Generating Knowledge in a Connected World: The Case of the ATLAS Experiment at CERN

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The ATLAS Experiment at CERN

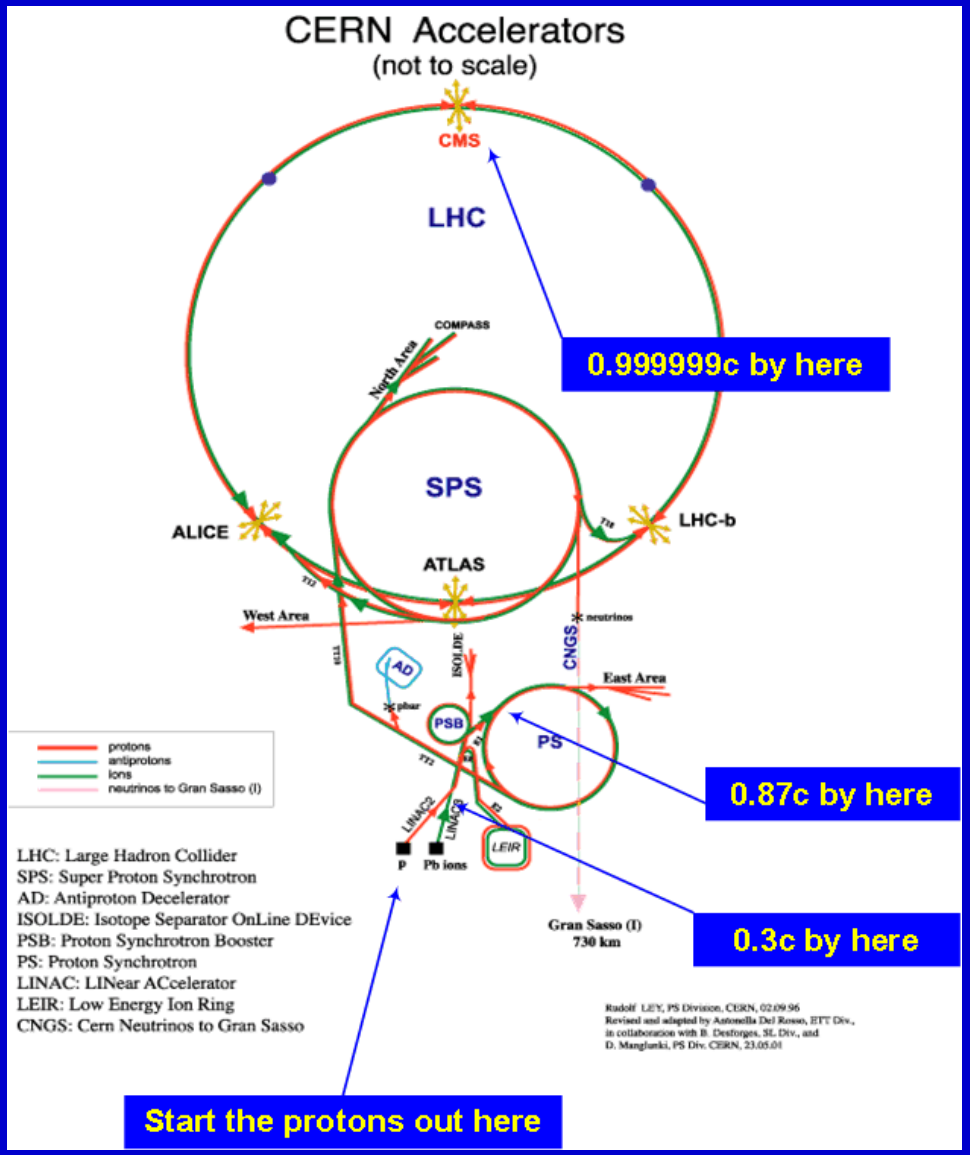
- The ATLAS experiment at CERN is one of four that, working with the Large Hadron Collider (LHC), will explore new physics in the 14 TeV energy range.
- The ATLAS detector is one of the largest and most complex experimental machines ever built.
- Its construction involved over 3000 physicists from 174 research institutes spread across 38 countries

How is coordination achieved in an organization as extended and complex as the ATLAS Collaboration?

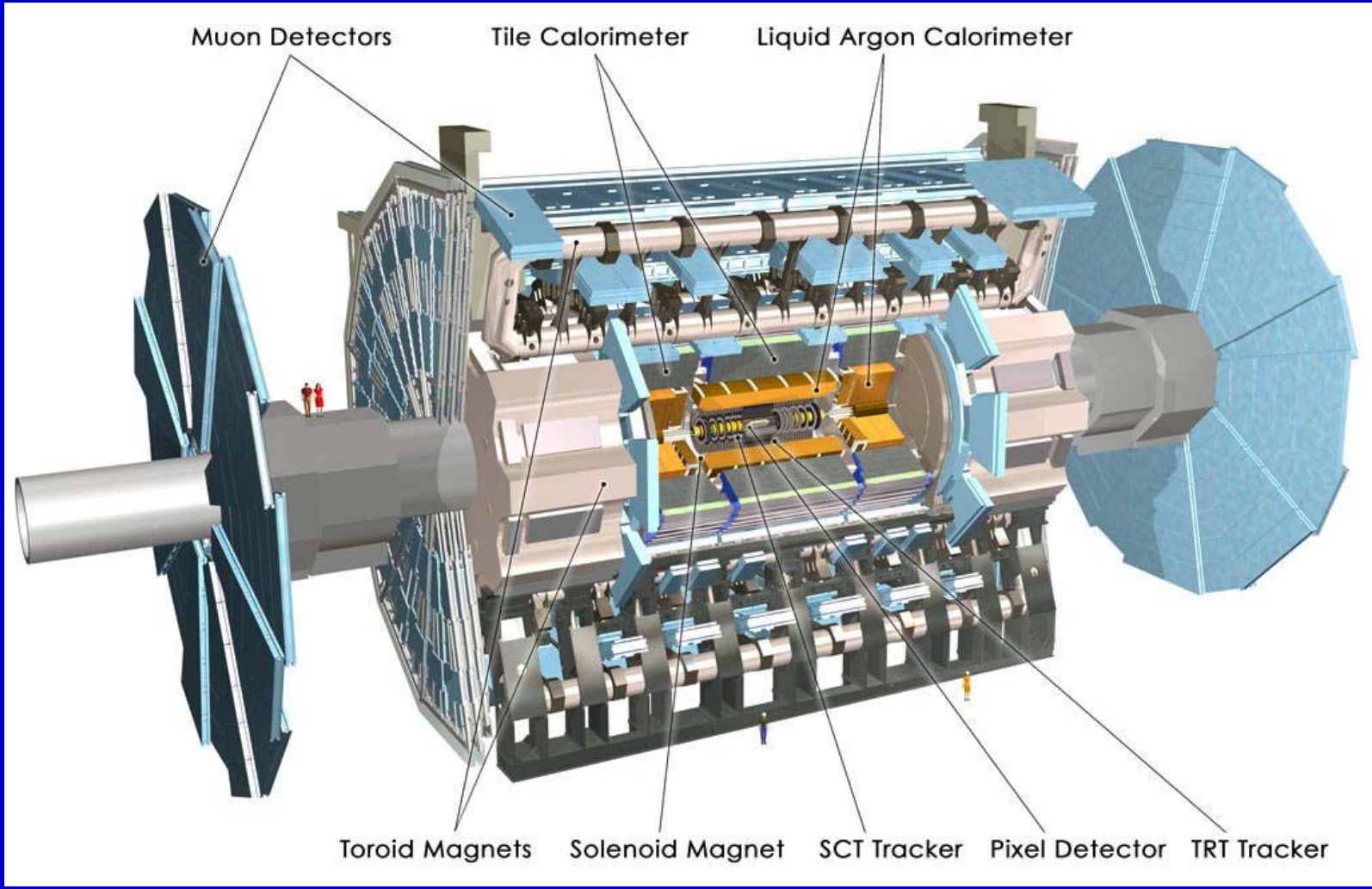
What lessons does the ATLAS experience hold for other complex organizations such a cities?

