What is a Cognitive System?

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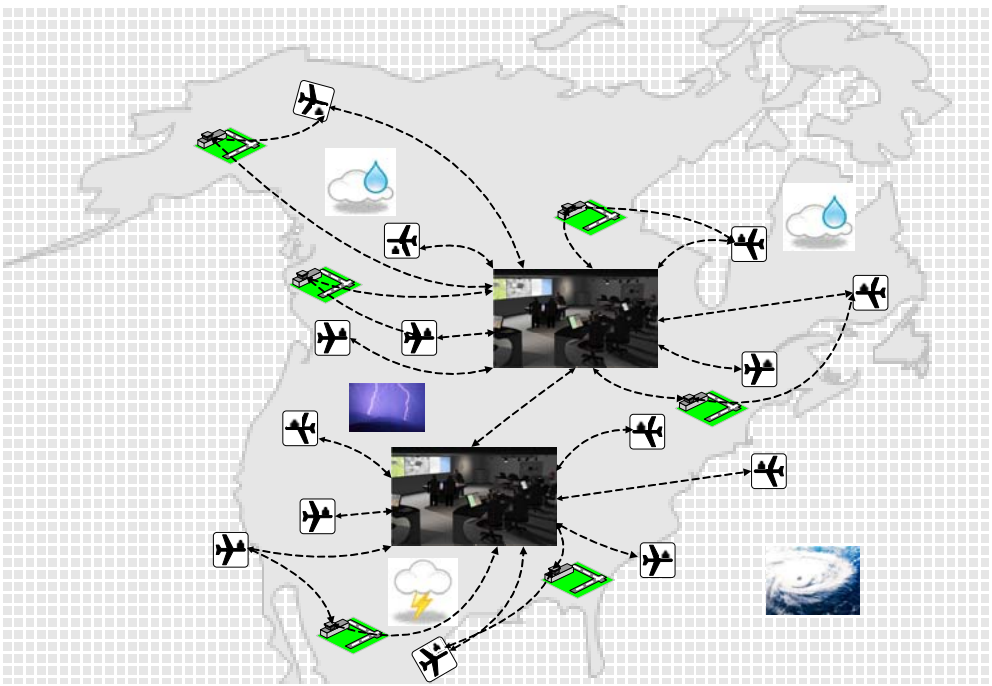
One of the better kept secrets

This year's symposium theme is:

The Airspace as a Cognitive System



Who cares?

Are there any design implications?

What is a Cognitive System?

