Ben Shaw

Stanford Product Design (Engineering + Art)

- Creativity and Problem Solving

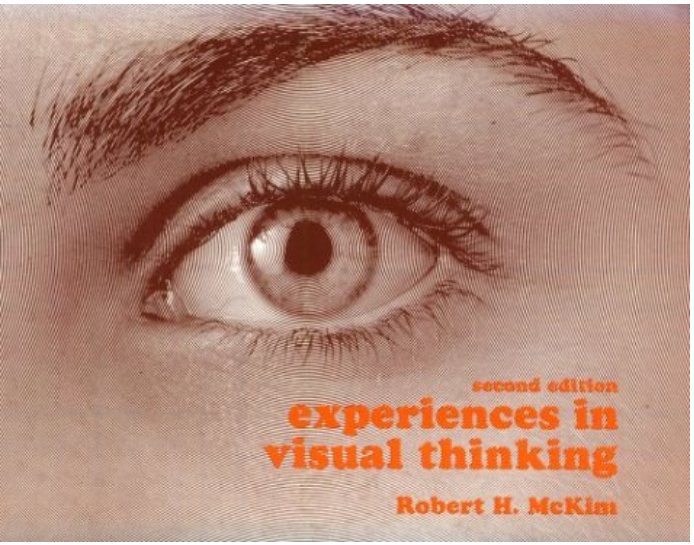
HP (science) and IDEO (collaboration)

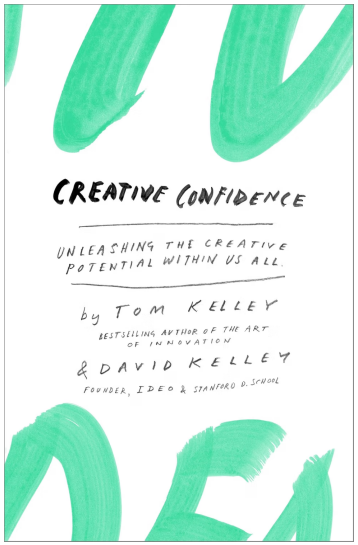
- Engineering Design, Consulting

Research

- MPhil, PhD Royal College of Art, London
- IBM Research (Service Design, Neuromorphic Computing)

Product Design





IDEO

IBM Service (System) Design

By Ben Shaw and Melissa Cefkin

California Governor Goodwin J. Knight receives model of IBM 702 computer from Sacramento Branch Mgr. Ralph Dow, 1957

Design and behaviour in complex B2B service engagements

Complex business-to-business (B2B) technology services challenge us to consider the impact of design on aspects of human behaviour on a number of levels. B2B services often encompass multiple lines of business, involve hundreds of participants and entail months if not years of effort. Effective Service Design brings together the right people at the right time to create opportunities and solve problems that allow each business to focus on what they do best, achieving more by working together than they could have otherwise. We approach the relationship between Service Design and human behaviour in such settings along four interdependent dimensions: affordance, awareness, activity and identity. Design is inherently holistic, and when things go well, all four of these dimensions reinforce one another.

Introduction: service system design

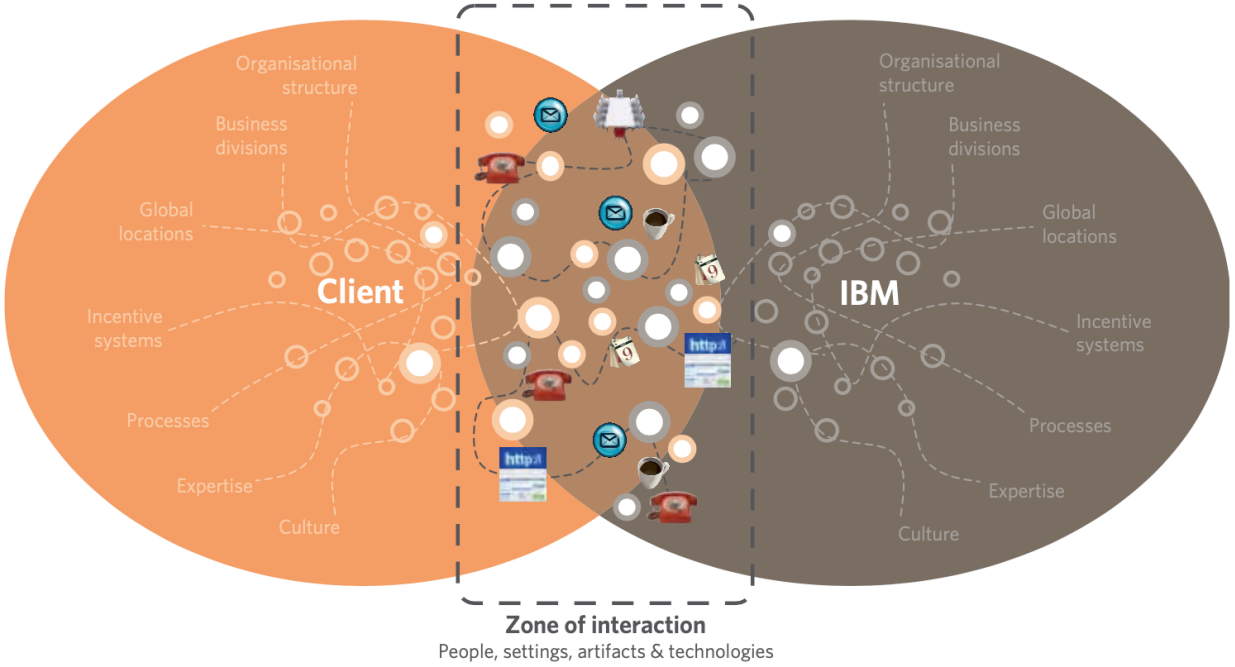
Over the years, IBM's business has migrated from hardware to become increasingly dominated by software and service. Service now accounts for more than 50% of the company's revenue and employs a large proportion of its nearly 400,000 employees worldwide. Offerings include technology outsourcing, business process outsourcing and business consulting services, in a truly global enterprise operating in over 170 countries. Engagements frequently unfold over years and involve a bewildering array of touchpoints between individuals, systems and organizations distributed across time and space. Such complex engagements make a mockery of the notion one could specify in advance every detail of how services should be performed, or exactly what the client might like to see – in essence, a more conventional notion of design.

Ben Shaw
Design researcher and post-doctoral fellow in Service Science and Service System Design at IBM Research – Almaden, San Jose, California, USA

Melissa Cefkin
Workplace ethnographer in Service System Design at IBM Research – Almaden, San Jose, California, USA

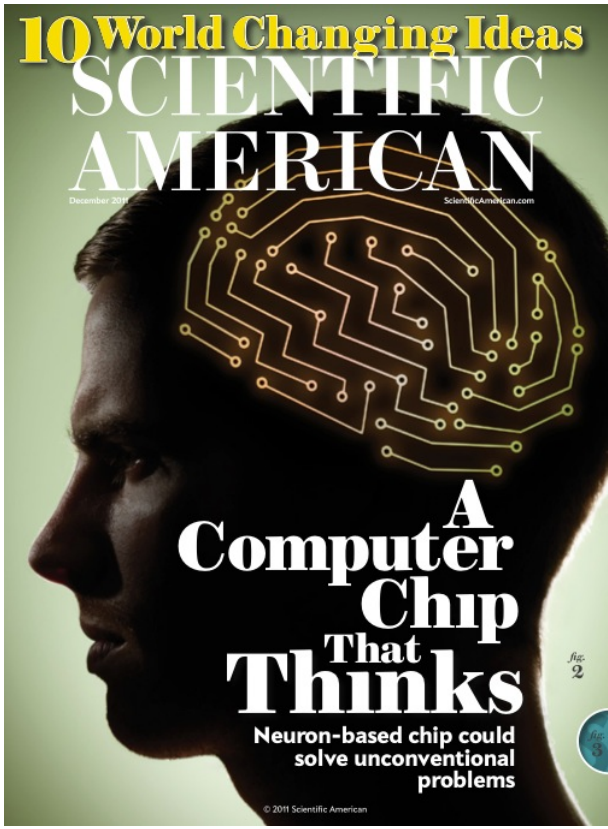
Service Design <> Design for Service

Client Touchpoint Modeling • Component Business Modeling • Global Solutions Pricing and Costing