The Large Hadron Collider (LHC)

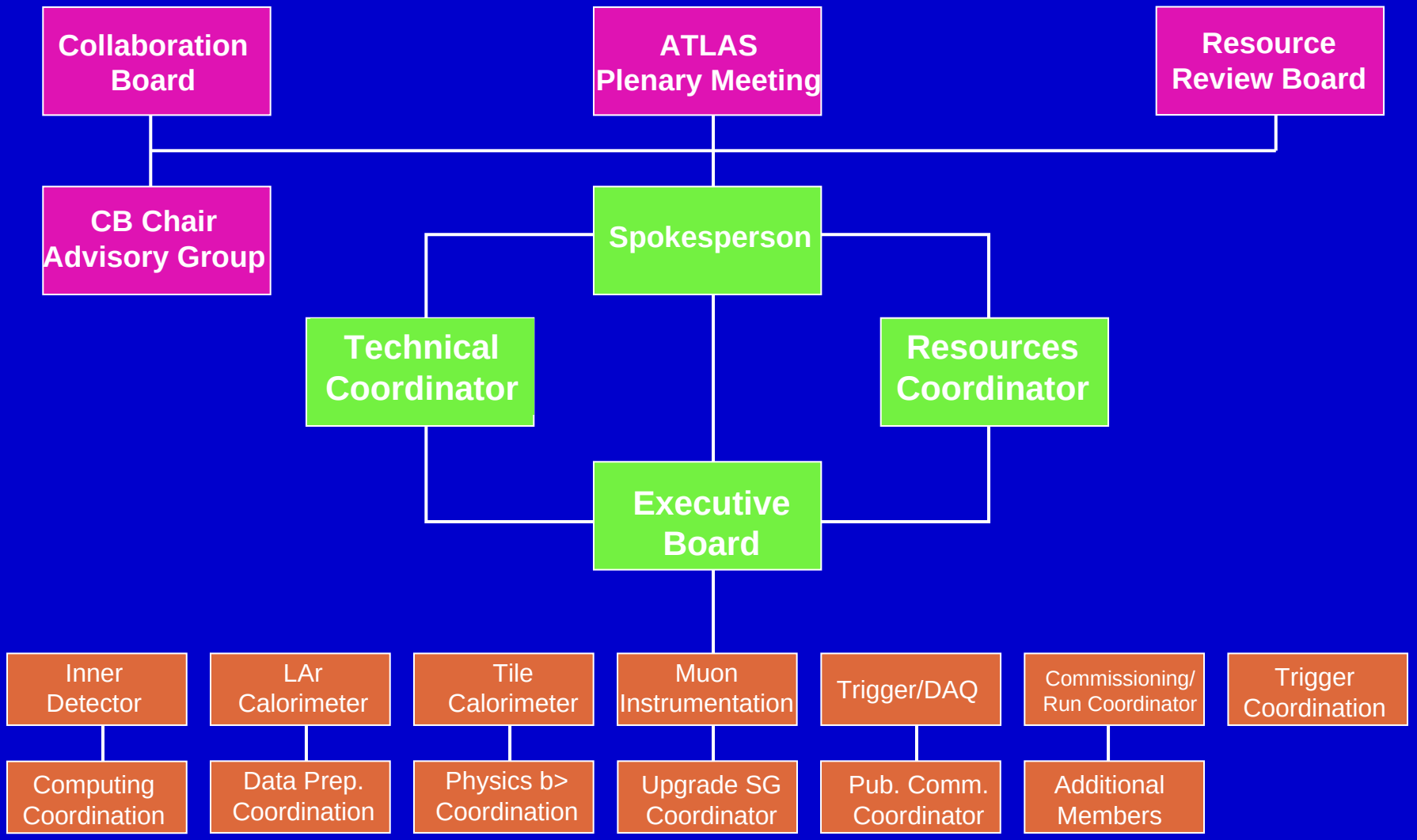
ATLAS is one of four detectors located on the LHC



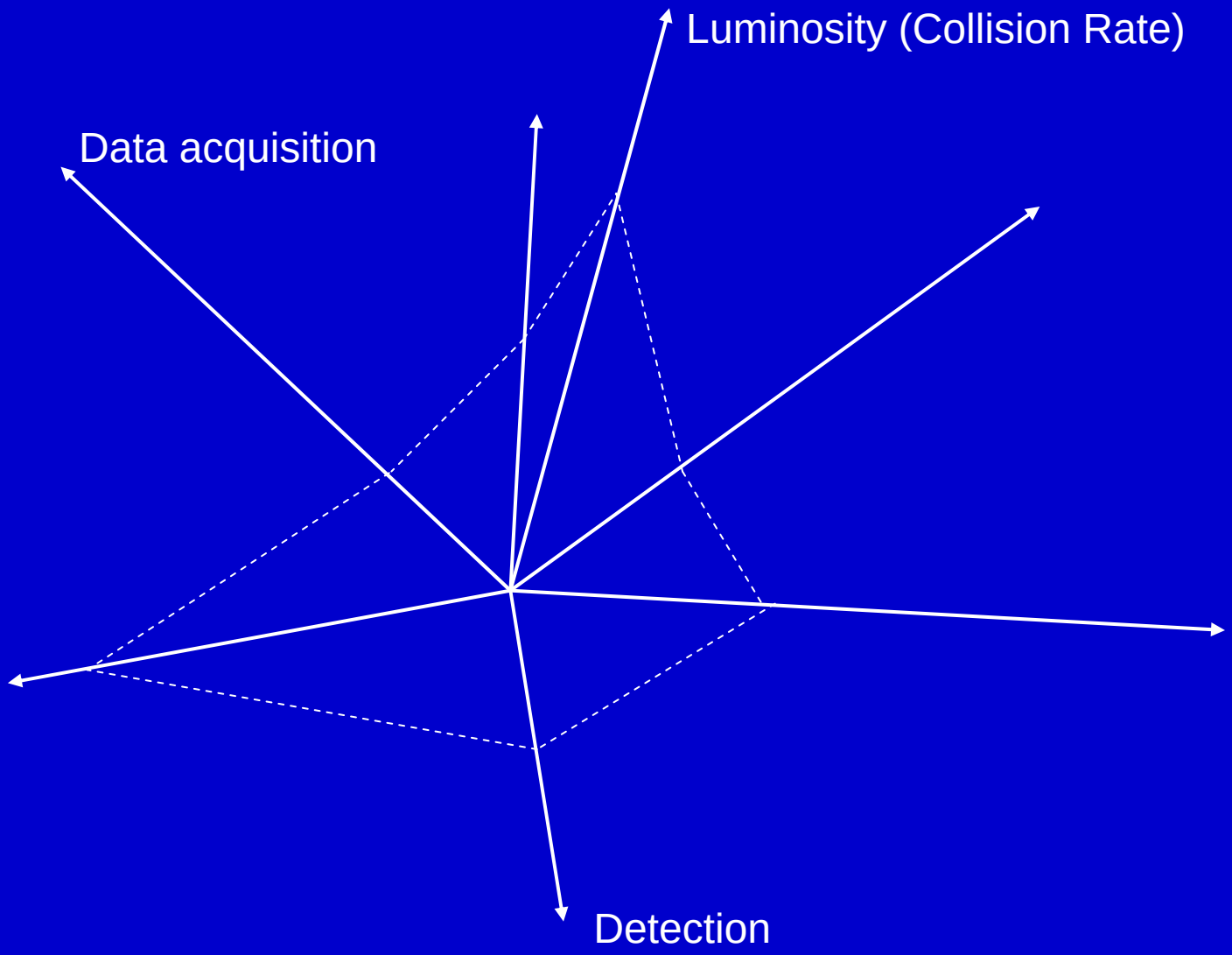
The ATLAS Detector



The ATLAS Organization



The Performance Spidergraph For ATLAS



The ATLAS Puzzle

- The Collaboration is held together by *MoUs*
- Decision making is mostly *bottom-up*
- Decision making is mostly *distributed*

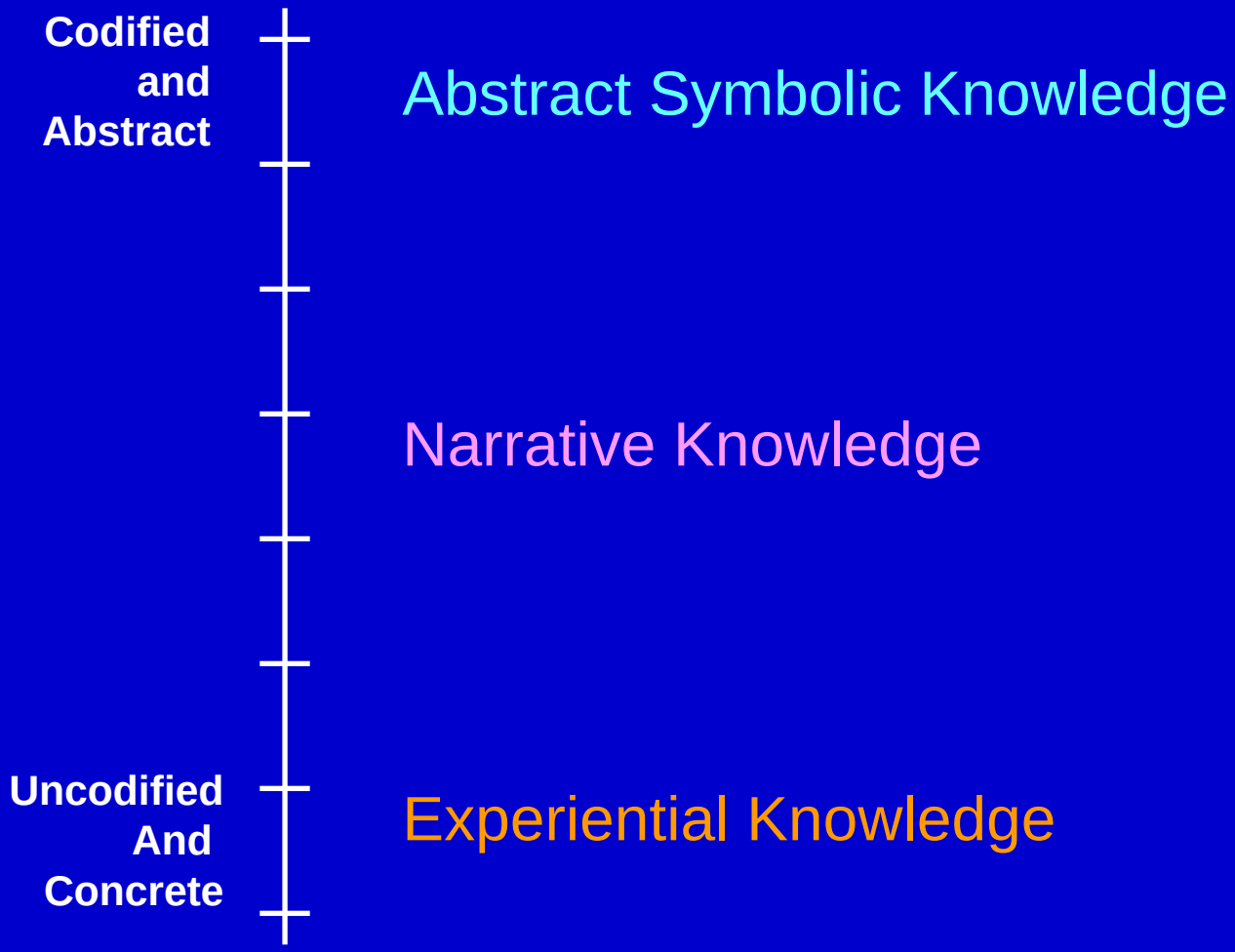
How does Collaboration manage to reach the tips of the performance spidergraph?

