

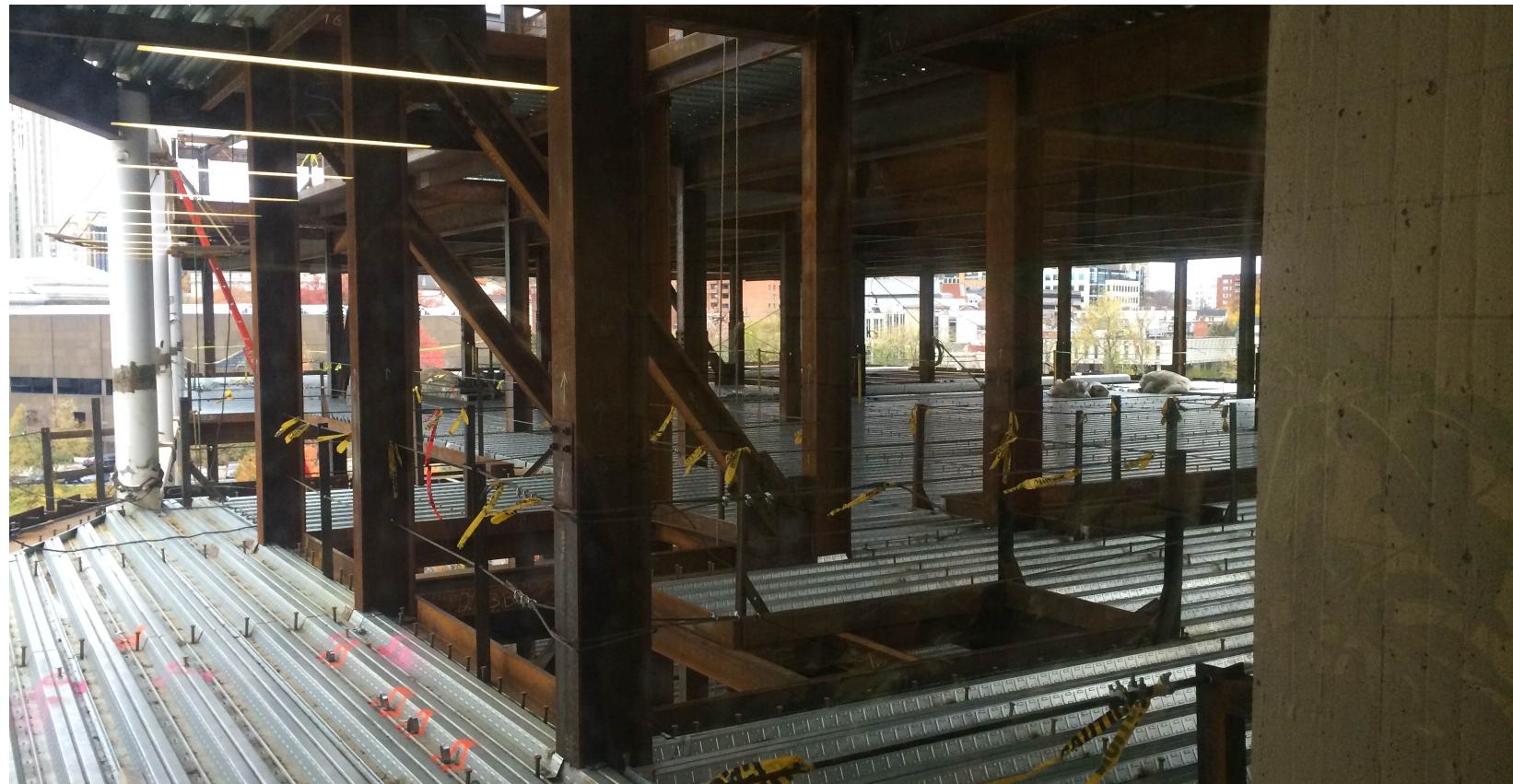


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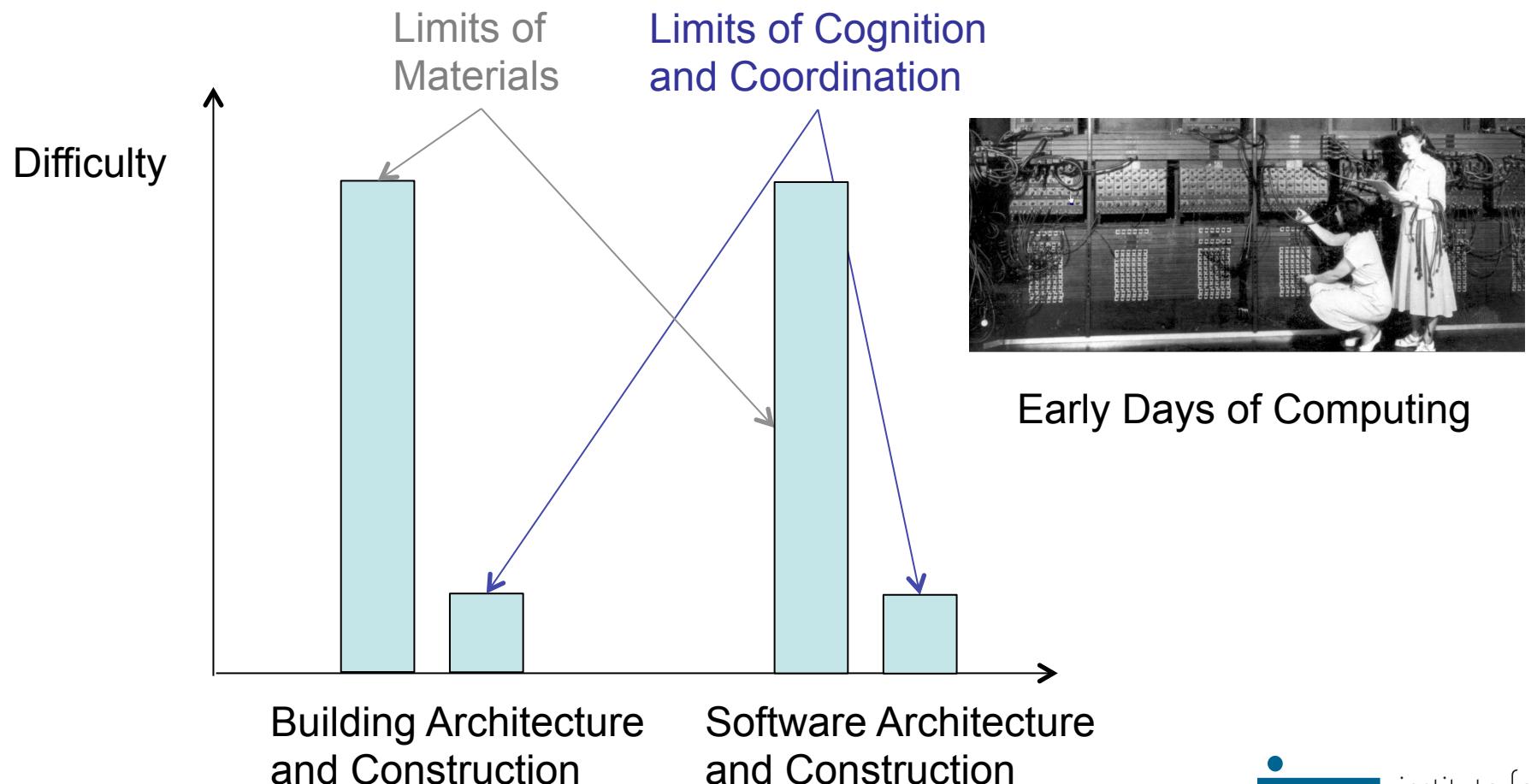