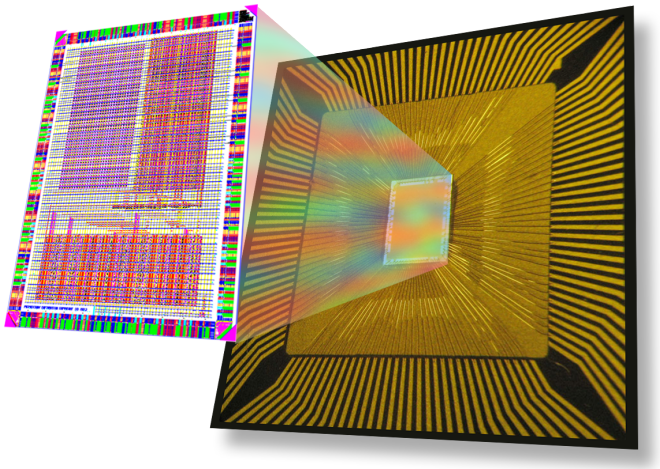


»In effective IT service engagements, IBM and the client's organisation are woven together in a complex manner creating a myriad of touchpoints. This interaction zone is the focus of our touchpoint mapping and modelling activity.«

Neuromorphic (Brain-Inspired) Computing



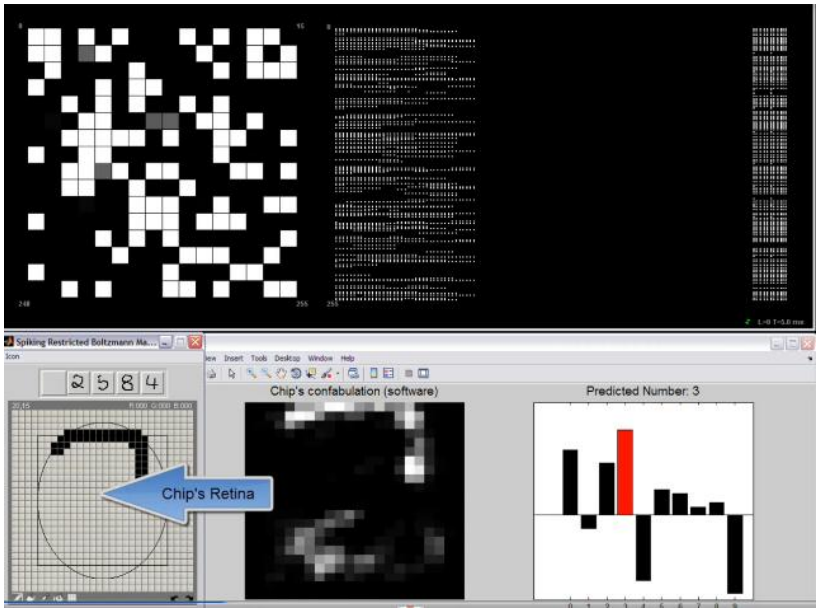
Neurosynaptic Chips

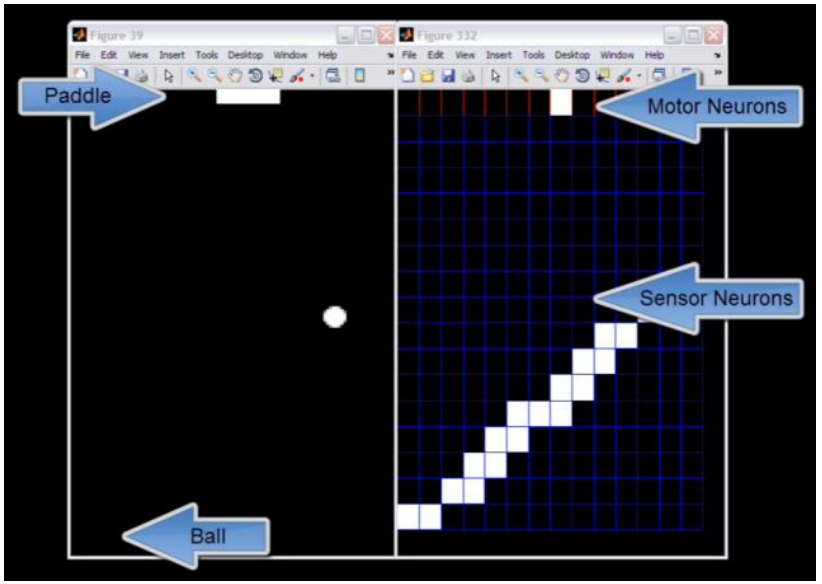


256 Neurons in 45nm CMOS

(Merolla et al. 2011, Arthur et al. 2012)

(about as many neurons as a worm)





Boundary Objects for Commercialization

For a million neuron chip

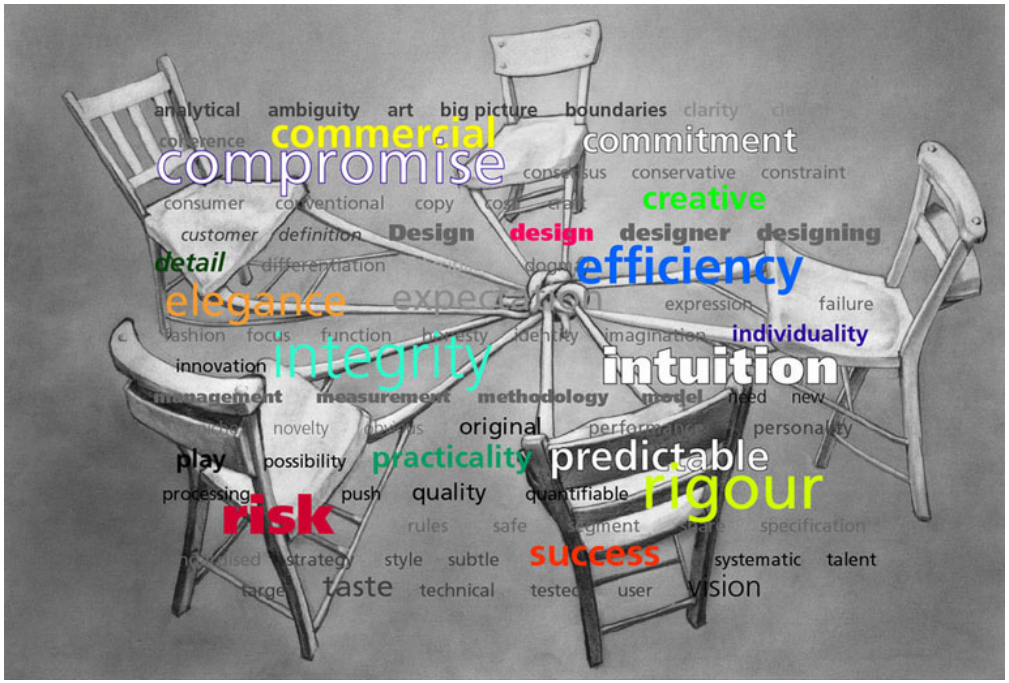
(left-to-right) top: Sensor Leaves, Conversation Flower, Jellyfish, Tumbleweed
middle: Braincube, Build-a-brain
bottom: Vision cubes, Composable Cubes, Blind assistive, Home Health

Abstractions

- *Physical*
  - compact, lightweight
  - low power
- *Information*
  - multi-modal, sub-symbolic, spatio-temporal,
  - low-precision, high-dimensional
- *Architecture*
  - parallel, scalable
  - event-driven, distributed
- *Performance*
  - real-time, robust
- *Programmability*
  - discrete, composable
  - reproducible, reusable

Research: MPhil (Master of Philosophy*)

People sometimes use the same word to mean something different, without necessarily realizing it.