What lessons for the rest of us?

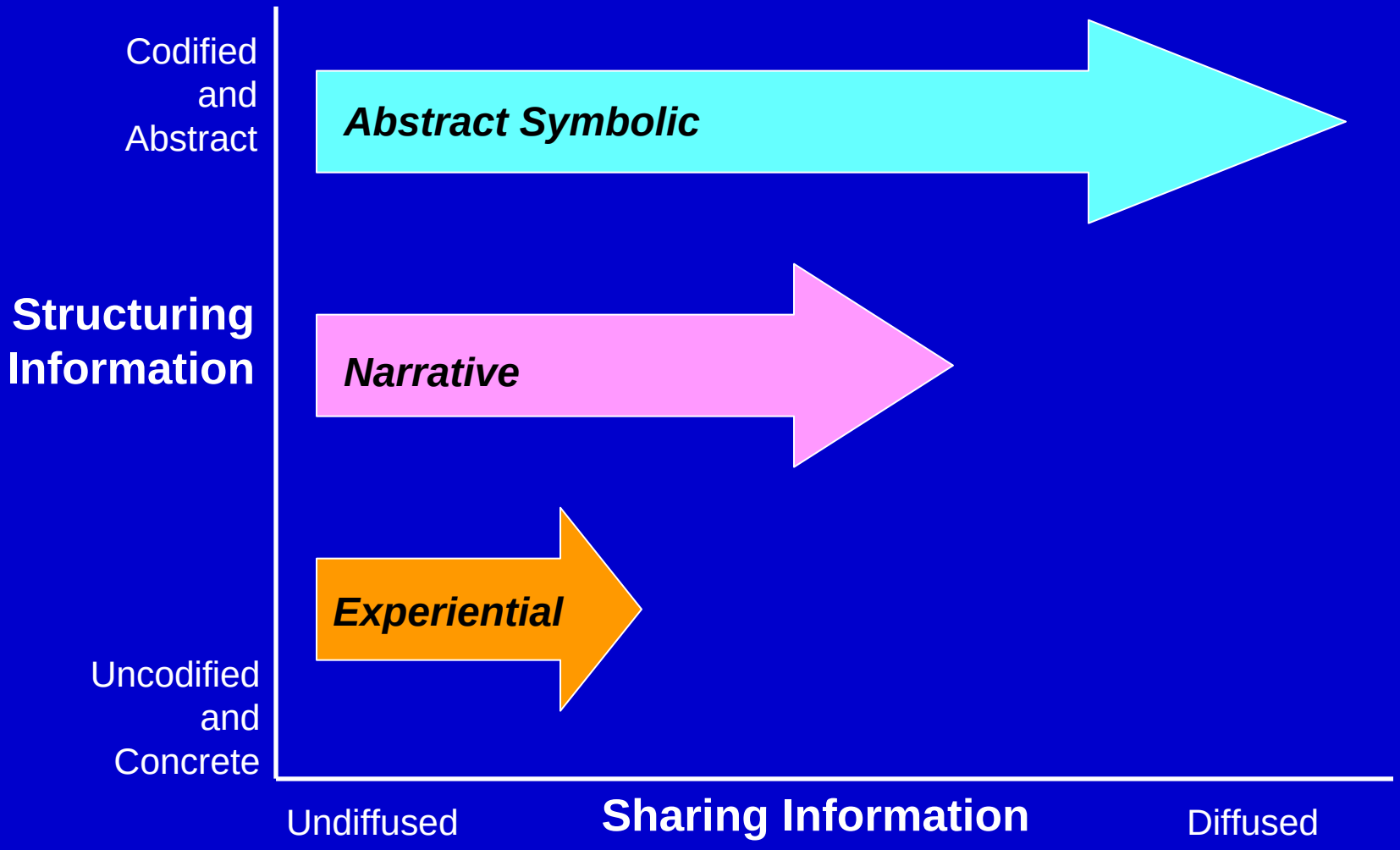
Three Kinds of Knowledge

- *Experiential* – what can I see, hear, feel, smell, or touch?
- *Narrative* – what can I say about it?
- *Abstract Symbolic* – what can I extract from it which is stable or durable?

Structuring Information



The I-Space: The Key Concept



The I-Space: The Key Concept

Codified and Abstract

Structuring Information

Uncodified And Concrete

Bond Traders

Yield movement

Name of Security	Yld as on Mar 11	Yld as on Mar 4
11.40% 2063	6.17	6.18
7.55% 2010	6.46	6.39
9.39% 2011	6.54	6.57
7.40% 2012	6.56	6.61
7.27% 2013	6.71	6.70
7.37% 2014	6.64	6.66
7.80% 2015	6.56	6.61
5.59% 2016	6.69	6.71
7.48% 2017	6.85	6.83
8.25% 2018	6.88	6.91
5.64% 2019	6.83	6.90
8.35% 2020	7.00	7.14
8.30% 2022	7.01	7.16
8.17% 2023	7.03	6.98
8.01% 2026	7.04	7.06
7.50% 2034	7.17	7.34