A cognitive system does cognitive work

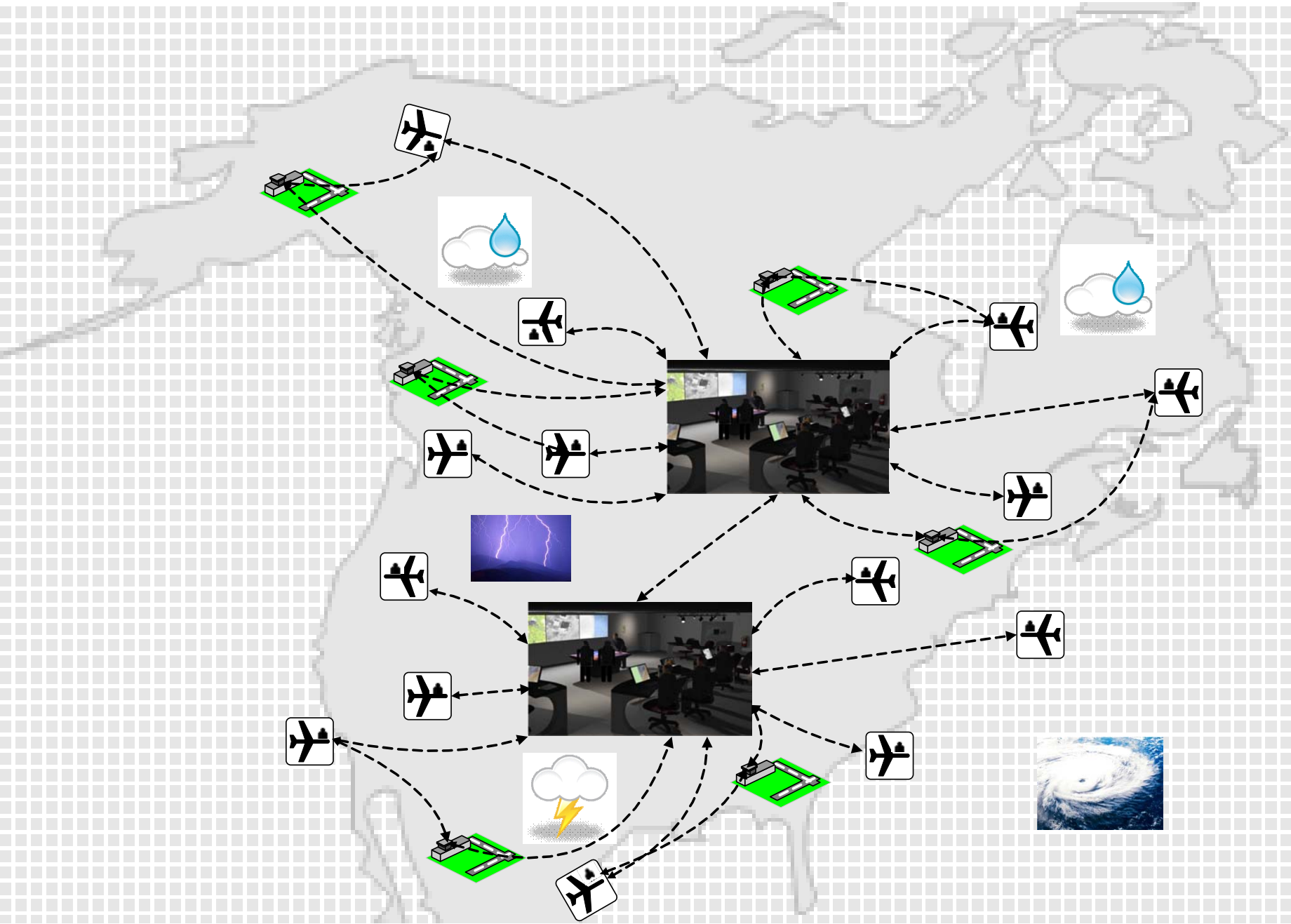
- Planning
- Deciding
- Problem Solving
- Acting

- Integrating
- Analyzing
- Synthesizing
- Assessing
- Manipulating

A Cognitive System is Distributed

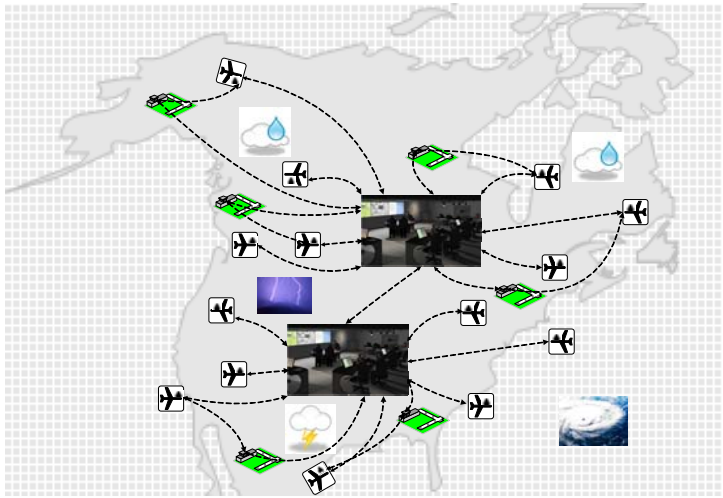
A cognitive system is distributed, involving many people & diverse artifacts in the performance of cognitive work:

- Subsystems outside individual minds
- Interactions between people as they work with technological resources
- Both internal mental activity & external interactions play important roles



Where is the Intelligence?