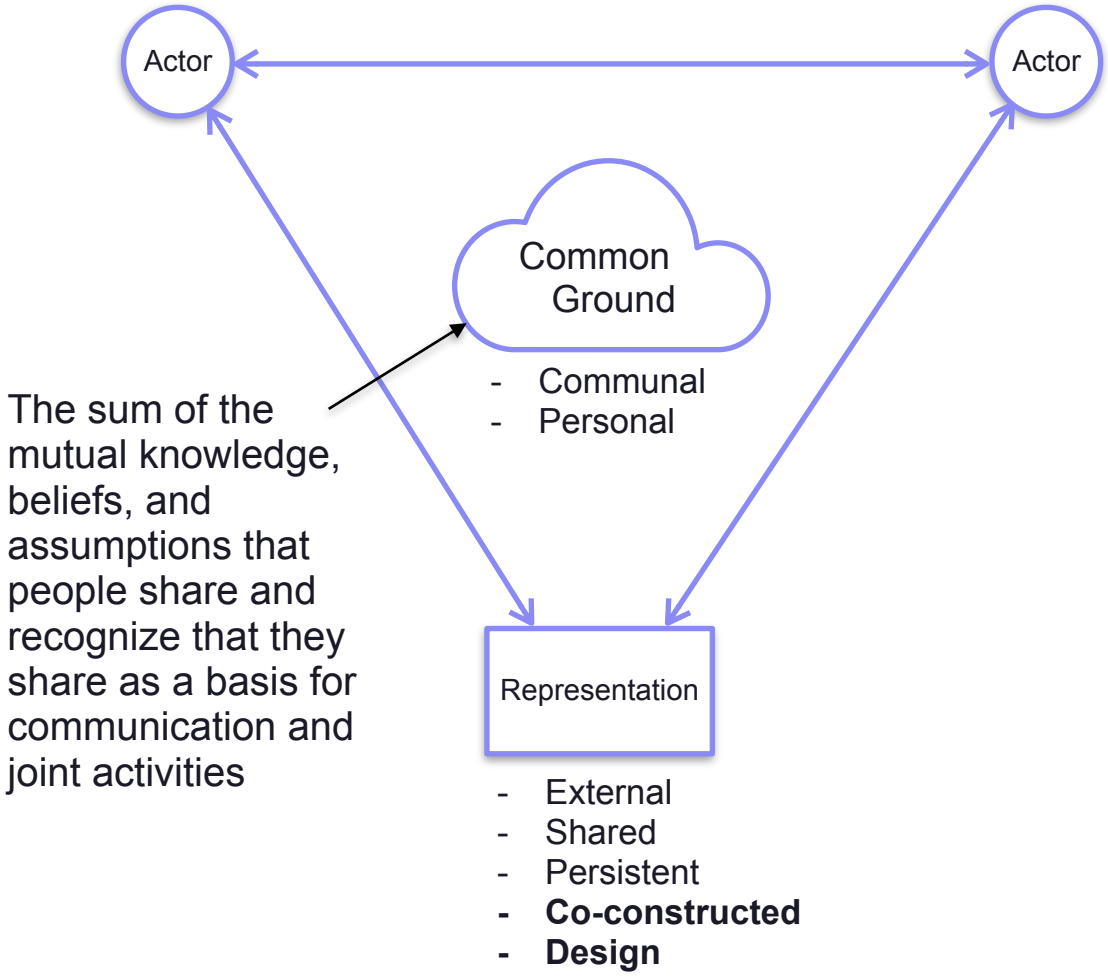
Speaking Different Languages:
Metaphor, Discourse and Disciplinary Conflict in Product Development

PhD

How can shared representations help teams perform better?

More than the Sum of the Parts:
Shared Representations in Collaborative Design Interaction

Communication Model (Triadic)



- Conversation is a joint project, generally with a **purpose**; participants seek to make their contributions **relevant**
- Participants manage their common ground to ensure it is **adequate for the purposes at hand** and **engage in repair** when they believe that may not be the case
- Mental models are not directly observable, but **you *can* observe participants' acts to manage their common ground**

Connections in Design Conversation

Common understanding of problem or opportunity

Relevance of proposals (in general, to problematic situation)

Specifics of proposals (with respect to objectives, constraints, criteria)

Building on one another's ideas

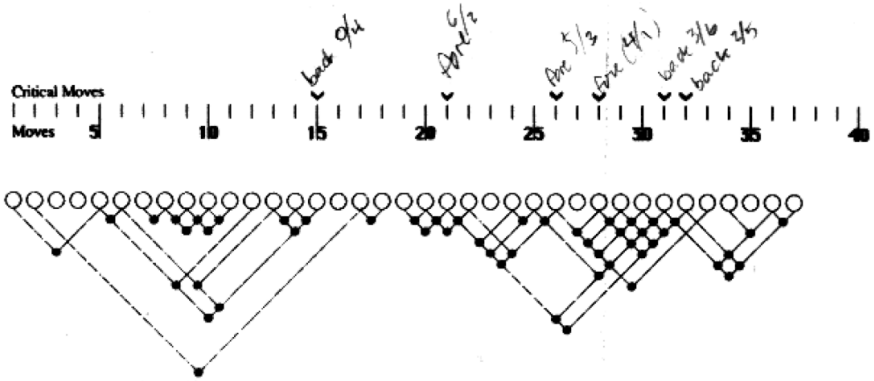
Challenging ideas' validity or effectiveness; resolving disagreements

Consensus on courses of action

“Connectedness” in Design Conversation

Structural vs. categorical coding

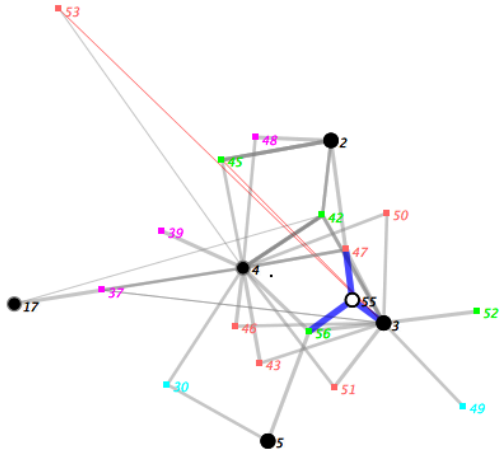
- Connections between ideas (vs. types of ideas)
- Goldschmidt: linkography



Linkograph example. (Goldschmidt, 1992)

Speech acts

- Grice: cooperative principle [implication]
- Clark: joint projects
- Layers, levels & tracks [observability]



Actor-discourse network. (Shaw, 2007)

Rocket Science

Shared Representations in a High-Performance Design Environment

Ben Shaw • IBM Research • Royal College of Art, London

Jet Propulsion Laboratory:
a history of “extreme collaboration”

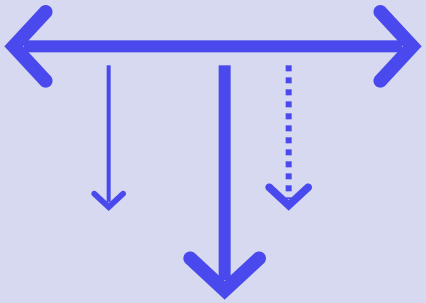
Early days, 1936

Explorer 1, 1958

Team-X (Mark, 2002)