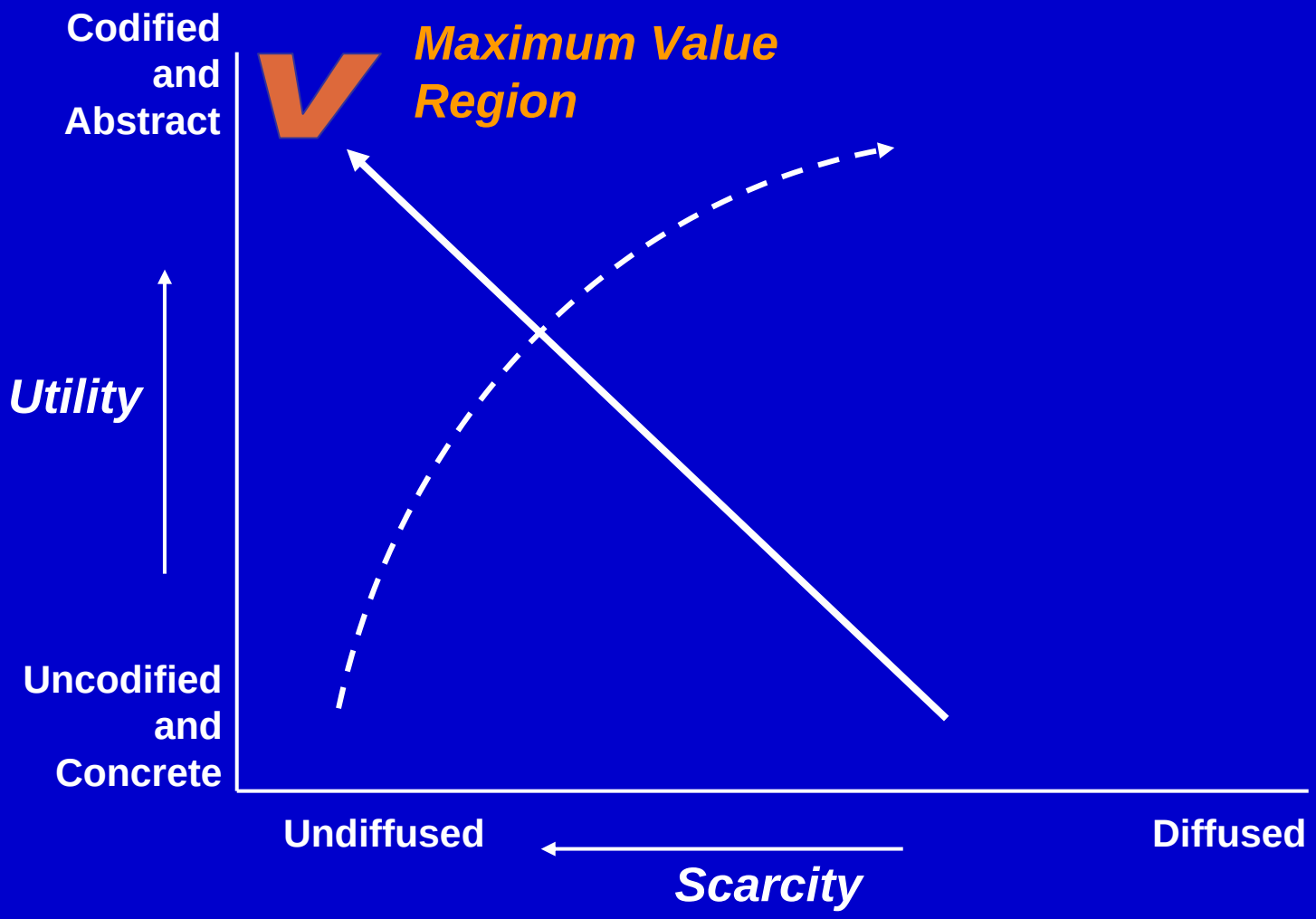
Zen Buddhists

Undiffused

Sharing Information

Diffused

The Paradox of Value



Codifying Knowledge

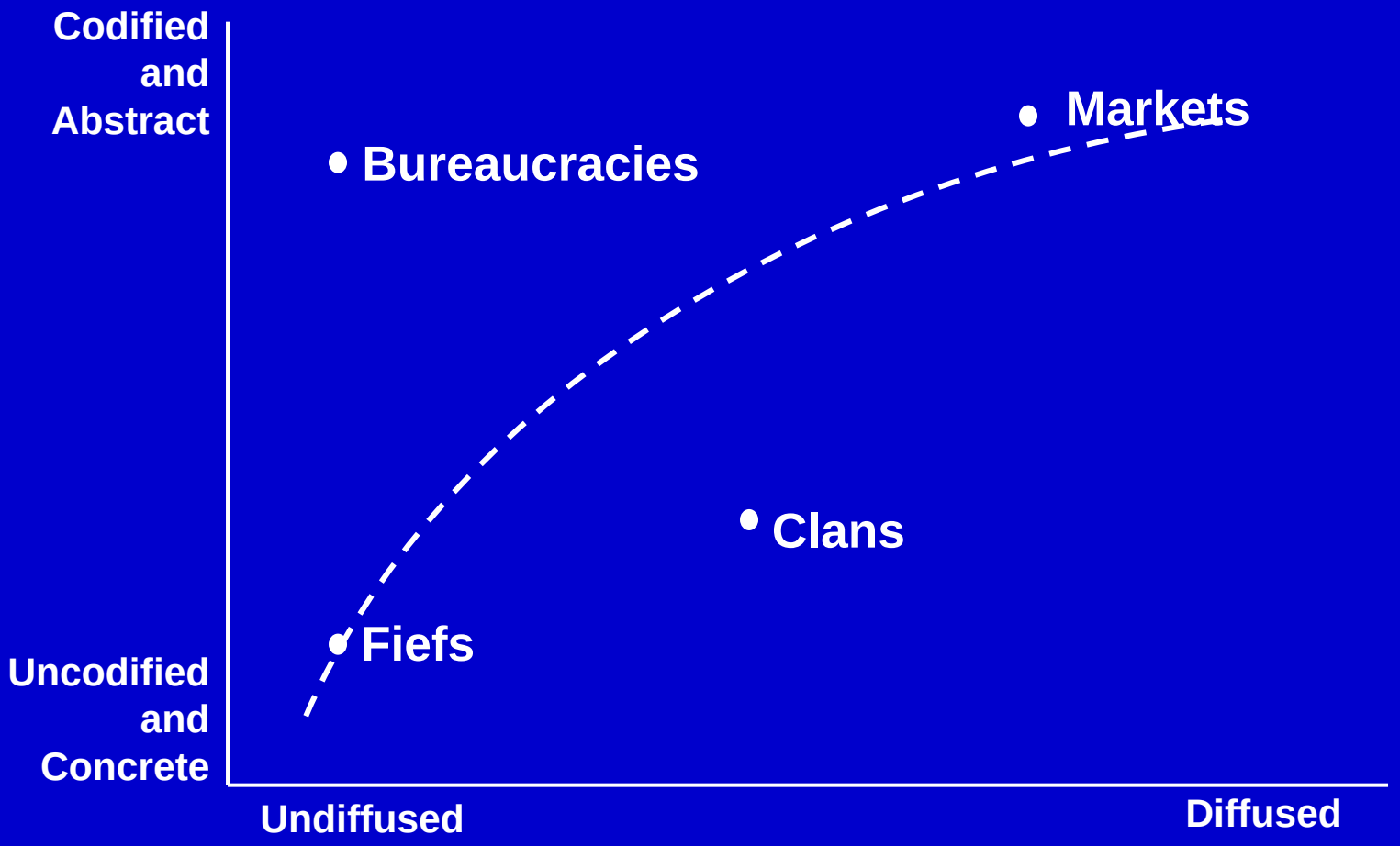
- You gain manipulability and predictability
- It behaves like an *object*
- You can store it
- You can write contracts
- You can sell it

But:

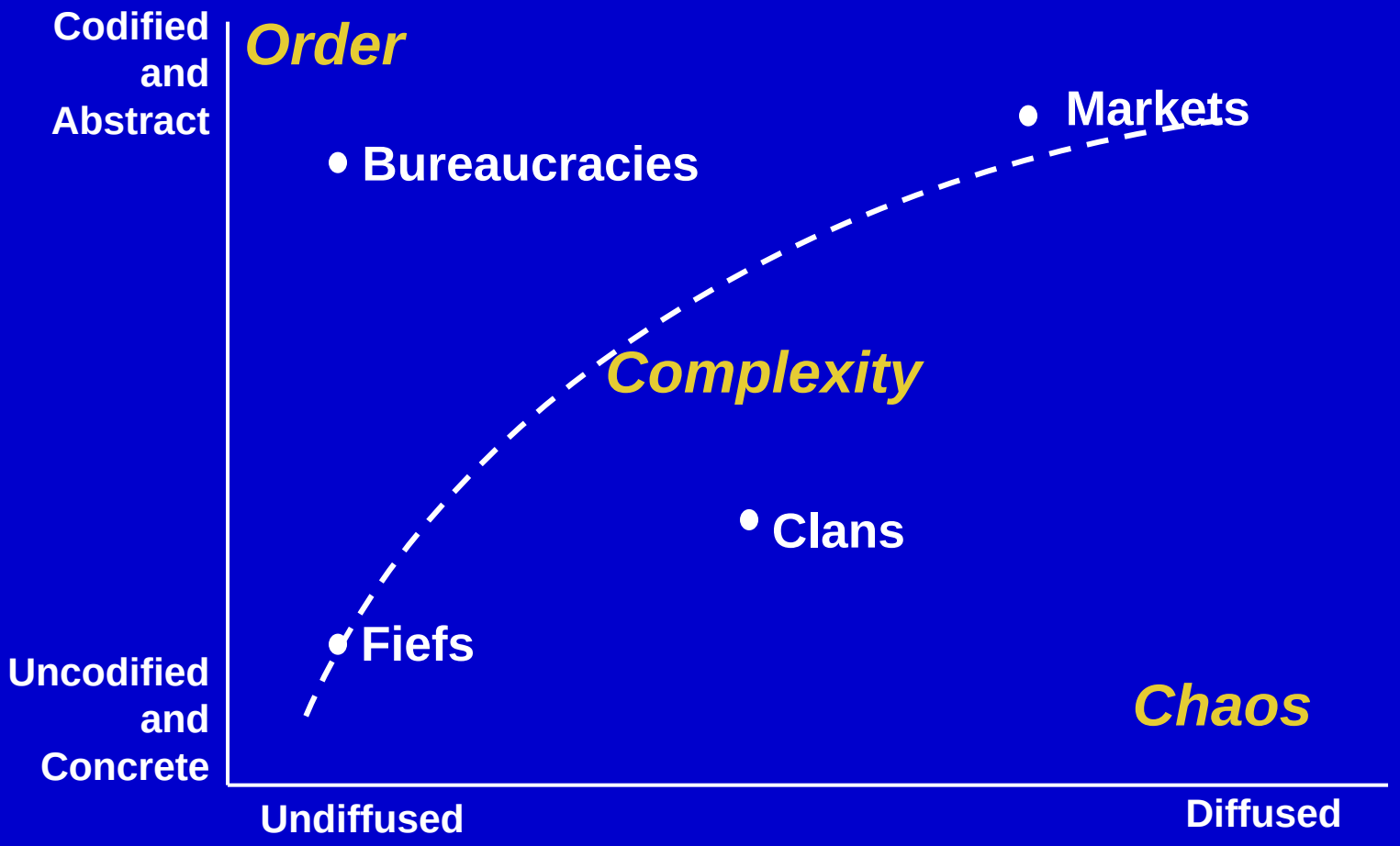
- You may lose contextual richness, feeling, and understanding

Lost for Words?