# Theories of Context

James Herbsleb

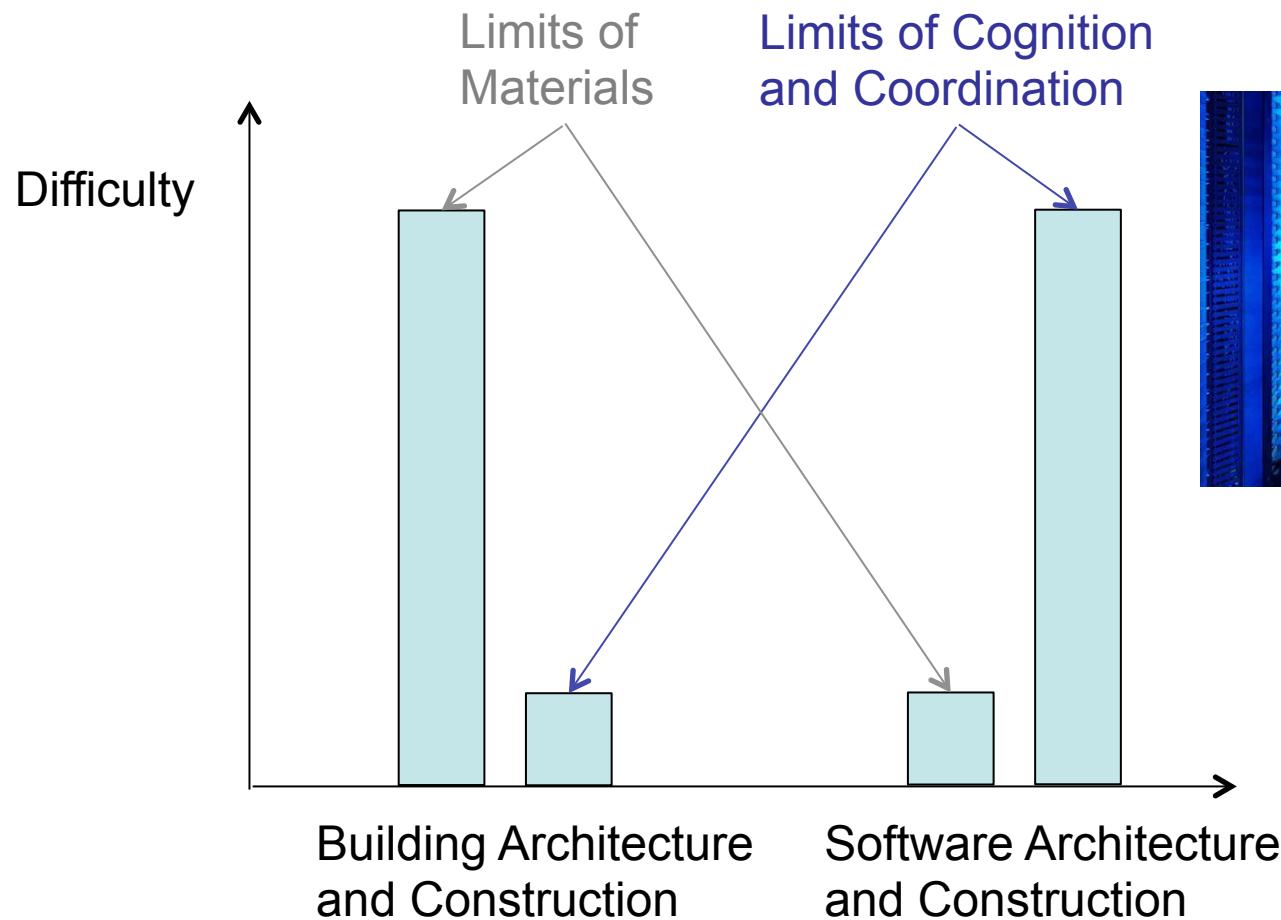
[jdh@cs.cmu.edu](mailto:jdh@cs.cmu.edu)