JPL Team Collaboration

Expertise



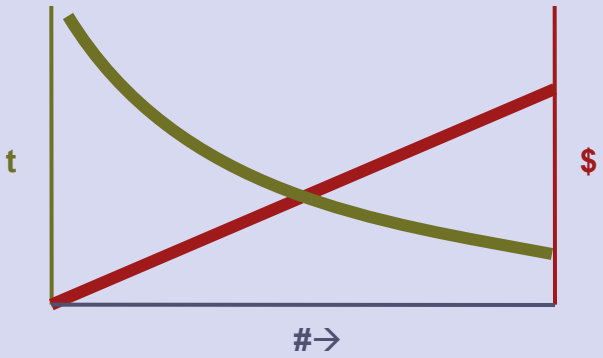
breadth vs. depth

communities of expertise

cross-disciplinary team work

efficiency vs. innovation

Team size



completion vs. burn rate

up-front planning & coordination

dependencies & parallelism

investment

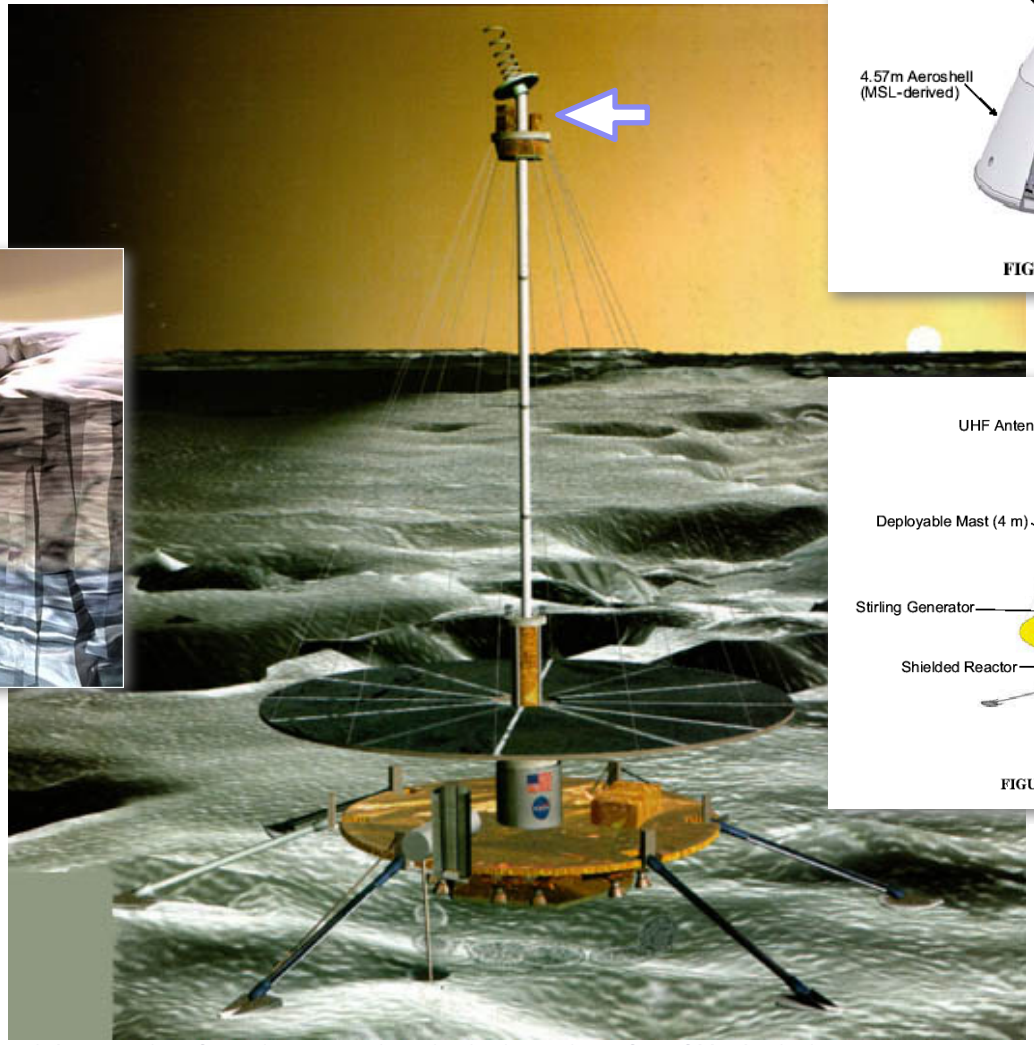
Ensemble performance

awareness and concentration

bringing as much of the work in-sessions as possible

constructive appropriation & collaborative emergence

Designing a cryobot lander



artist's conception of a nuclear-powered cryobot lander on the surface of Mars' polar ice cap

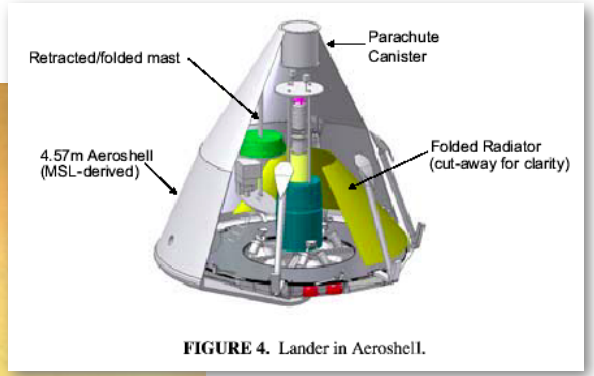


FIGURE 4. Lander in Aeroshell.

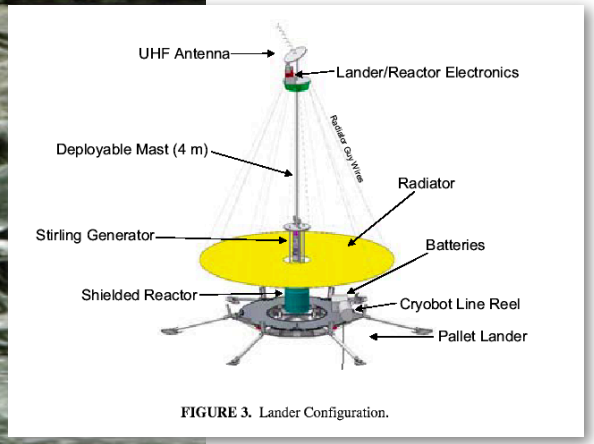


FIGURE 3. Lander Configuration.

Reconstruct Mars' climate history going back millions of years!

Find evidence of life?

But you need kilowatts of power ...

Radiator size?

Sensitive electronics & shielding mass?

Launch windows and landing site selection?

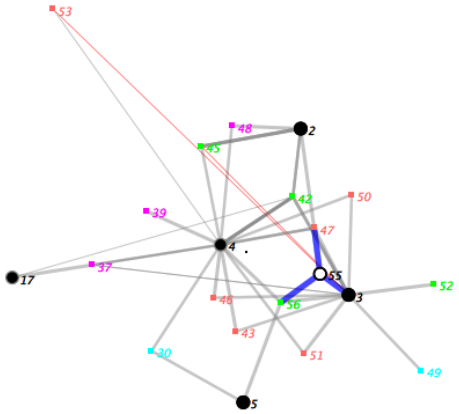
Telecommunications?

20 years ago:

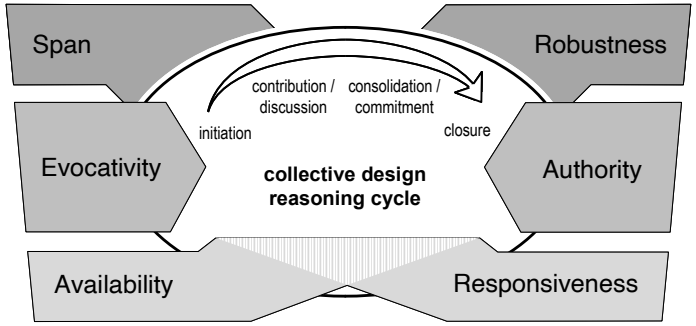
Representations as actors on par with human participants

kind of radical

Network Formalization



Representational support



Actor-Discourse Networks

Actors

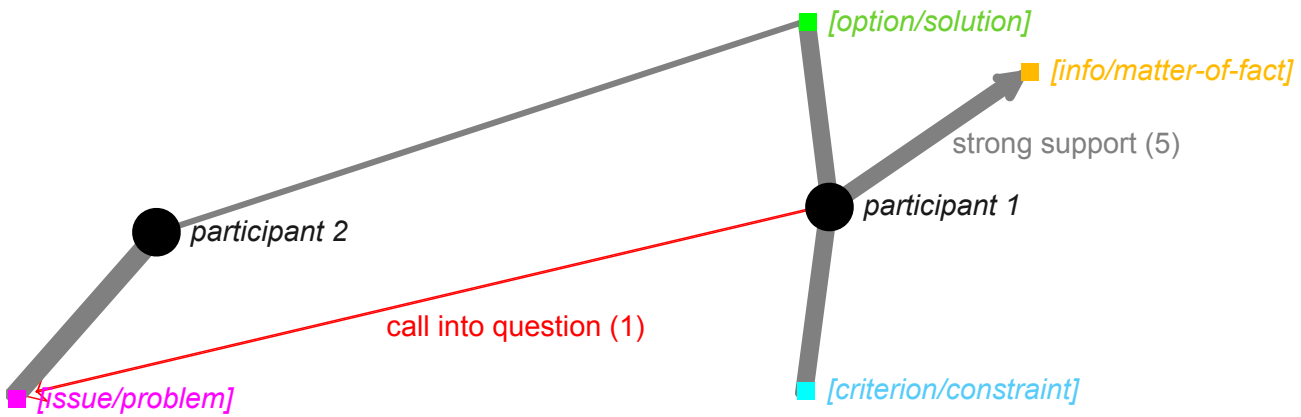
- human participants
- representations

Discourse

- issues, options, criteria
- information/matters-of-fact
- image/schema

Arcs

- alignment: degree of expressed support or commitment
- "spatial metaphor" for network distance: Proximity = Affinity