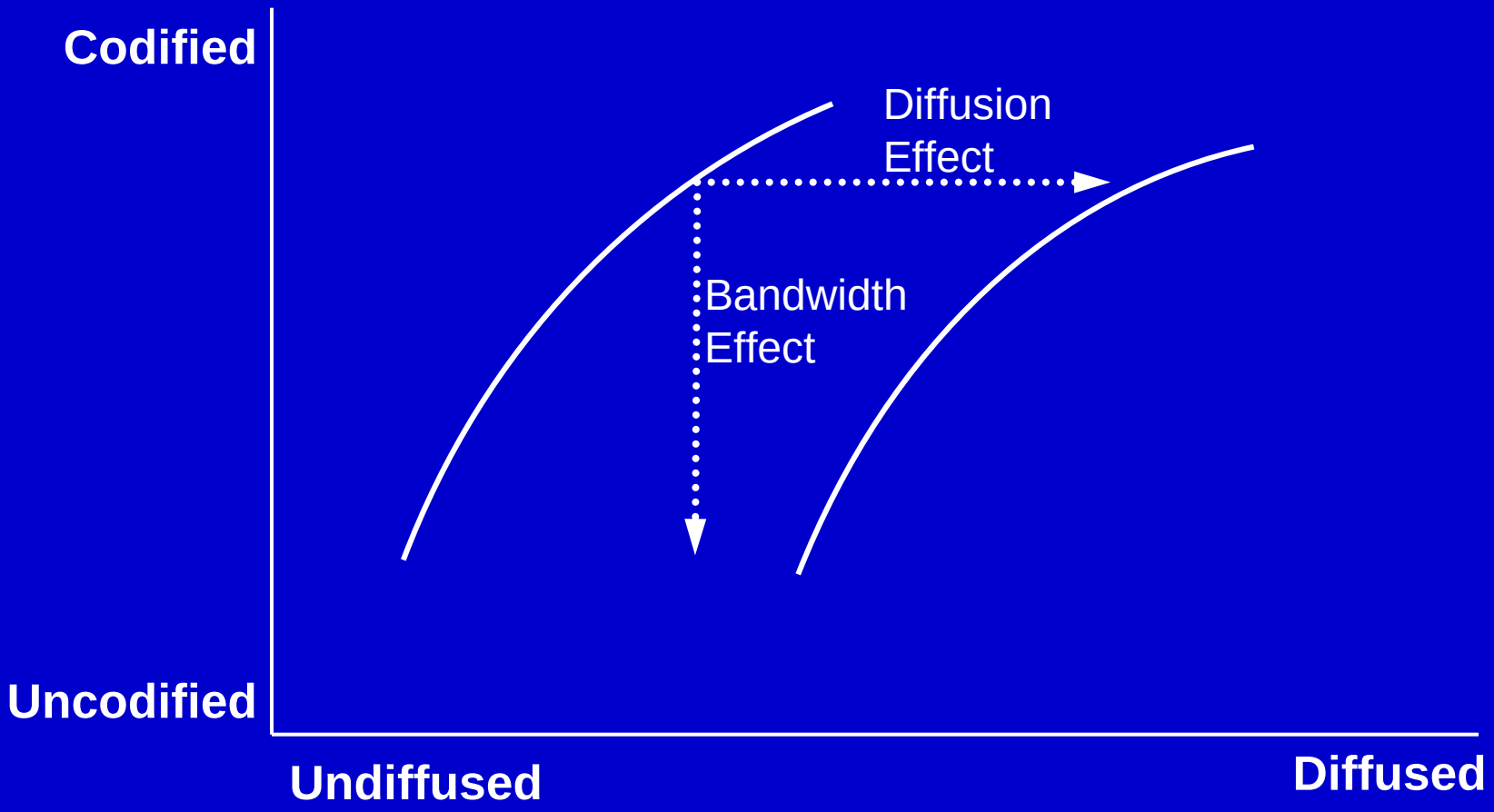
Institutions and Cultures in the I-Space



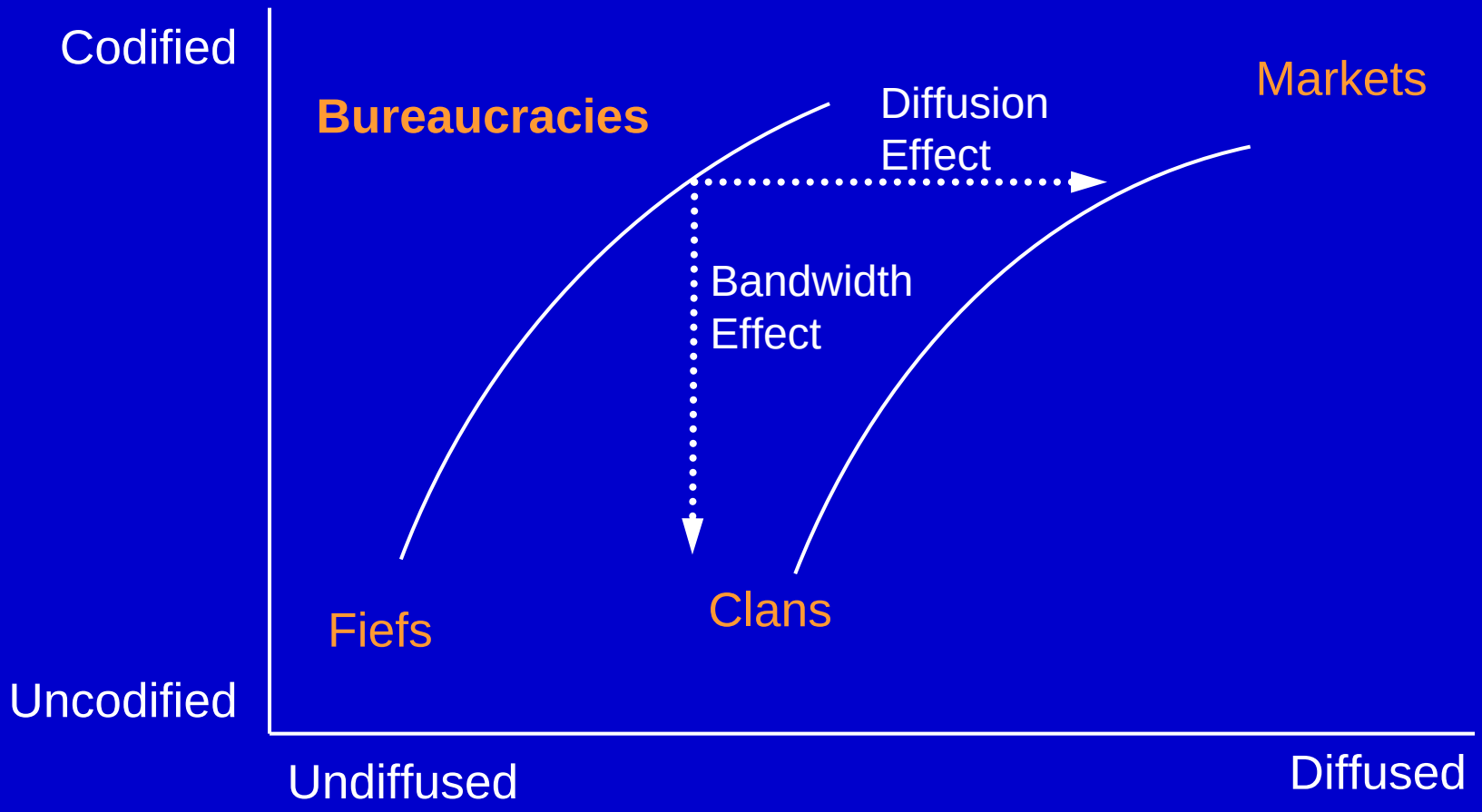
Institutions and Cultures in the I-Space



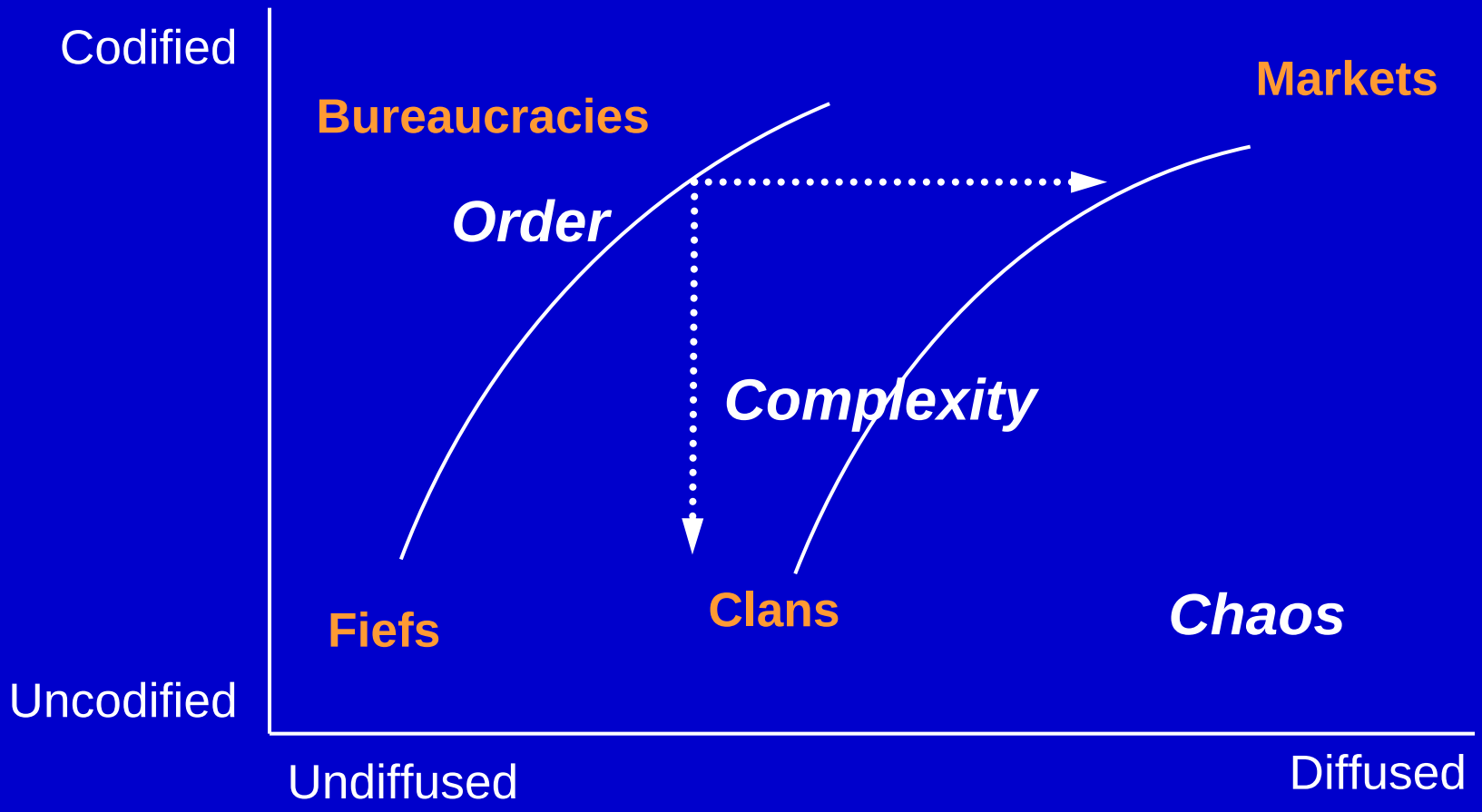
The Impact of ICTs on the Diffusion Curve