- Not generated by the activity of intelligent technological functions as many in the discipline of Artificial Intelligence (& Science Fiction) will want to claim

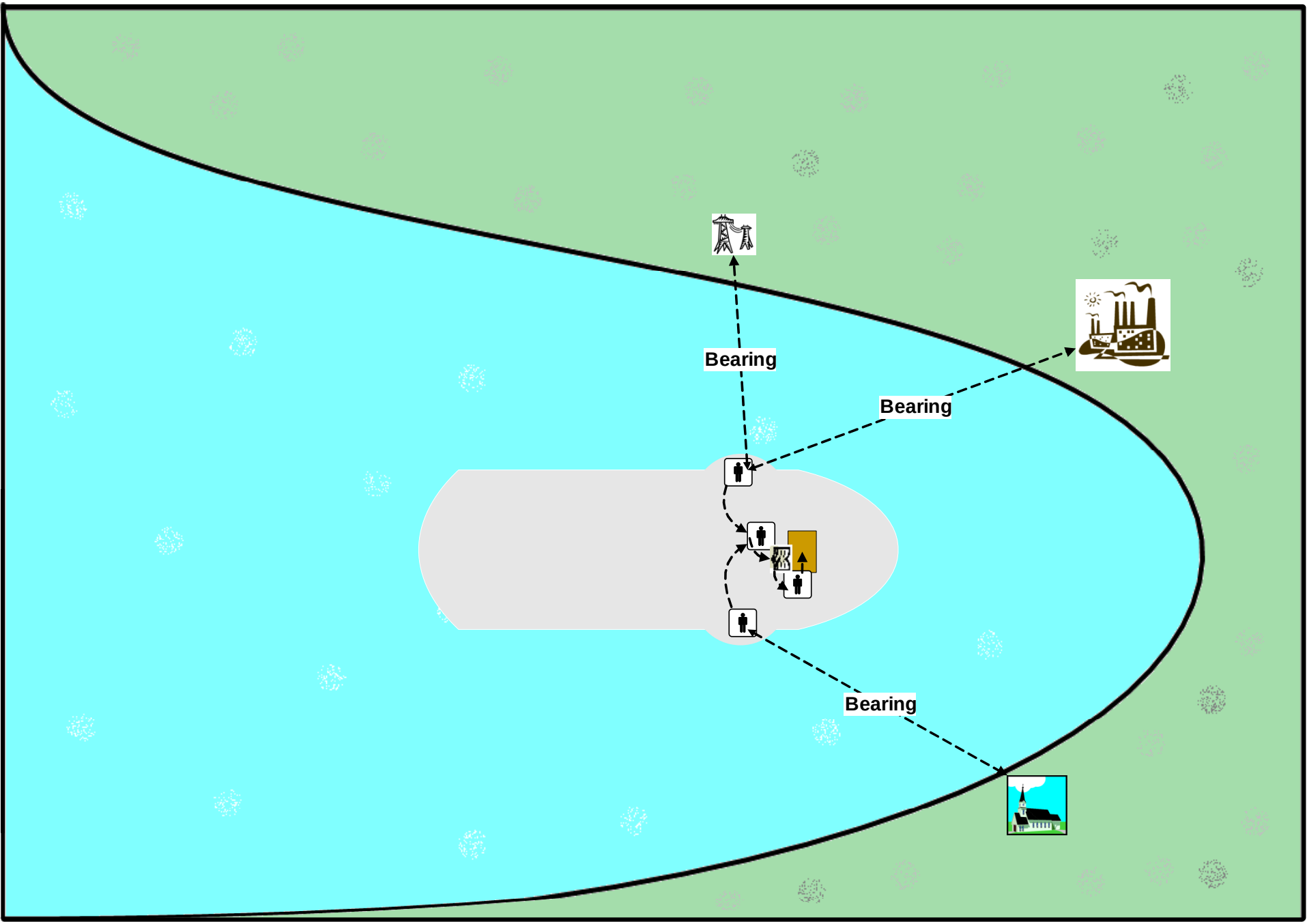


- Emerges from the coordinated collaboration of distributed human agents via their interactions with each other and with functionally heterogeneous technological artifacts
- In the sense that collaborations between human agents & their use of technological artifacts are coordinated, effective, robust, & meaningful, the distributed system is intelligent