Levels of Analysis

Micro analysis

- Selection of episodes
- Iterative coding scheme development (modeling)
- Conventional network metrics to understand interactional productivity

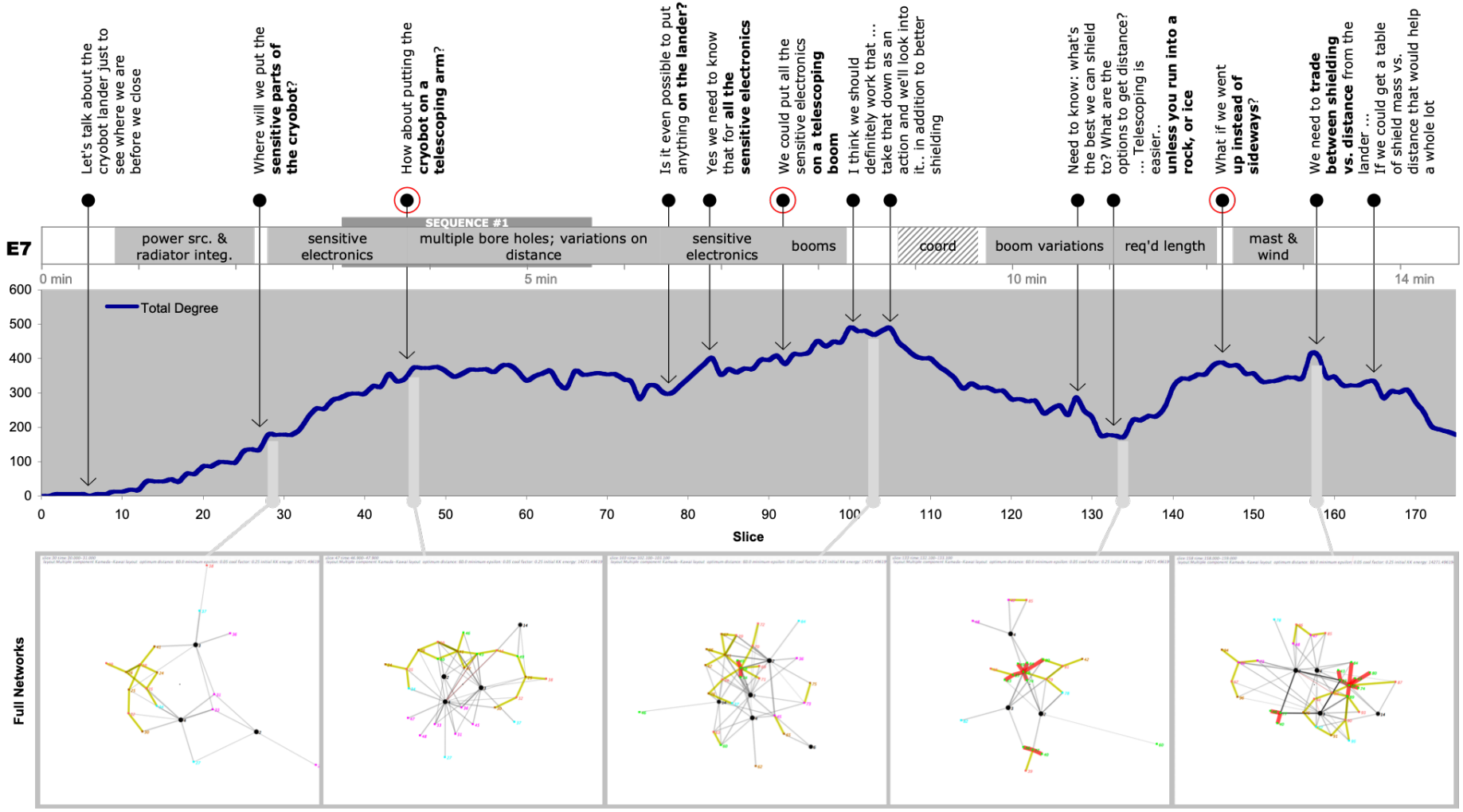
Overall alignment (total degree centrality)

Mutual engagement (flow betweenness centrality)

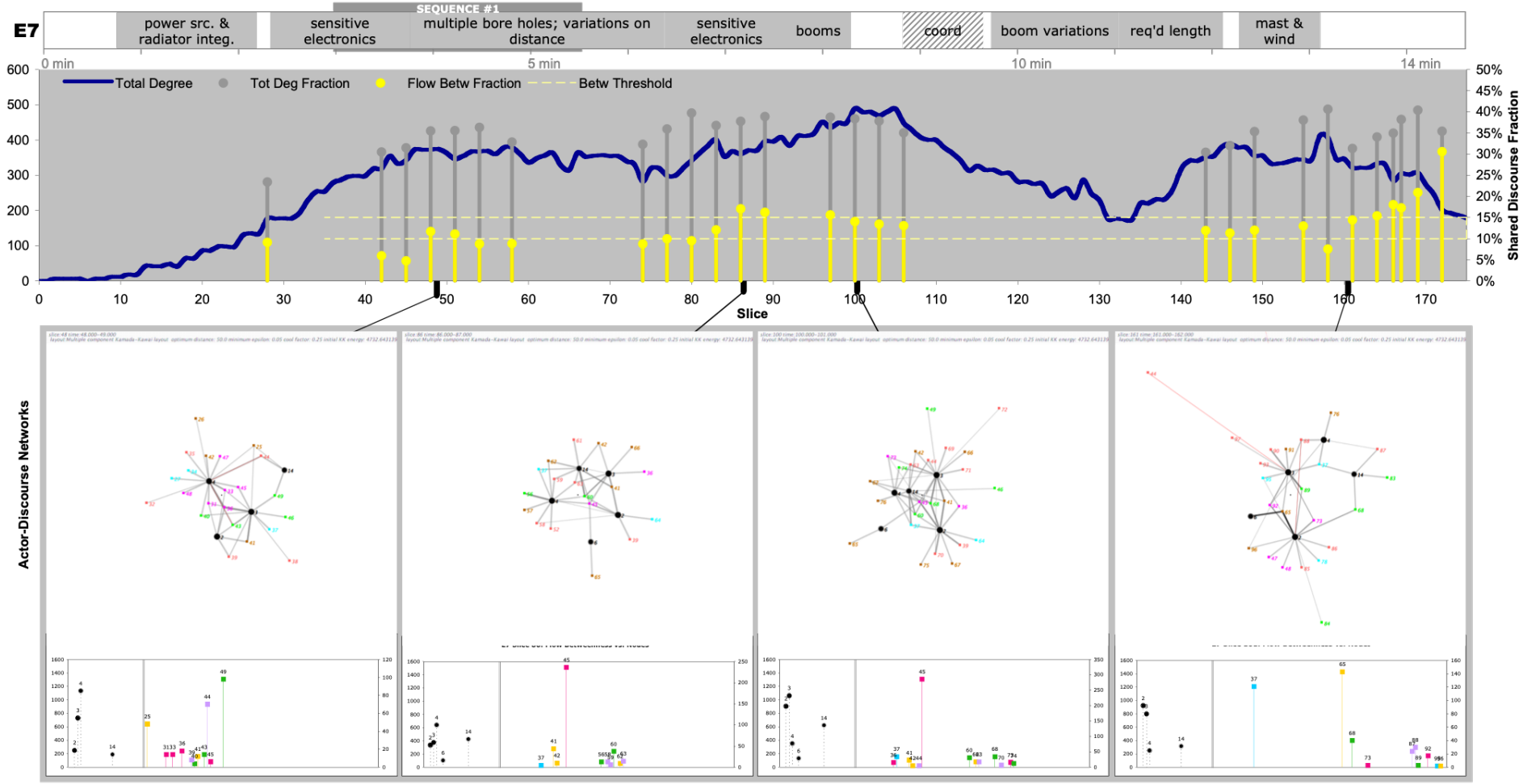
Macro analysis

- Threads of recurring design issues across episodes
- Roles of representations across threads and longer periods of time