# Problem Frontier

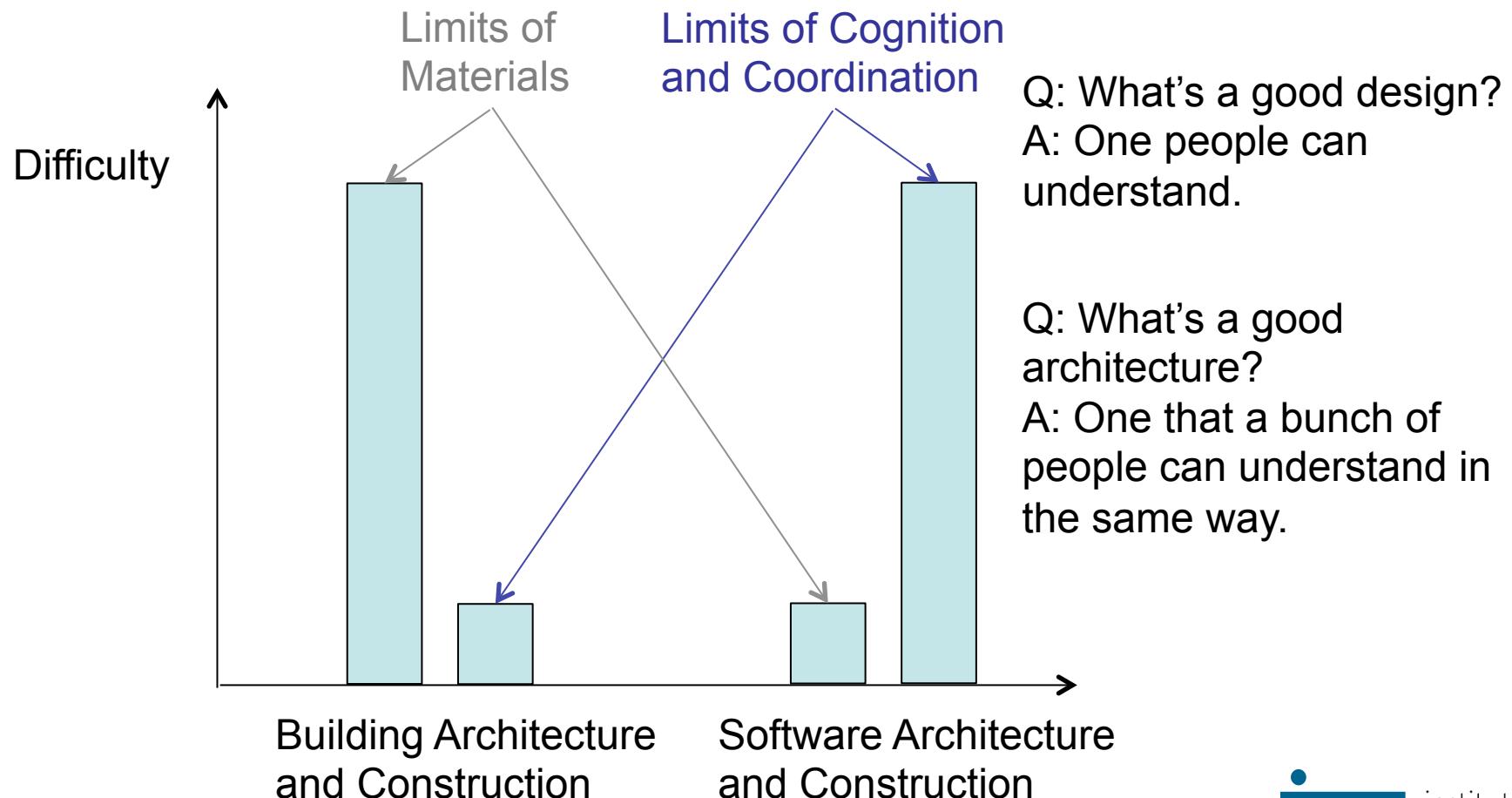


# Problem Frontier Now

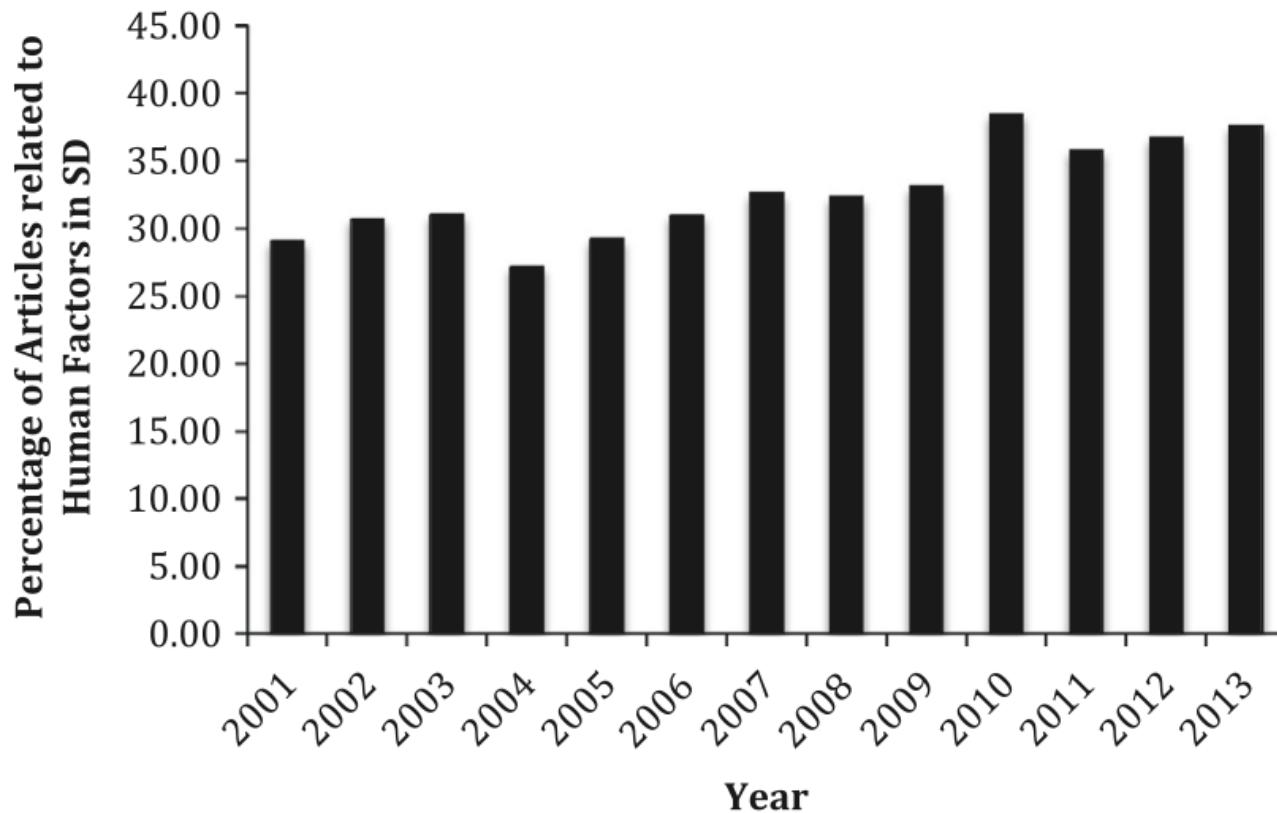


Computing Today

# Problem Frontier Now



# Increasing Attention to Human Factors



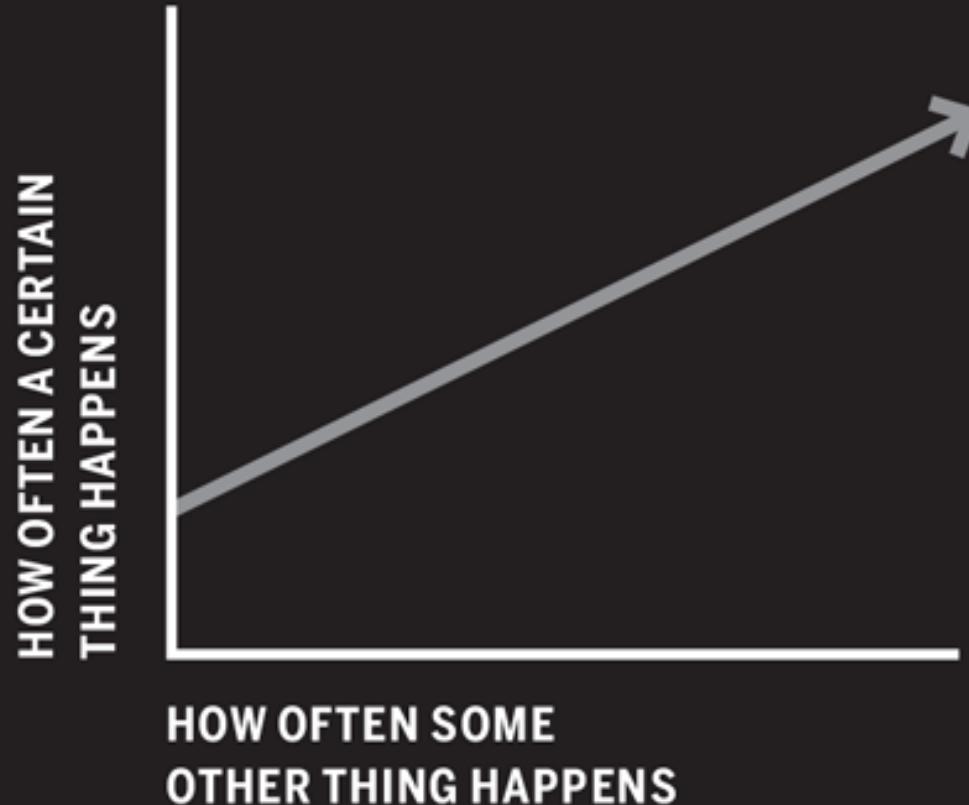
**Jim**

Likes to mix things up, put them on alcohol flame  
See if they catch fire or (YES!) explode  
Knows nothing, cares nothing about chemistry



**LDA  
SVD  
SVM  
Etc.**

**There's not much chemistry going on here!**



This may be very useful. This is not science.



# Medical Research Analogy

- Bleeding common medical practice
- Late 18th century
- Francois Joseph Victor Broussais
  - Promoted bleeding of “affected organ”
- Pierre-Charles-Alexandre Louis
  - Actual data collection about outcomes
  - Bleeding is not such a great idea
- Clinical trial is important, is not enough!
  - Nature of disease processes
- Empiricism in software engineering: “clinical trial”
- How do we progress better than trial and error?

# Takeaways, Part 1

- Theories must take account of the primary constraints
  - Cognition, communication, organizations
- Data mining, machine learning, prediction models don't further our understanding of the phenomenon