The Defining Example

Ship navigation in enclosed waters

Hutchins (1995)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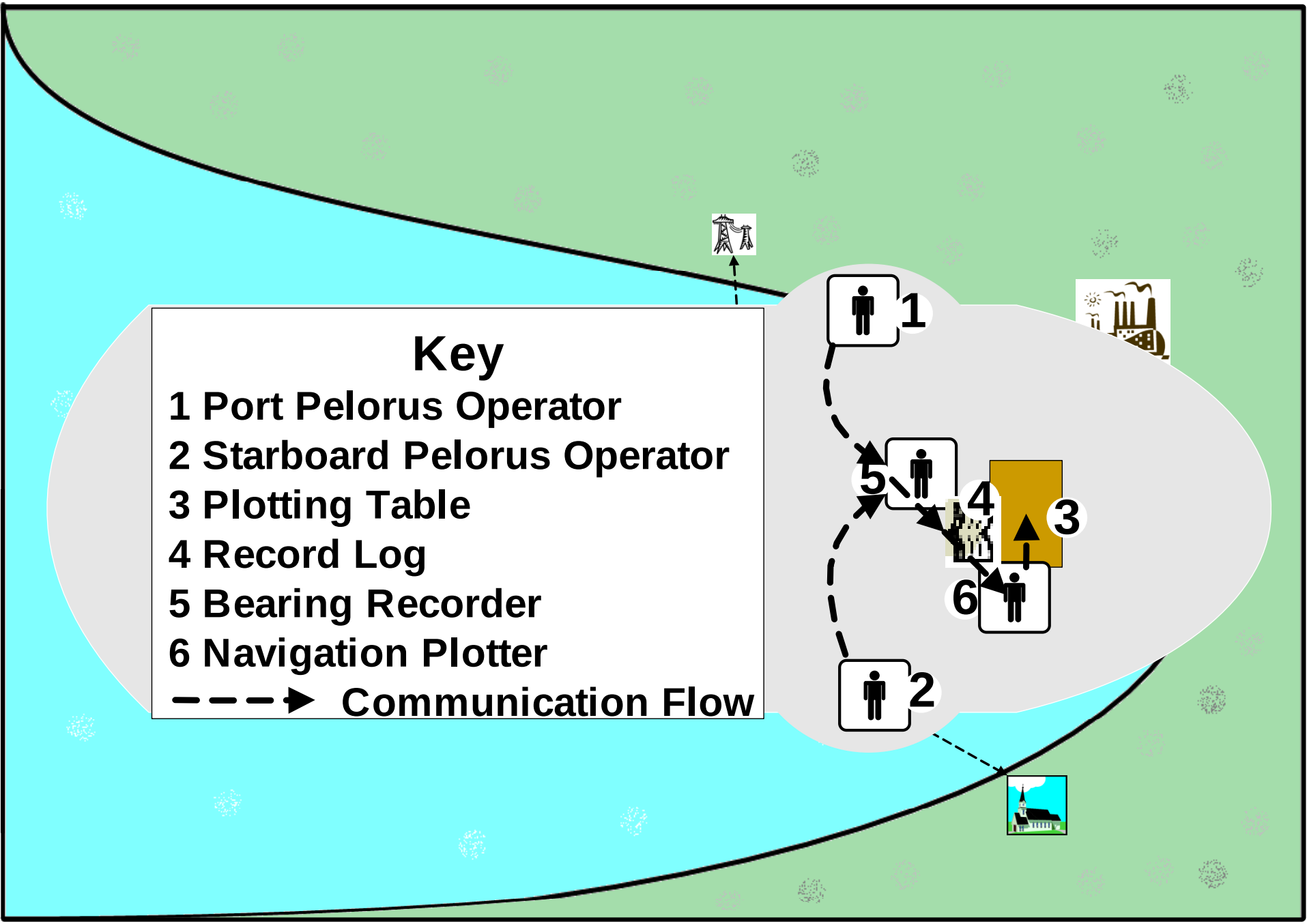
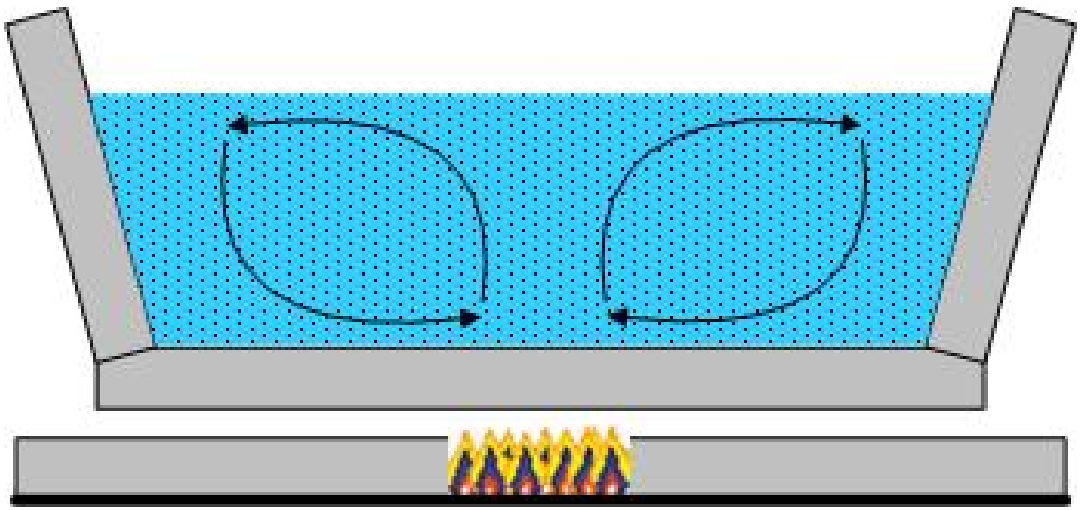