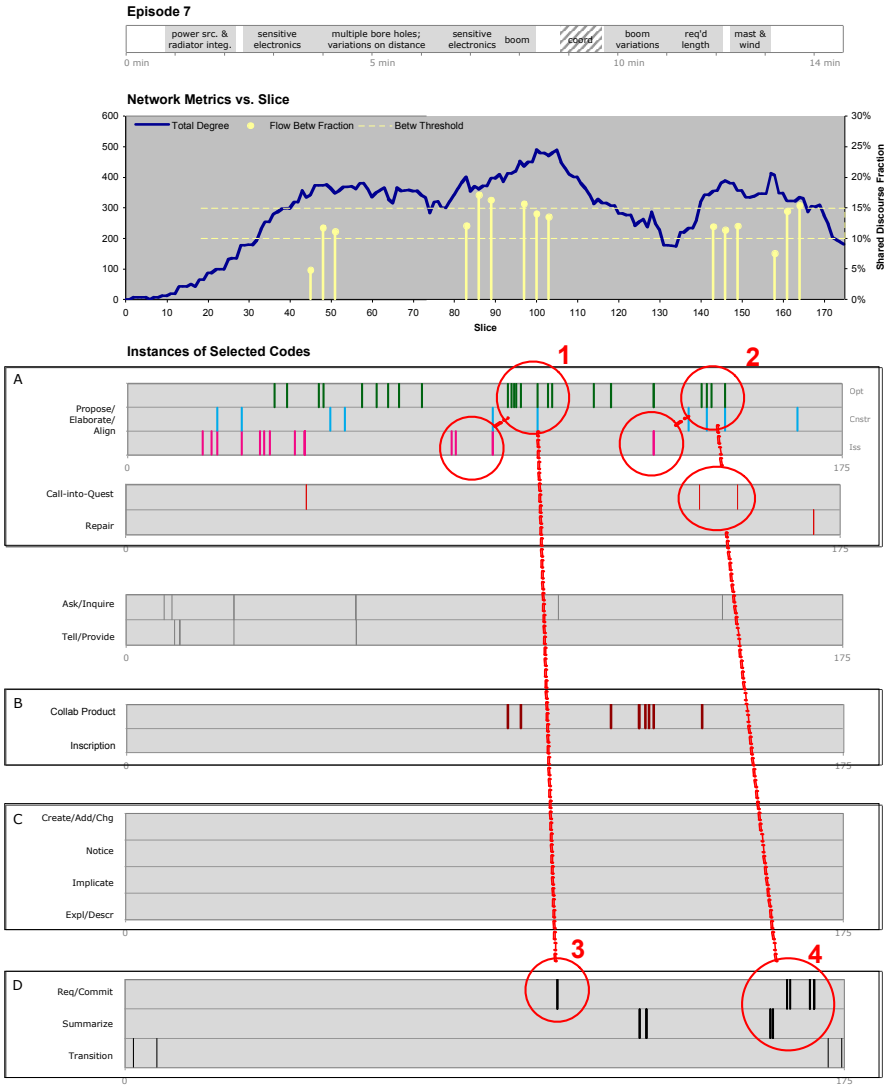
Overall alignment: total degree

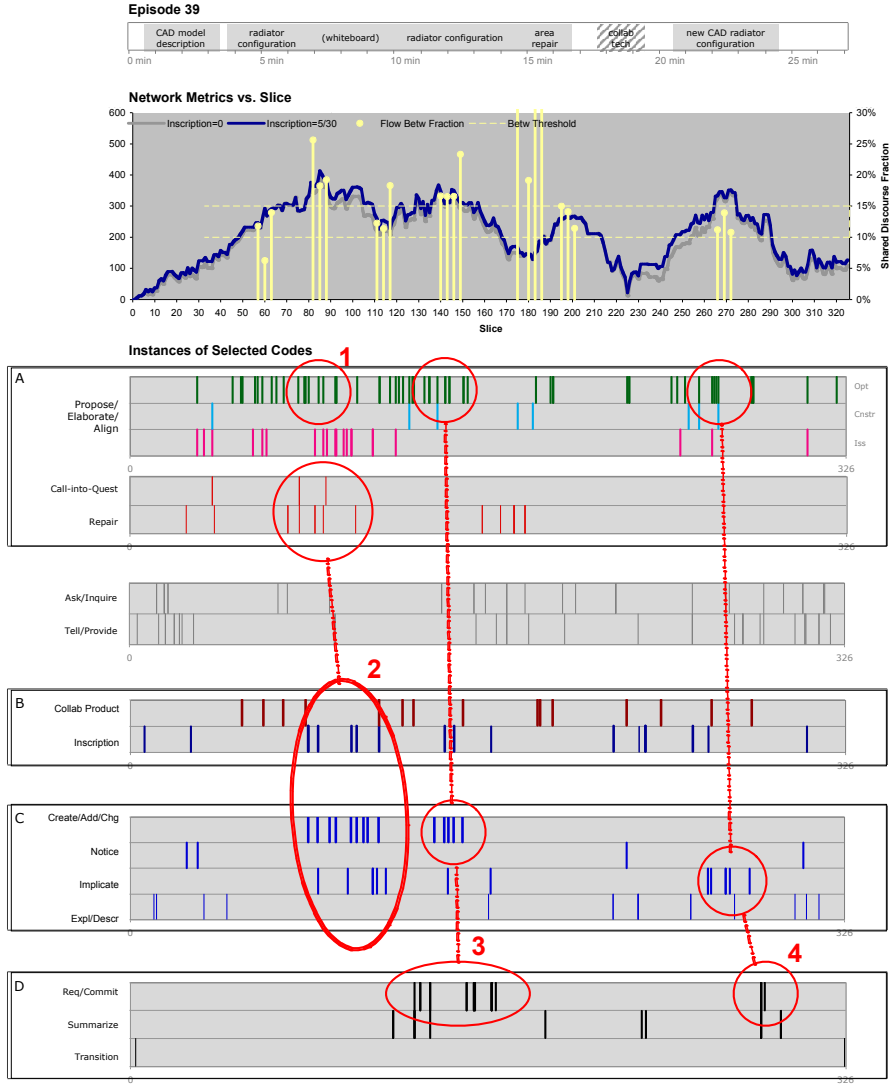


Mutual engagement: discourse betweenness

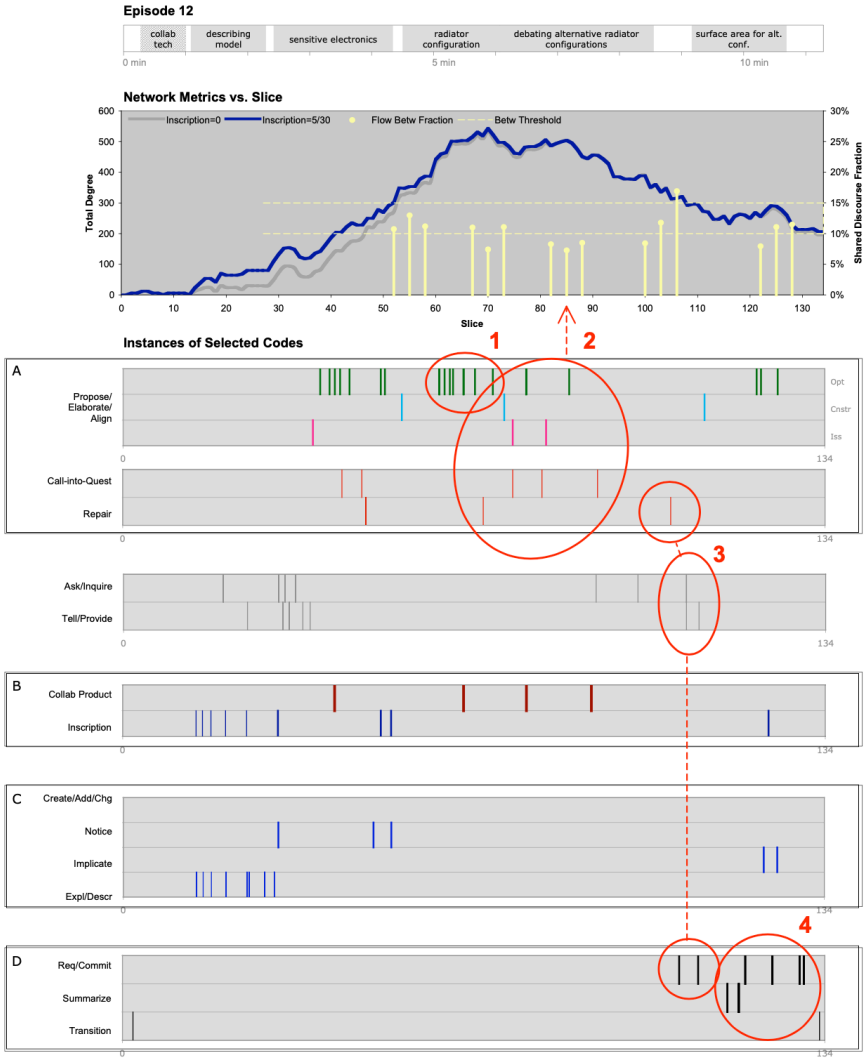


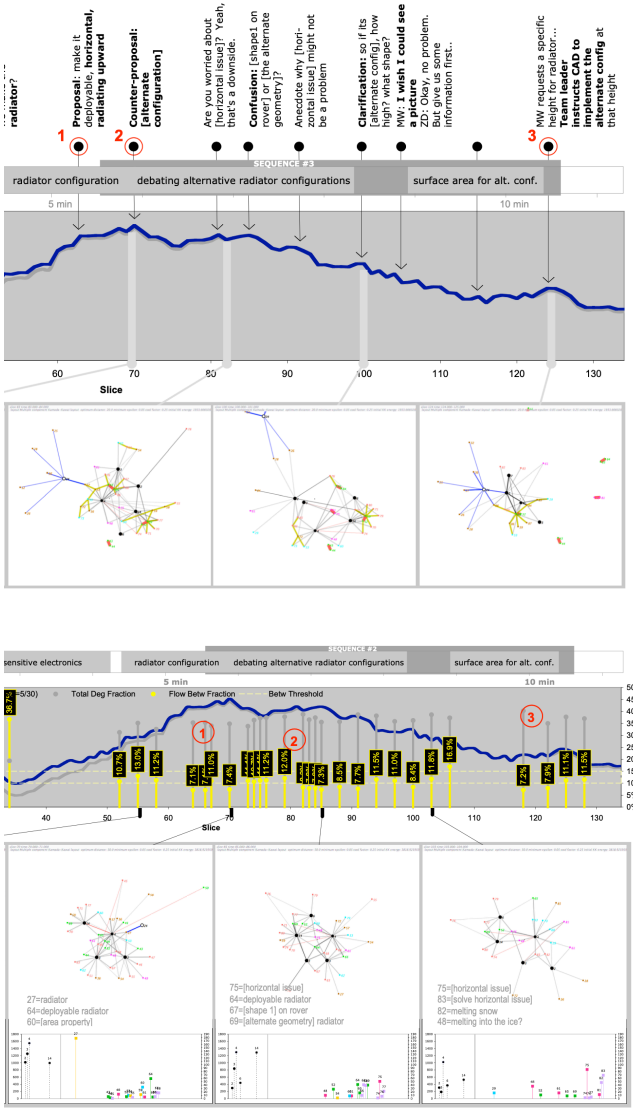
Collective design reasoning cycle





Positively triangulated episodes all exhibited an essential cycle of design reasoning. This was revealed through a combination of network structure and categorical composition of coding. Once initiated, these cycles involved more intense design discourse that culminated in closure (marked by meta-process acts) with enhanced specificity in the design and/or specific commitment to follow-on work

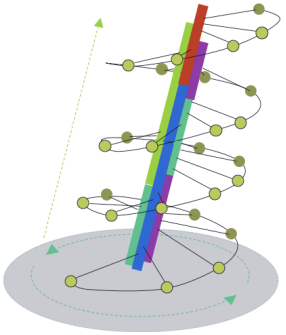

Episode 12
collab tech
describing model
sensitive electronics
radiator configuration
debating alternative radiator configurations
surface area for alt. conf.
0 min
5 min
10 min
Network Metrics vs. Slice
Inscription=0
Inscription=5/30
Flow Betw Fraction
Betw Threshold
Total Degree
Shared Discourse Fraction
Slice
Instances of Selected Codes
A
Propose/ Elaborate/ Align
Opt
Cnstr
Iss
Call-into-Quest
Repair
Ask/Inquire
Tell/Provide