- Clinical trials – seeing if a given technique works – does not build understanding
- What we really need:
  - Theories spanning human behavior (from individual to community) and software
  - Empirical tests of hypotheses derived from theories

# Context: Three Promising Theories

- Transparency
- Signaling
- Collective intelligence

# Transparency and Signaling

- Transparency
  - “accurate observability, of an organization’s low-level activities, routines, behaviors, output, and performance”\*
- + Politics, finance, government, workplace
- + Performing in front of an audience
- + Accountability, coordination
- May hurt creativity and streamlining
- Information overload

# GitHub: Transparency

- Open source hosting environment
- 8 million users, 16 million repositories
- Social media functionality
- Transparency

# Example: Information Overload

The Ruby Programming Language <http://www.ruby-lang.org/>

37,555 commits    34 branches    290 releases    36 contributors

branch: `trunk` / +

\* common.mk: Specify dependencies for generated C sources. `...`

akr authored 8 hours ago    latest commit `2a87fdedb7`

Commit	Message	Time Ago
benchmark	benchmark/bm_hash_aref_sym*.rb: force static symbols	a month ago
bin	erb: multiline anchors	a month ago
bootstraptest	normalize reference to Timeout::Error	a month ago
ccan	ccan/container_of: add container_of_or_null	2 months ago
coverage	fix a typo [ci skip]	2 months ago
cygwin	* cygwin/GNUmakefile.in (uncommon.mk): link *.res.o.	2 years ago
defs	id.def: attrset	2 days ago
doc	* ext/dl/*: remove DL as it is replaced by Fiddle.	15 days ago
enc	Mark auogenerated part.	13 hours ago
ext	* internal.h: Include ruby.h and ruby/encoding.h to be	12 hours ago

Code

Pull Requests (73)

Pulse

Graphs

HTTPS clone URL  
<https://github.com/ruby/ruby>

You can clone with **HTTPS** or **Subversion**.

Clone in Desktop

Download ZIP



Contributors

Commits

Code frequency

Punch card

Network

Members

Nov 21, 2004 – Nov 15, 2014

Contributions: **Commits** ▾

Contributions to master, excluding merge commits



dhh

3,414 commits / 202,650 ++ / 102,798 --

#1



jeremy

3,163 commits / 132,694 ++ / 110,179 --

#2



Contributors

Commits

Code frequency

Punch card

Network

Members

Additions and Deletions per week

150k

100k

50k

0

50k

100k

17



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JonAbrams / synth ★ Star 952 Fork 70