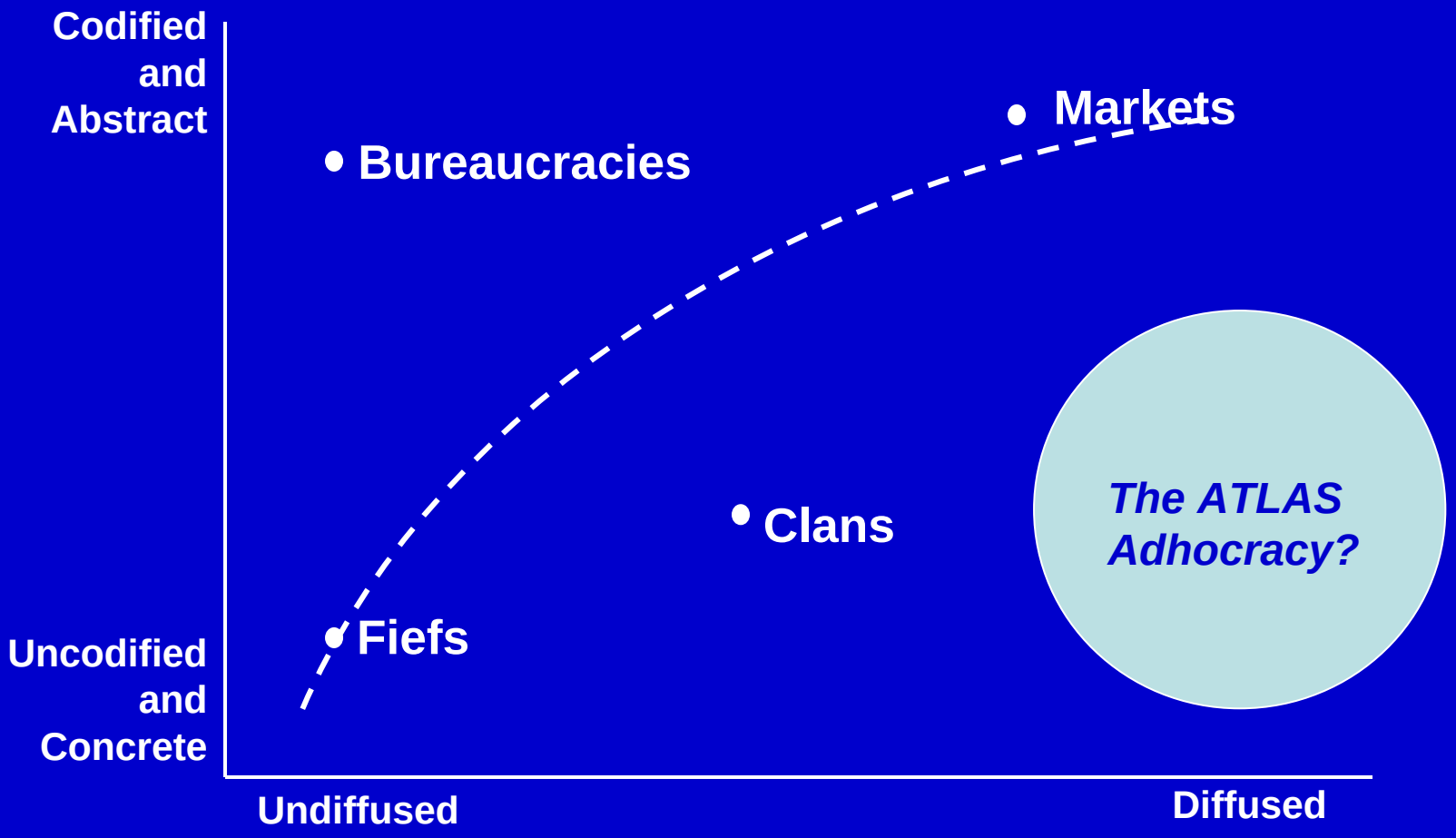
The Impact of ICTs on Culture



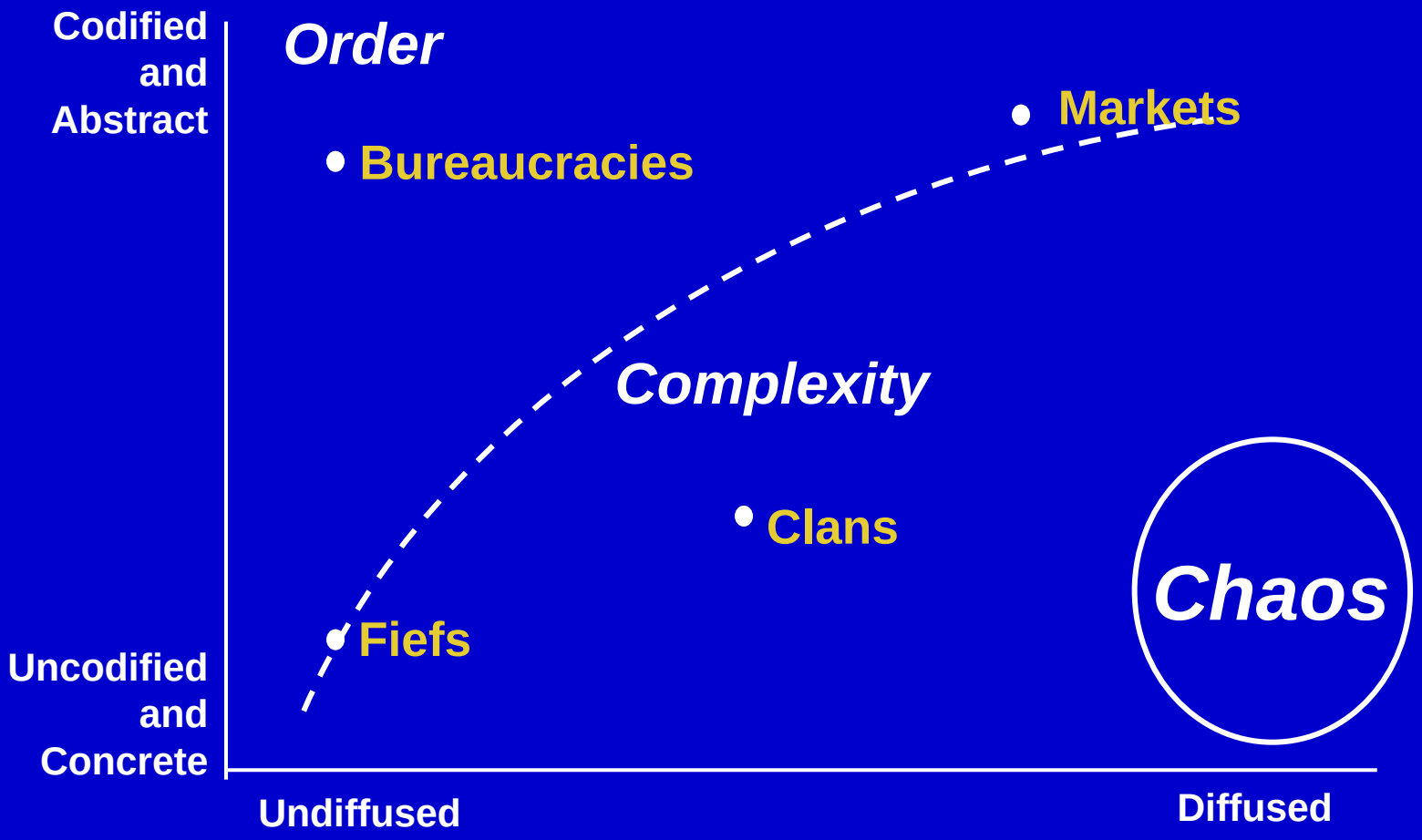
Culture and Complexity



Distributed Networks & Adhocracies: A New Hypothesis?