B
Collab Product
Inscription
C
Create/Add/Chg
Notice
Implicate
Expl/Descr
D
Req/Commit
Summarize
Transition
1
2
3
4

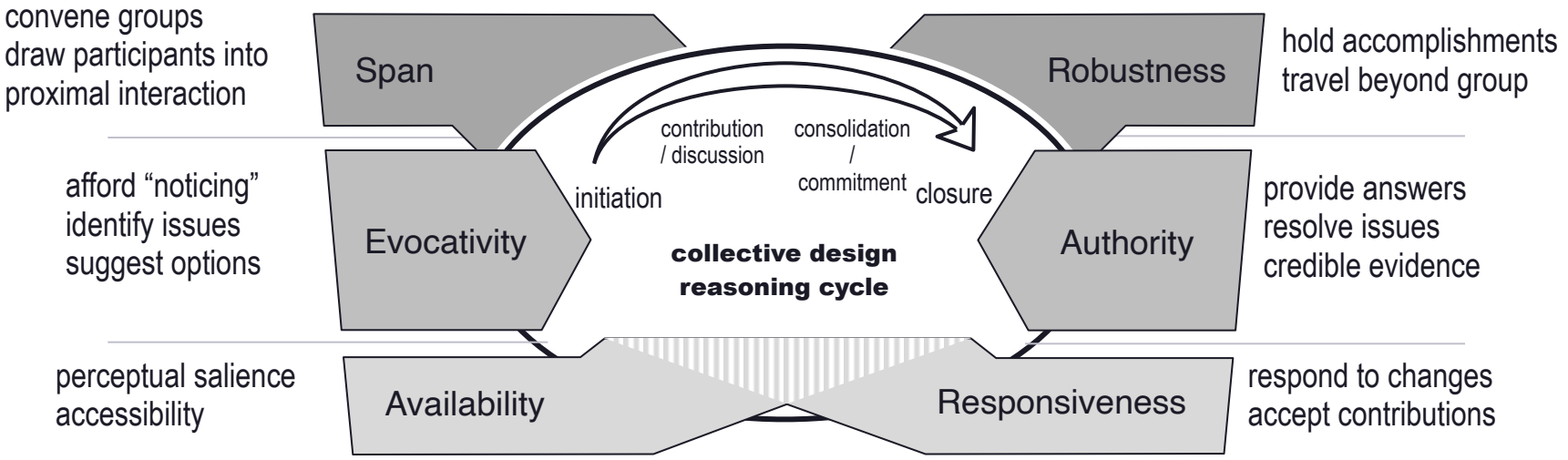

Proposal: make it deployable horizontal, radiating upward
Counter-proposal: [alternate configuration]
Are you worried about [horizontal issue]? Yeah, that's a downside.
Confusion: [shape1 on rover] or [the alternate geometry]?
Anecdote why [horizontal issue] might not be a problem
Clarification: so if its [alternate config], how high? what shape?
MW: I wish I could see a picture
Chris: no problem. But gives some information first..
MW requests a specific height for radiator...
Team sketches
instructs CAD to implement the alternate config at that height
radiator configuration
debating alternative radiator configurations
surface area for alt. conf.
5 min
10 min
Slice
sensitive electronics
Total Deg Fraction
Flow Betw Fraction
Betw Threshold
27=radiator
64=deployable radiator
60=[area property]
75=[horizontal issue]
64=deployable radiator
67=[shape 1] on rover
69=[alternate geometry] radiator
75=[horizontal issue]
83=[solve horizontal issue]
82=melting snow
48=melting into the ice?