Contributors Commits Code frequency Punch card Network Members

Owners Sep Oct Nov

20 25 26 27 29 13 20 22 24 26 29 10 3

JonAbrams

etanlubeck

ky0615

DanDeMicco

kumagi

rzmz

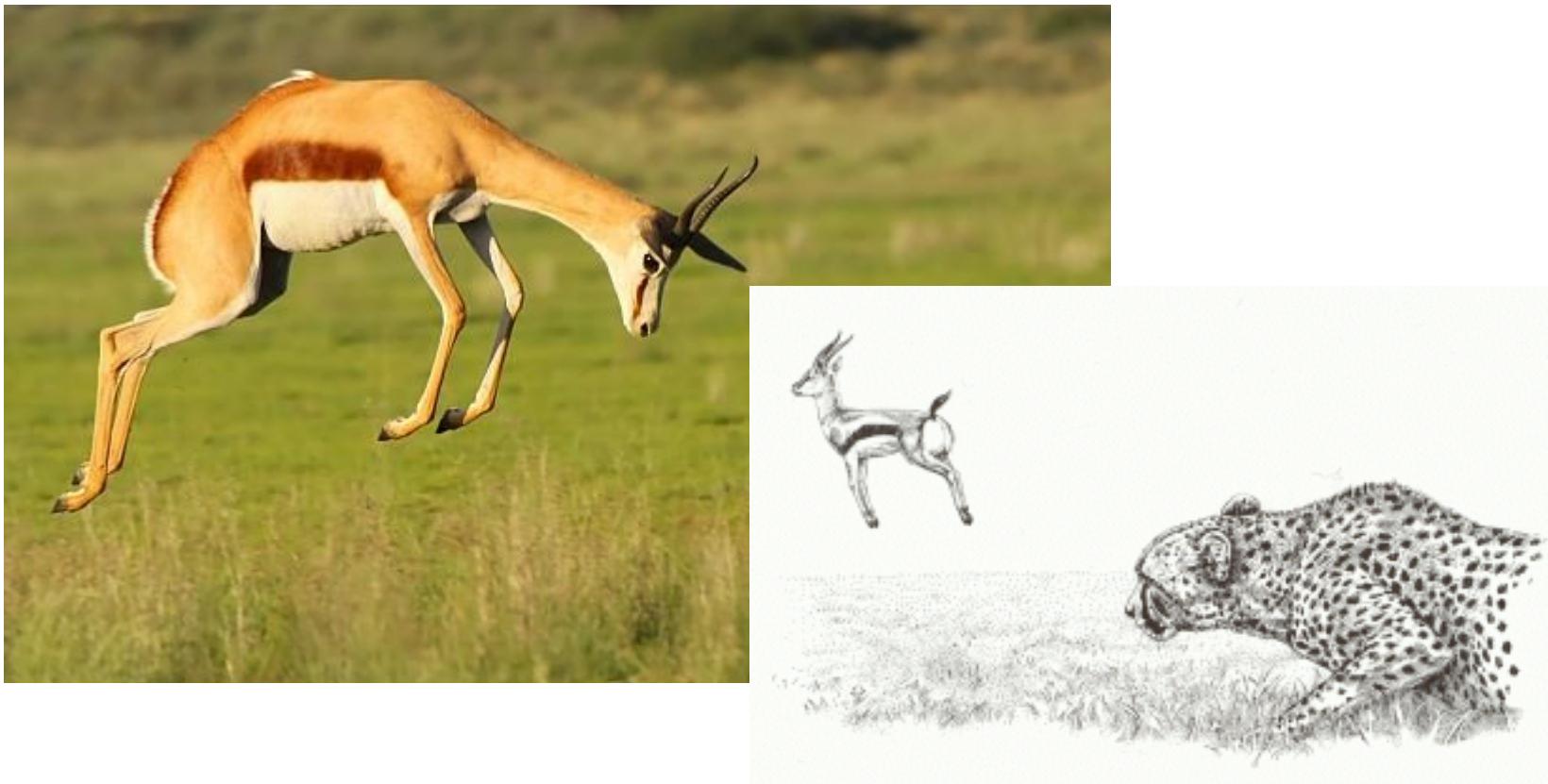
stevemanuel

18

# Transparency and Signaling

- Signals
  - Original idea from evolutionary biology
  - Visible clues that imply hidden quality
  - Types of signals
    - Assessment: visible clue cannot be produced without hidden quality
    - Conventional: meaning is agreed upon, will continue to exist only if enforced by norms

# Stotting as Honest Signal



# Avoid Colorful Snakes



a) Eastern coral snake (poisonous)

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# Avoid Colorful Snakes



a) Eastern coral snake (poisonous)

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(b) Scarlet king snake (nonpoisonous)

# Conventional Signals



James D. Herbsleb

**Professor, Institute for Software Research  
School of Computer Science  
Carnegie Mellon University**

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## Jim Herbsleb's Home Page

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Software is in everything. Software shapes the digital environment, which in turn shapes how we find information, conduct commerce, share and socialize, do our work, and amuse ourselves.

Our old ways of designing software for a specific known purpose are no longer adequate.

### Rather than ask

How can I specify, design, and build the system that my stakeholders need?