Key
1 Port Pelorus Operator
2 Starboard Pelorus Operator
3 Plotting Table
4 Record Log
5 Bearing Recorder
6 Navigation Plotter
Communication Flow
1
2
3
4
5
6

Cognitive Systems Design

Cognition is Emergent

- Cognitive organization emerges from the interplay between local interactions and global constraints as found in non-linear, self-organizing systems



- Property descriptions are not embedded in plans, specifications or instructions –no **pre-image**

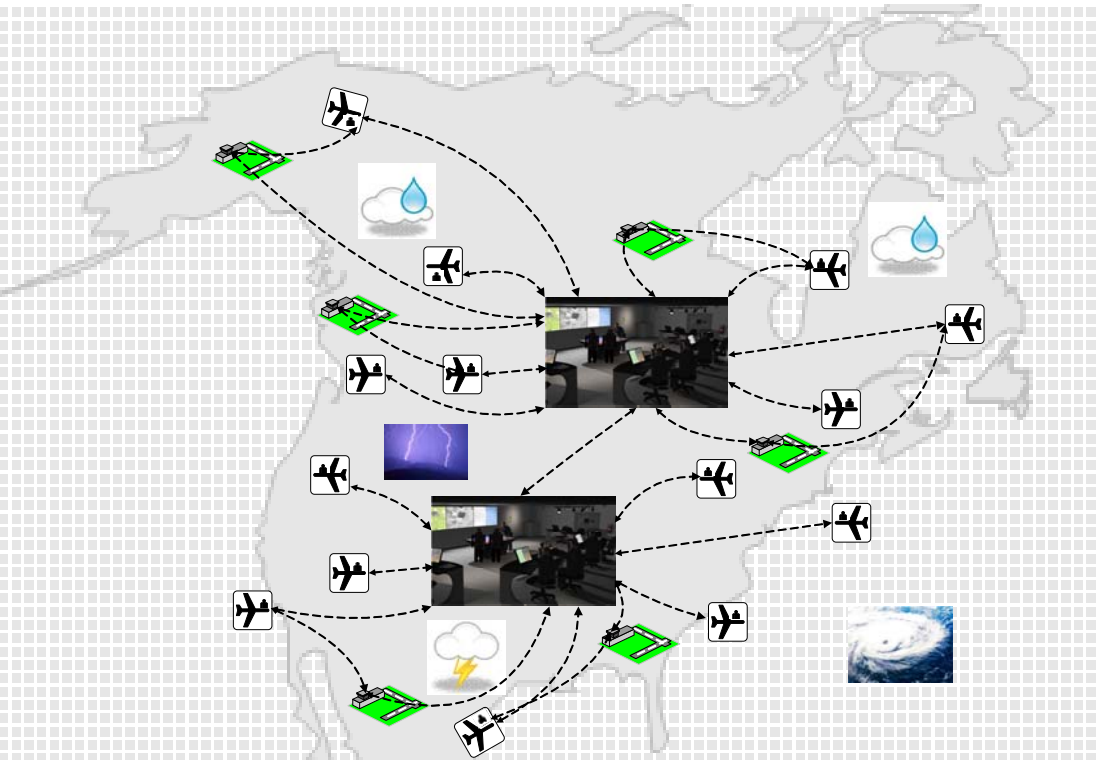
Cognitive Emergence

- Owes as much to the functional layout of the environment as it does to the local interactions of individuals with each other and with artifacts
  - The cognitive architecture determines the way information flows through the system
  - This cognitive architecture encompasses the functional structure of the physical environment, the social organization of the workplace & the functional structure of individual minds
- Cognition emerges from activity undertaken within the constraints imposed by the cognitive architecture & is shaped by those architectural constraints

