



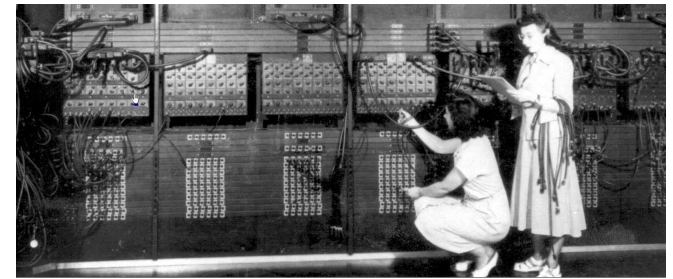
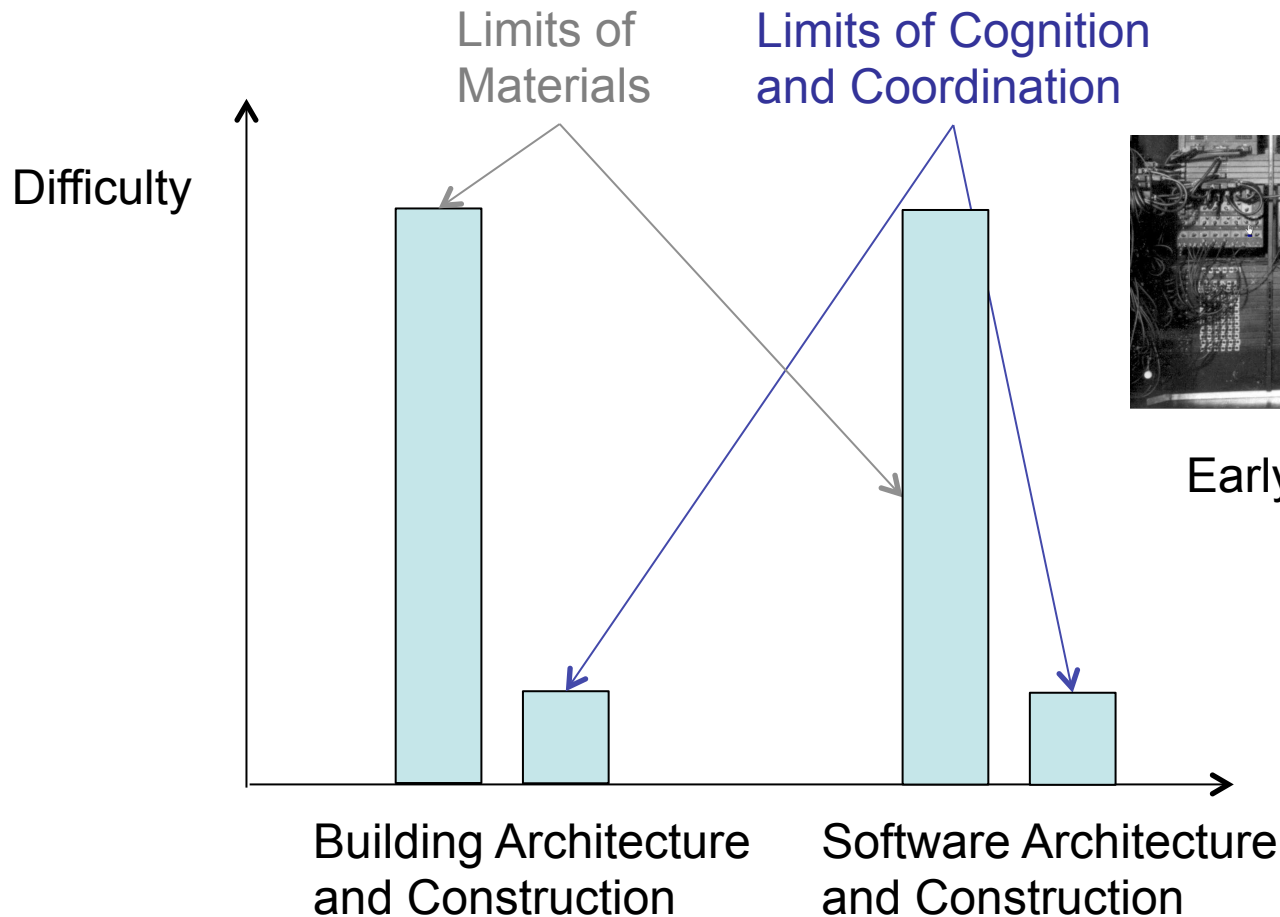
Theories of Context