### Maybe we should ask

How can I set up the socio-technical ecosystem that will allow users, developers, businesses, and everyone else to cooperate and compete to build what everyone needs?

Even though those needs are currently unknowable and evolving . . .

These are the kinds of questions that drive my research group. (See my [research page](#).) We are funded by the National Science

# Conventional Signals – Trustworthy?





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#### Fake CV? Chances are your company will catch you out

Mishita Mehra, ET Bureau Jan 8, 2012, 02.27AM IST

**Tags:** Sunday ET | Steve Jobs | resume | Fake CV | CV | company

Did you say deception? It is not even a lie, not in the lowly, how-can-you-do-this sort of way. Call it an exaggeration, if you must - the stretched truth that boosts your resume. So what if you forget the 'assistant' in your designation and just write manager or add a few thousands to your current pay. Or extend a job tenure to cover three months of vegetating before the TV - even Steve Jobs needed his psychedelic breaks, didn't he?

RELATED ARTICLES

Check on job applicants gets deeper as hiring activity goes...  
November 28, 2009

 Submit



# GitHub Signals

- Hiring, evaluating people
- Deciding what to pay attention to
- Deciding what to use
- Deciding where to contribute
- Deciding what contributions to accept

# Early Results

Task	Inference Type	Inference	Metric
Attention	Project Dynamics	Pace of Project Development	Commit Velocity
	Personal Utility	Learning	Downstream Dependencies
	Community Evaluation	Social Influence	Core Member Followers
Usage	Project Dynamics	Project Activity and Liveliness	Commit Velocity
	Personal Utility	Technical Utility	Upstream Dependencies
	Community Evaluation	Community Interest	Stars
Contribution	Project Dynamics	Responsiveness of Core Team	Time to Close Pull Request
	Personal Utility	Accessible Contribution Opportunity	Issues
	Community Evaluation	Community Benefit	Downstream Dependencies

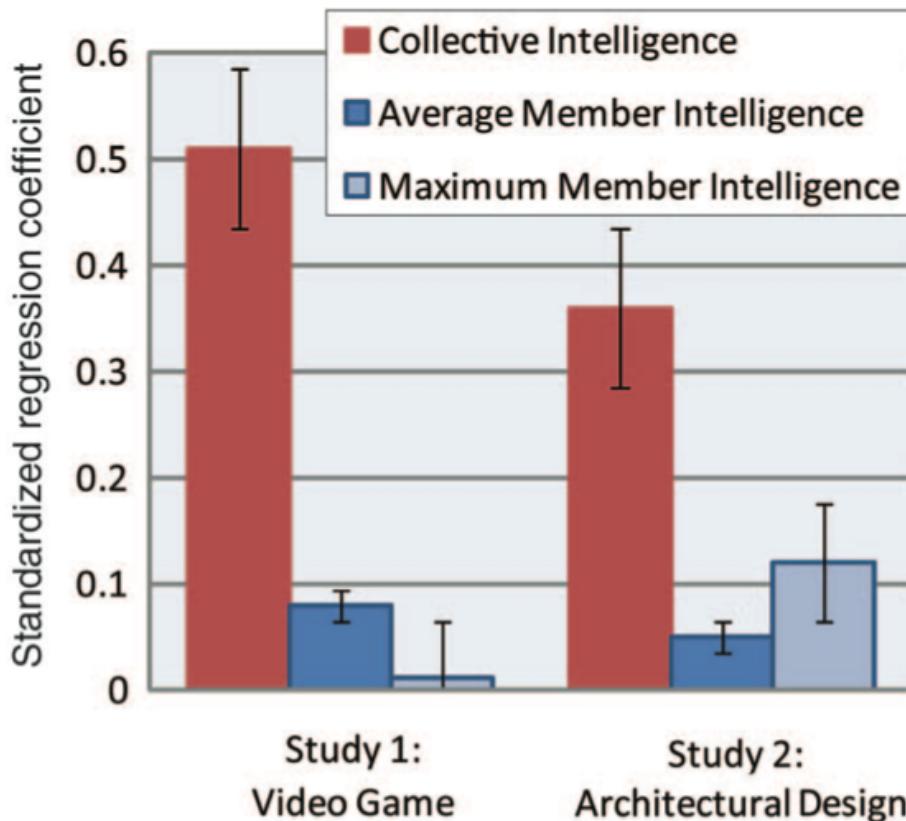
# Signaling Takeaways

- A way to make sense of information-rich environment
- Theory creates expectations about how various signals can work
  - How is signal produced?
  - How easy/hard is it to evaluate?
  - What norms influence how it is used?