Design Implications

Human agents have a crucial, integrative role in complex socio-technical systems

A technology-first approach constrains the cognitive potential of the system

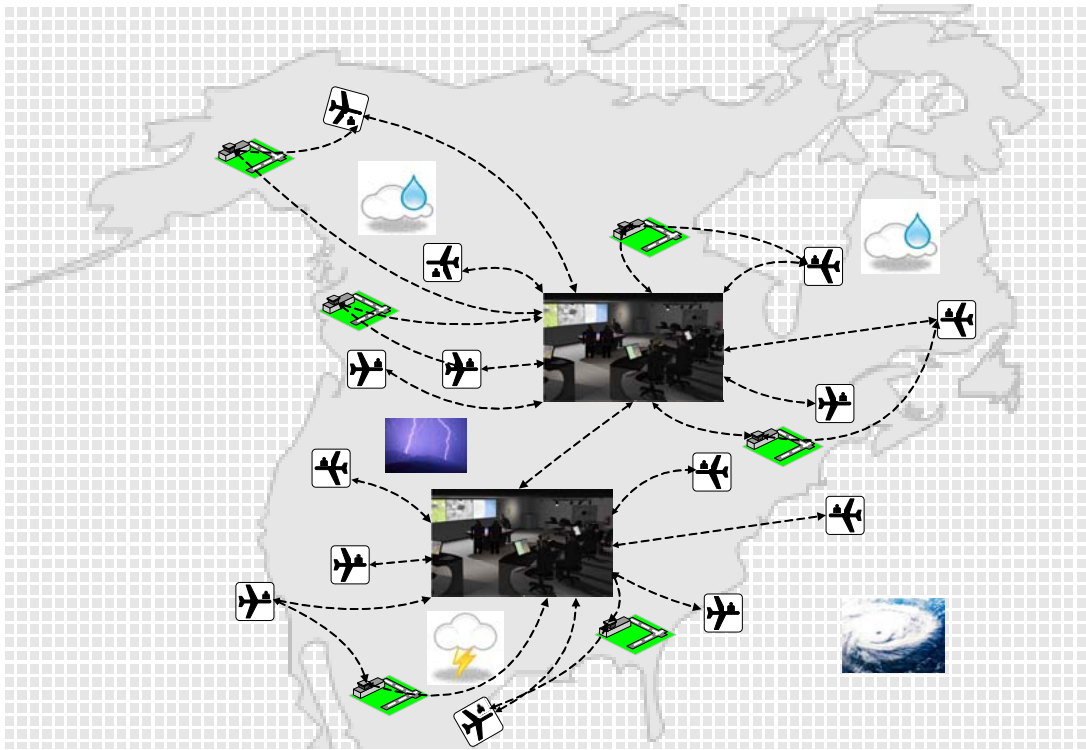


Structure the work environment carefully & explicitly to ensure that the emergent cognitive patterns are the ones we want

Design Challenges

Develop an airspace system that is more robust & intelligent principally because it amplifies rather than replaces the cognitive and coordinative capabilities of its human participants:

- Build better cognitive systems through emphasis on the coordinating, adaptive and sense-making roles played by the human participants
- Develop a coordinated system of human agents and technological functionality in which there are effective communication tools to support collaboration between human agents and effective interfaces to support use of the technological functionality

Your world view matters!!!!!

Questions?