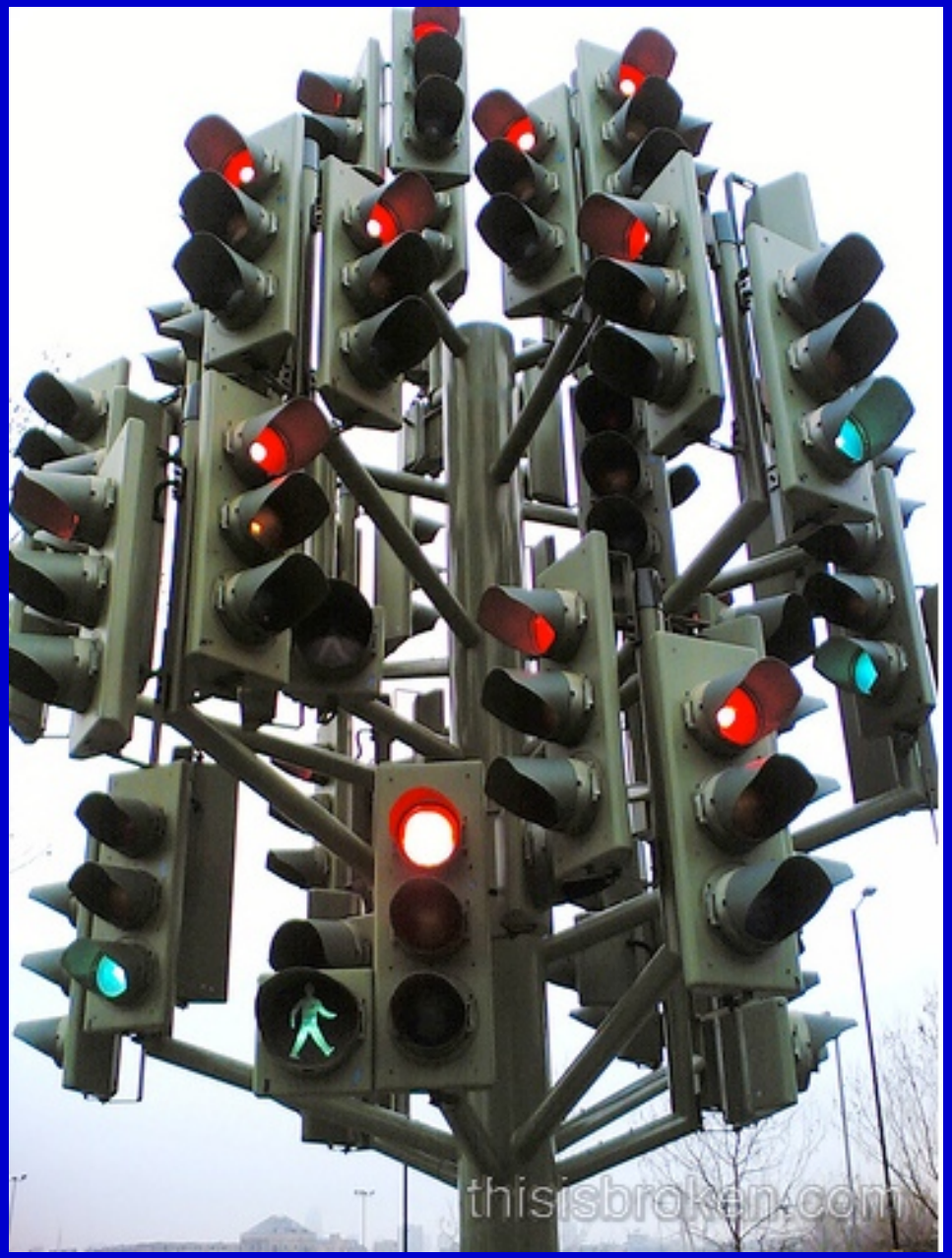


Why Doesn't ATLAS Fly Apart?



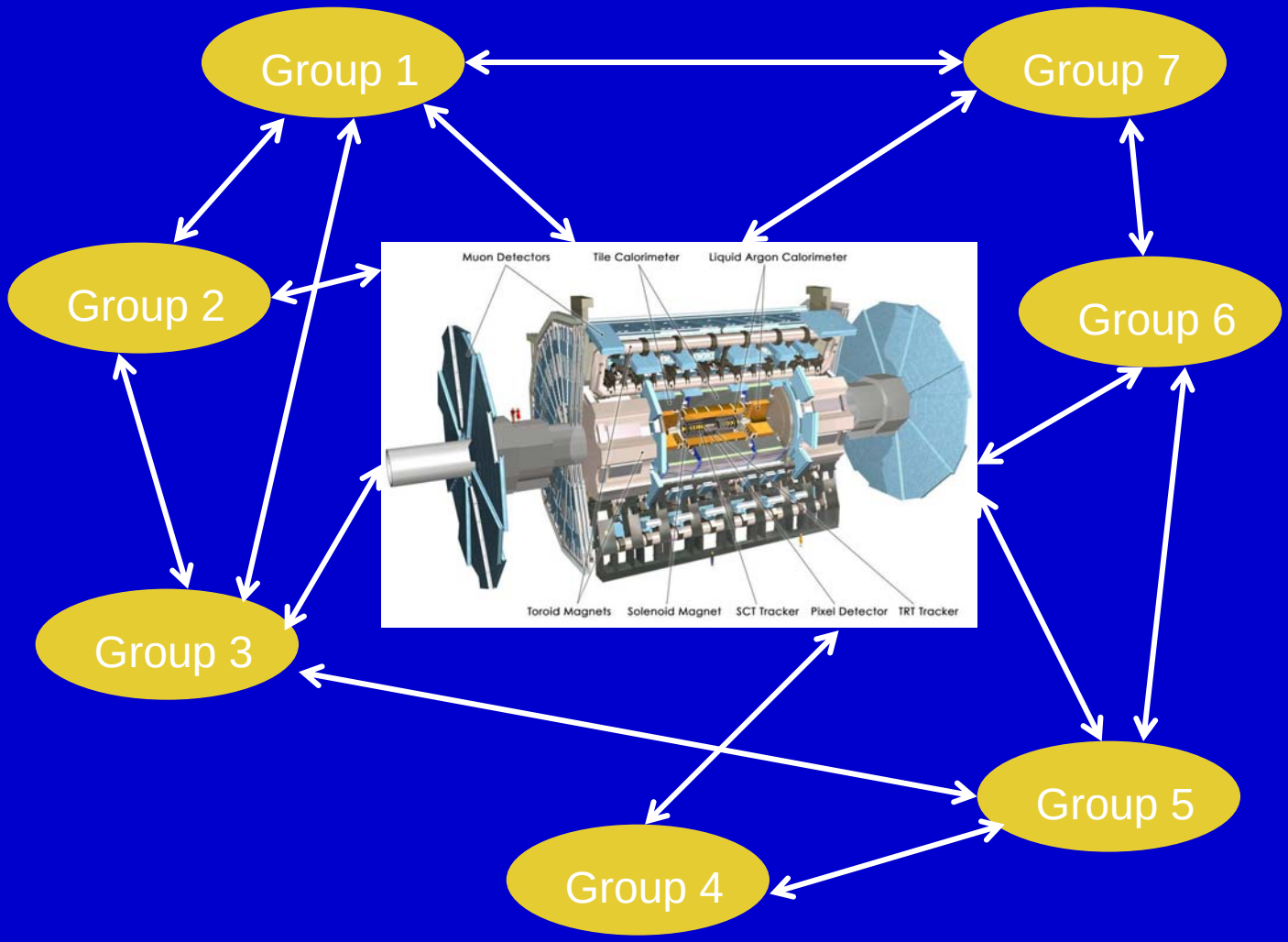
Traffic Lights as Hierarchical Coordination and Control

Hierarchical Control Can Get Complicated!