# Collective Intelligence

- $c$  exists!
  - Groups perform well on one task tend tend to perform well on others
  - This effect is much stronger than average or highest intelligence in group

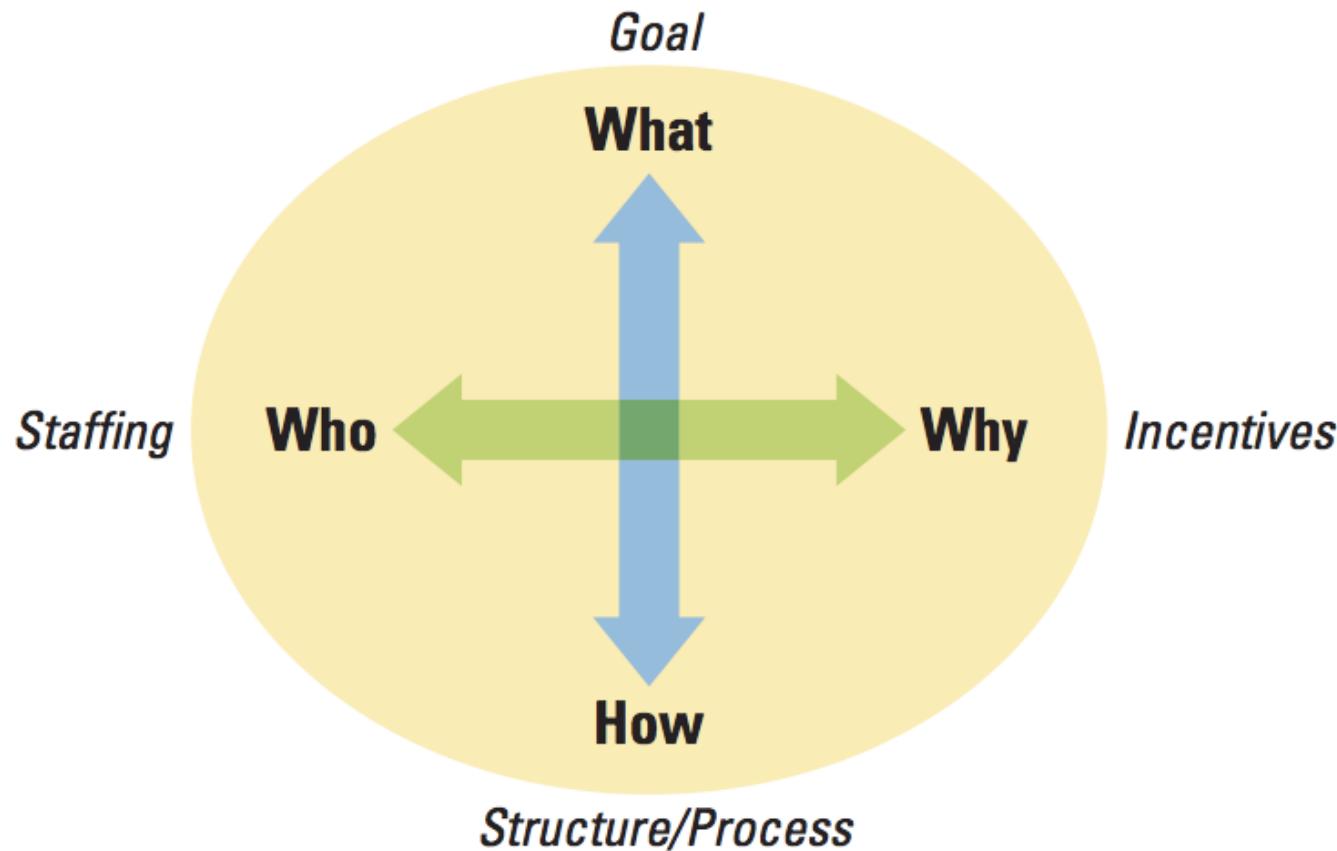
# Evidence for $c$



$c$  is predicted by

- Social sensitivity
- Equality of participation
- Proportion of women

# Collective Intelligence Genome



Malone, T.W., Laubacher, R., & Dellarocas, C. (2010). The collective intelligence genome. *MIT Sloan Management Review*, 51(3), pp. 20-31.

# Basic Genes

- What
    - Create
    - Decide
  - Who
    - Hierarchy
    - Crowd
  - Why
    - Money
    - Love
    - Glory
  - How
    - Collection
    - Contest
    - Collaboration
    - Group decision
    - Individual decision
- 
- The diagram illustrates the grouping of 'How' items. A brace on the right side groups the first three items ('Collection', 'Contest', 'Collaboration') under the label 'Create'. Another brace groups the last two items ('Group decision', 'Individual decision') under the label 'Decide'.

# THE COLLECTIVE INTELLIGENCE GENOME FOR WIKIPEDIA

	EXAMPLE	WHAT	WHO	WHY	HOW
<b>Create the collection of Wikipedia articles</b>	Create	New article	Crowd	Love, Glory	Collection
	Decide	Whether to delete (preliminary)	Crowd	Love, Glory	Voting
	Decide	Whether to delete (final)	Wikipedia administrators	Love, Glory	Hierarchy
<b>Edit an existing Wikipedia article</b>	Create	New version of article	Crowd	Love, Glory	Collaboration
	Decide	Whether to keep current	Crowd	Love, Glory	Consensus

# Collective Intelligence Takeaways

- Understanding the interplay among
  - Structure/process
  - Incentives
  - Staffing
  - Goal
- Effective collaboration systems can be designed

**Q&A Genome**  
Create  
Crowd  
Collaborate  
Love & Glory