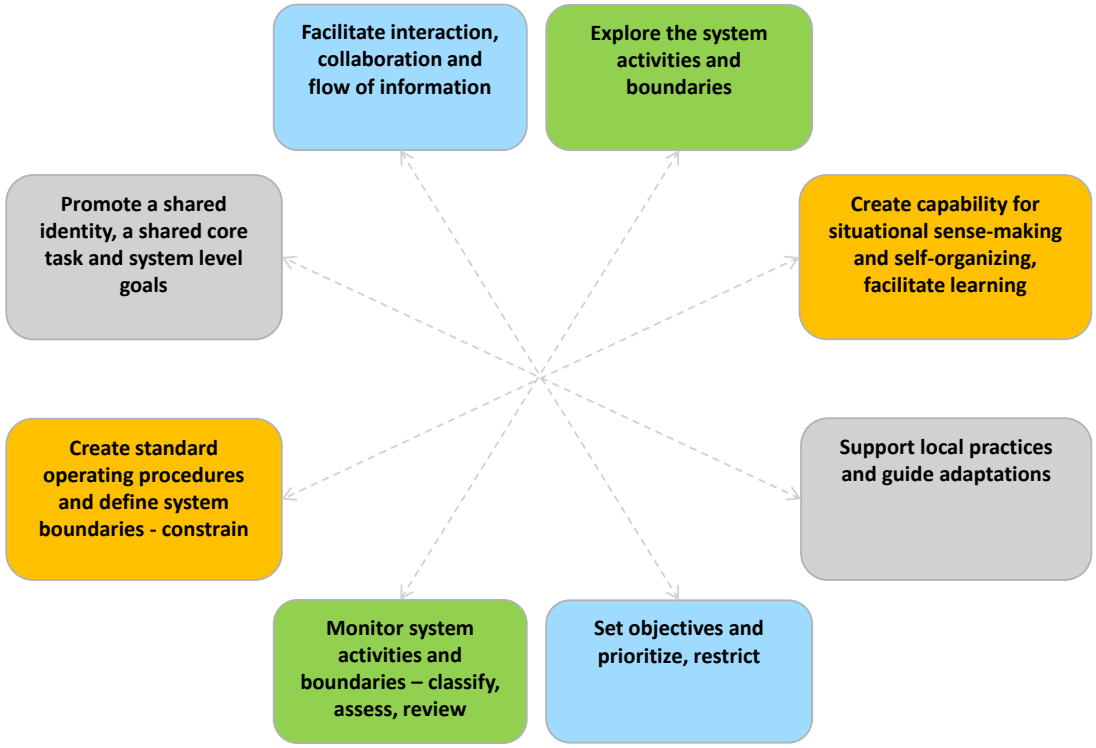

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