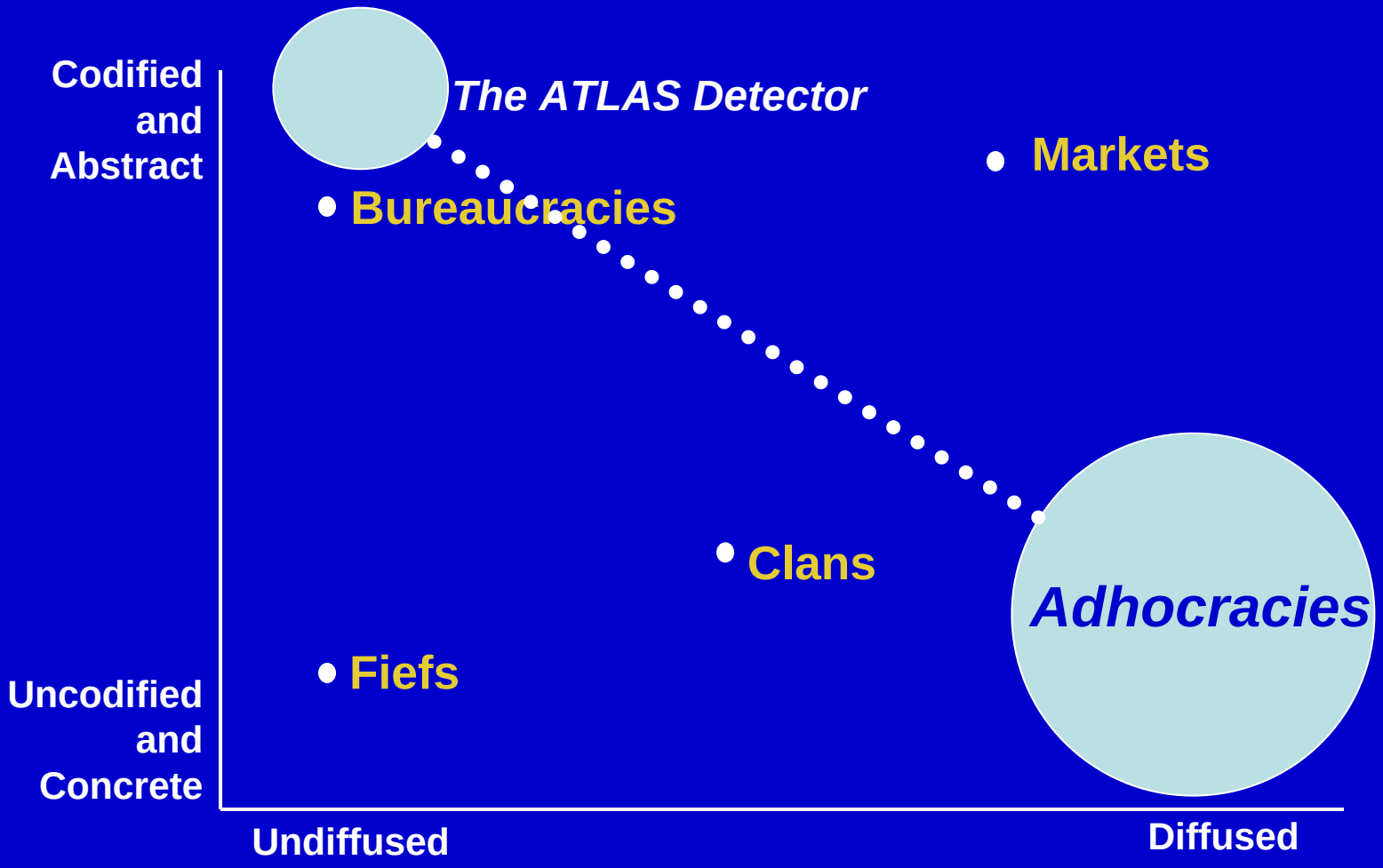


The Traffic Roundabout as a Boundary Object

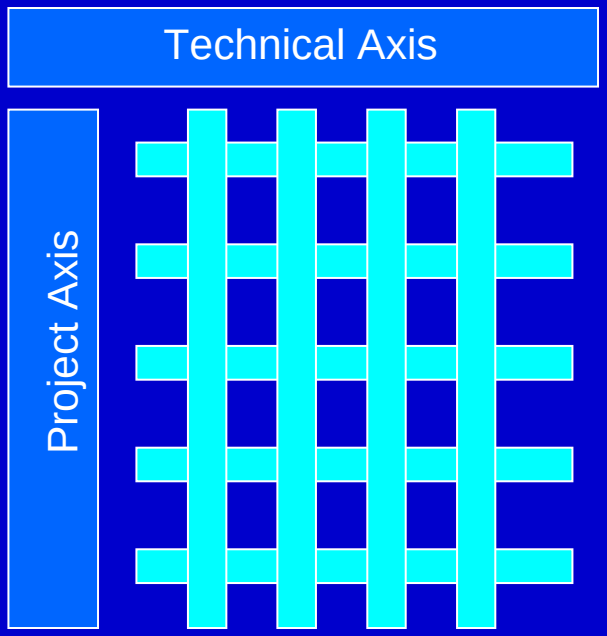
The Detector as a Collection of Boundary Objects?



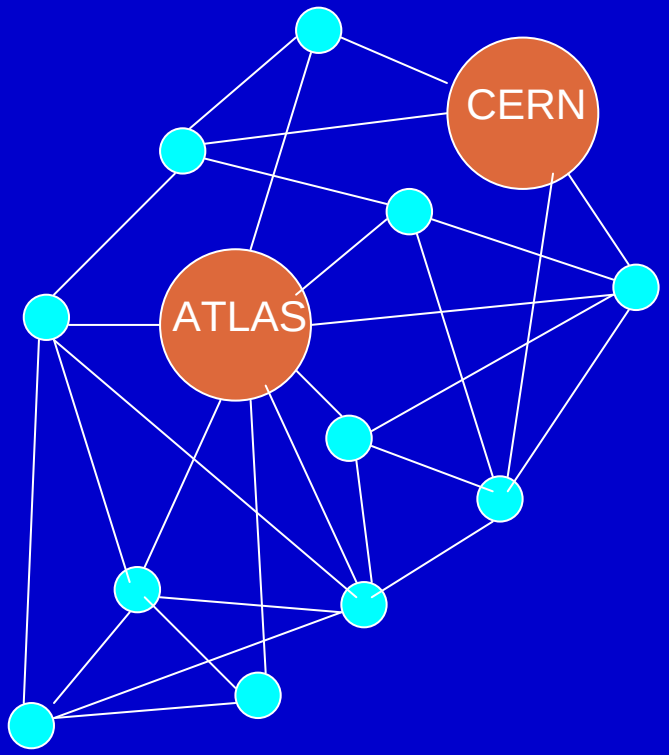
Distributed Networks & Adhocracies: The Role of Boundary Objects



Organization Structures vs Organization Ecologies



The NASA Matrix



The ATLAS/CERN Ecology

Some Hypotheses Concerning ATLAS:

- The ATLAS Collaboration has to navigate multiple *stakeholder* cultures, each operating with different *cognitive* and *affective* conditions.

- The ATLAS challenge is to manage a complex *cultural ecology.*

- The binding agents are *trust* based on *shared values* and shared interactions with a boundary object: *the detector*

Hypothesis:

The Detector thus acts as a *boundary object* that binds the cultural ecology into a *complex adaptive system* (CAS)

Trust, Culture, and Economic Growth

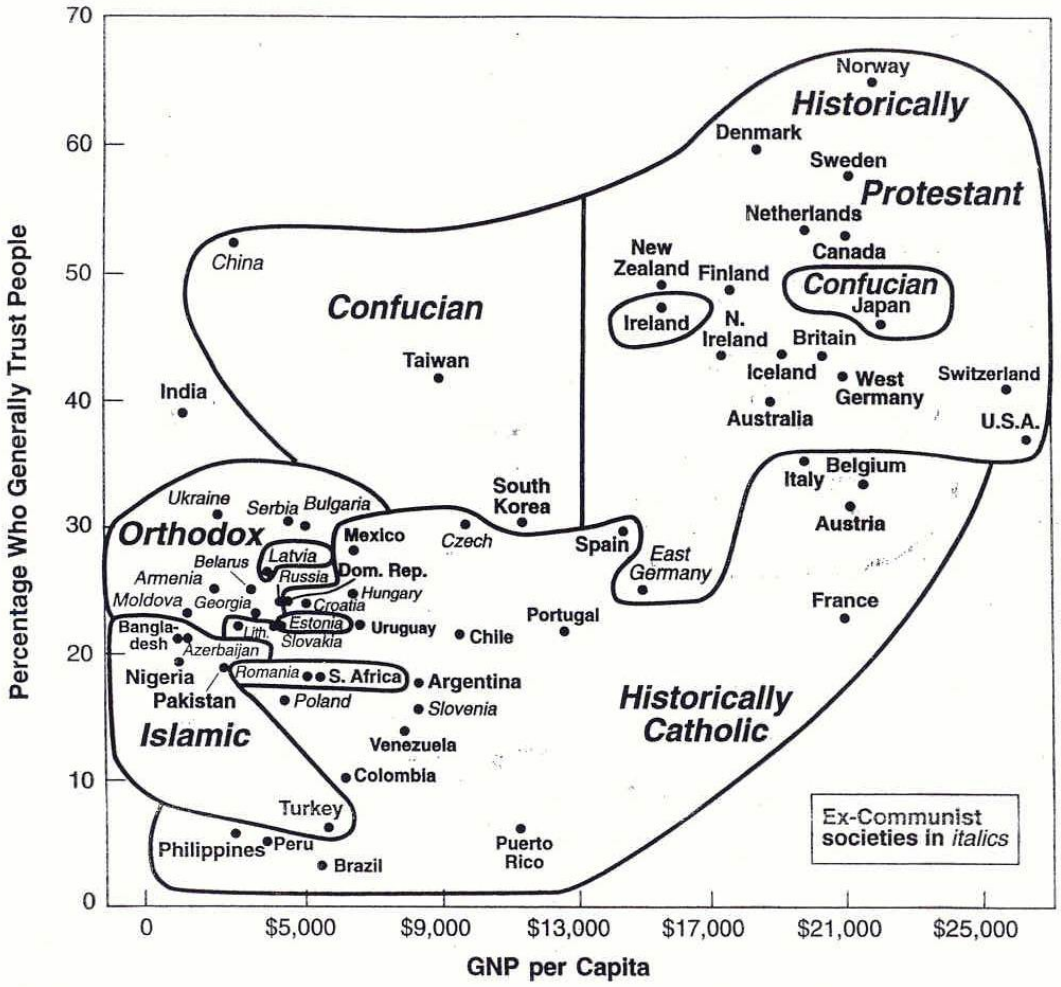


Figure 4. Locations of 65 Societies on Dimensions of Interpersonal Trust and Economic Development, by Cultural/Religious Tradition

Note: GNP per capita is measured by World Bank purchasing power parity estimates in 1995 U.S. dollars. Trust is correlated with GNP per capita at $r = .60$ ($p < .001$).

Source:
Redding (2008)

Some Hypotheses Concerning Glasgow

- The city is a complex adaptive system that sits at the so-called *'edge of chaos'*
- Its physical, social and institutional features act as a collection of *boundary objects*
- The *'Glasgow effect'* suggests that the binding agents of trust, based on shared values and shared interactions with a boundary object, need further developing