Roles of shared representations

What	*How*
Resolve ambiguity	Provide shared reference
Gather, convene groups; make interactions proximal	
Initiate topics, manage returns	Afford “noticing”
Draw questions	
Suggest alternatives	
Provide a locus for expression	Accept contributions
Respond to changes	
Provide answers	Foster decisions
Stabilize consensus	
Preserve accomplishments	Carry inscription
Travel beyond the bounds of the group	

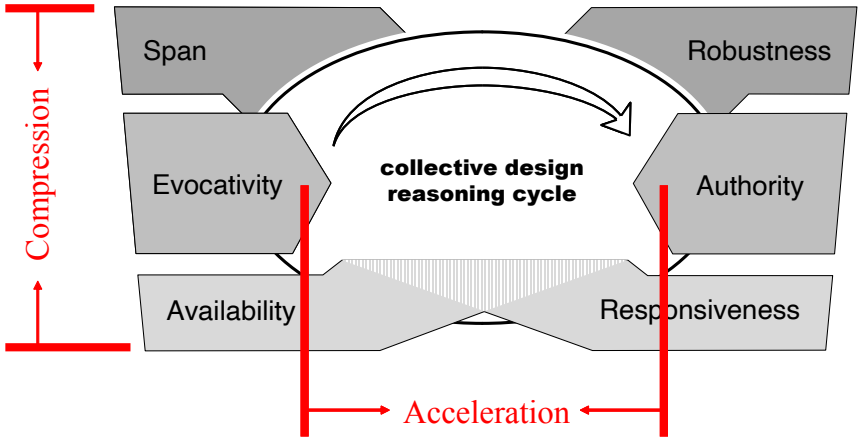
Attributes of representational support



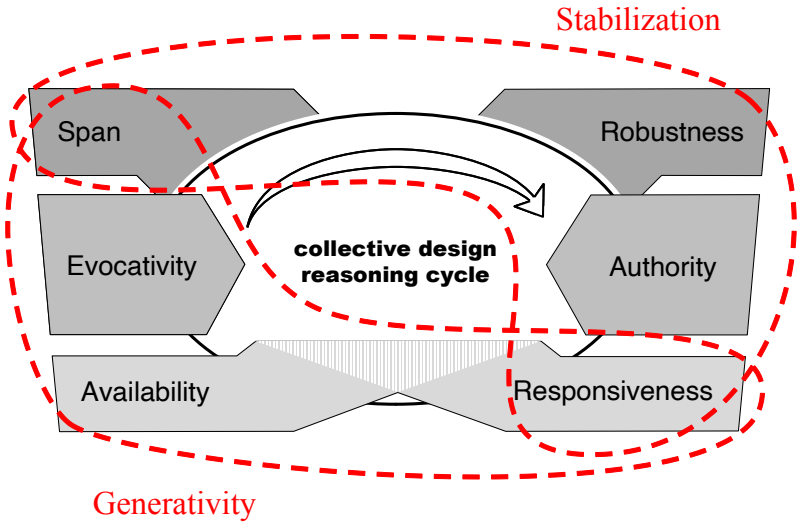


Representational dynamics in real-time design

- **acceleration**: reducing time from initiation to closure of design reasoning cycle
- **compression**: putting more comprehensive or mature-stage representational tools in situations of greater availability and responsiveness



- **stabilization**: ground conversation, anchor collective decisions, propagate features of practice
- **generativity**: provide affordances for perceptual/cognitive and collaborative emergence



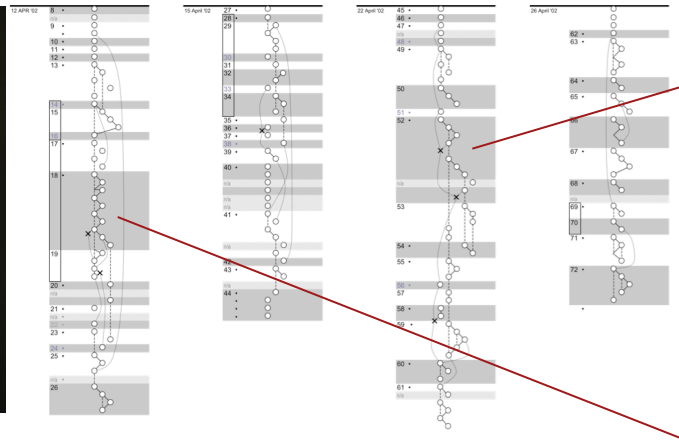
***All this parsing was necessary because the analysis was so **excruciatingly** labor-intensive!*

Transitions & topic shifts

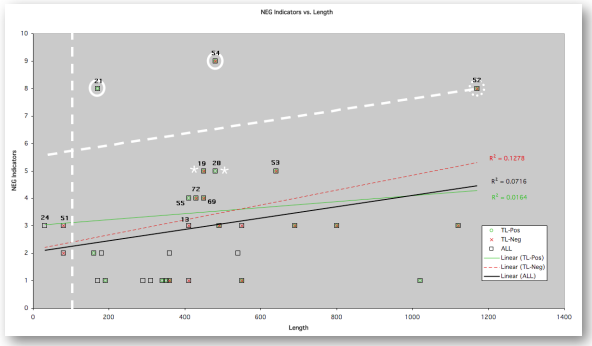
Process ⟷ Content

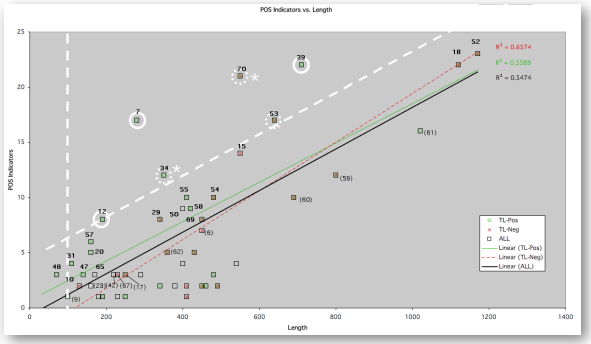
Episode parsing & selection

[in preparation for micro-analysis]



episode	transition	topic shift	turns	initiator
51	•	check-in	80	ZD
52	•	next	1178	ZD, EN
		organic		
		organic		
		return		
		waiting / resume		
		organic		
		organic		
n/a		coordination		
		resume		
53		resume / waiting	700	ZD
		organic		
		directly related		
		check-in		
		directly related		
54	•	resume	480	ZD, LE
		forced / return		EN
55	•	resume	411	ZD
		organic		
		return		
56	•	next / resume	80	ZD
57		check-in	160	ZD
		directly related		
58	•	next	430	ZD





Selection on basis of positive and negative indicators

episode	transition	topic shift	turns	initiator
		organic		
		organic		
16		return	75	ZD
17	•	next	123	ZD
		waiting		
		resume		
		triggered, waiting		
18	•	resume	1118	ZD
		organic		
		return, organic		
		return		
		organic		
		return		
		organic		
		return		
		organic		
		organic		
19		resume, organic	480	ZD
		return		
		directly related		
		directly related		
20	•	next / resume	160	ZD
n/a		collab tech		
		resume		
21	•	next	170	LE
n/a		coordination		

Rip Van Winkle moment:

Augmented Collaboration

Real-time analysis and feedback on productivity of conversation

- Development of design discourse
- Coherence, convergence, closure

Identification of strongly shared and bridging concepts

- Topics of alignment
- Feedback on mutual engagement

Sharpening and resolution of disagreements

- Clarification of alternatives
- Weighing of evidence

Technological Actors

What is the role of human creativity in interaction with generative technologies?

How to preserve human agency?

How should we frame the role(s) of technological actors?


Ben Shaw
ben.shaw@mindspring.com
Backup Slides >