James Herbsleb

jdh@cs.cmu.edu

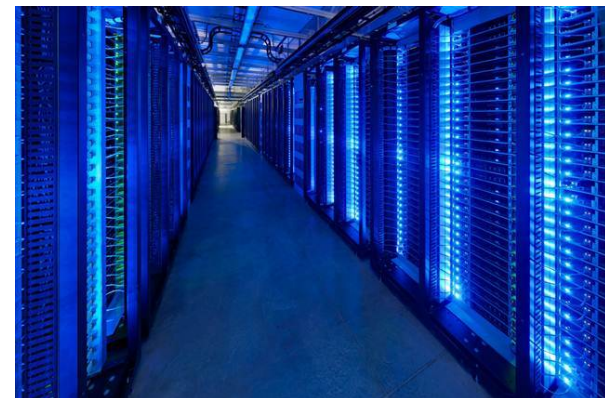
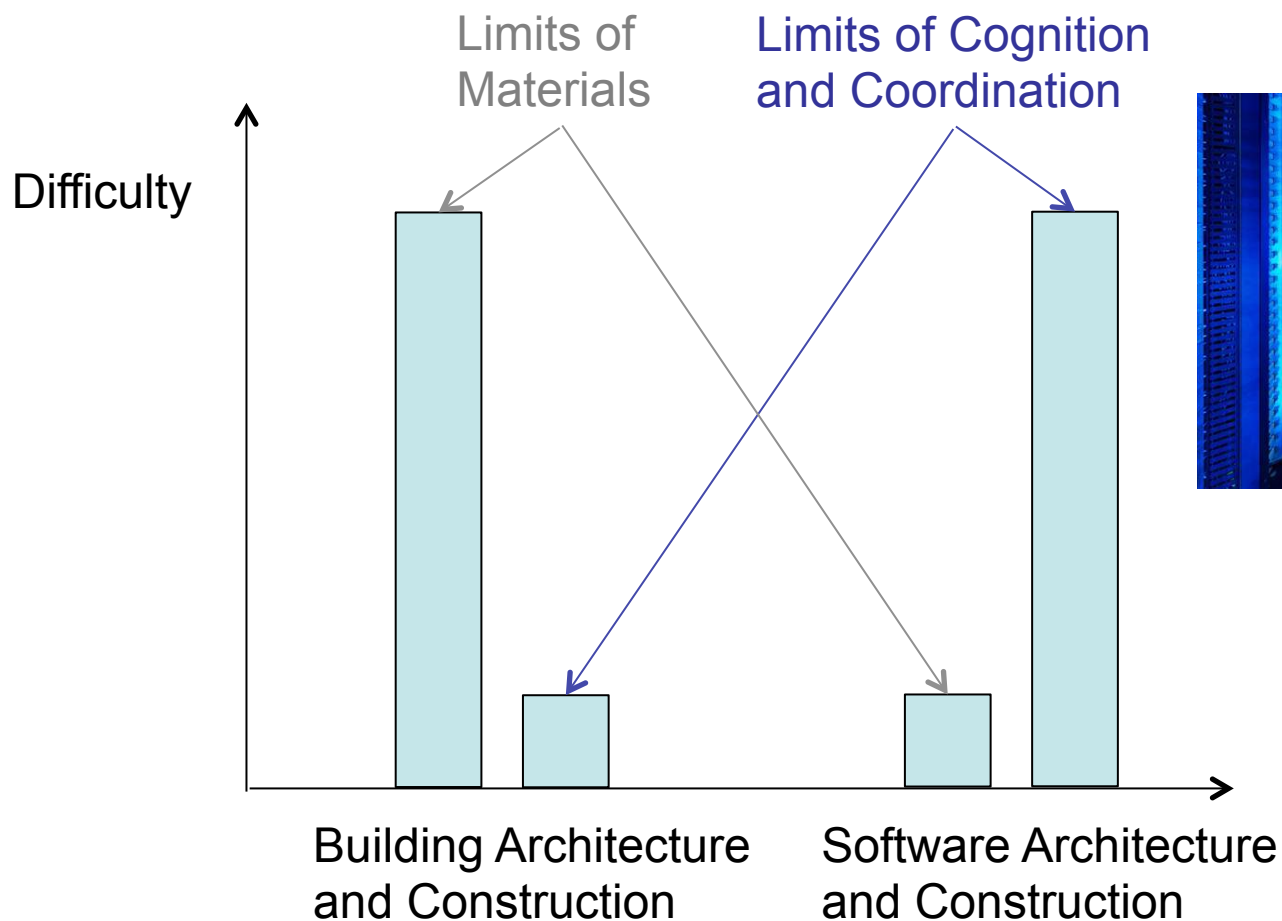


Problem Frontier



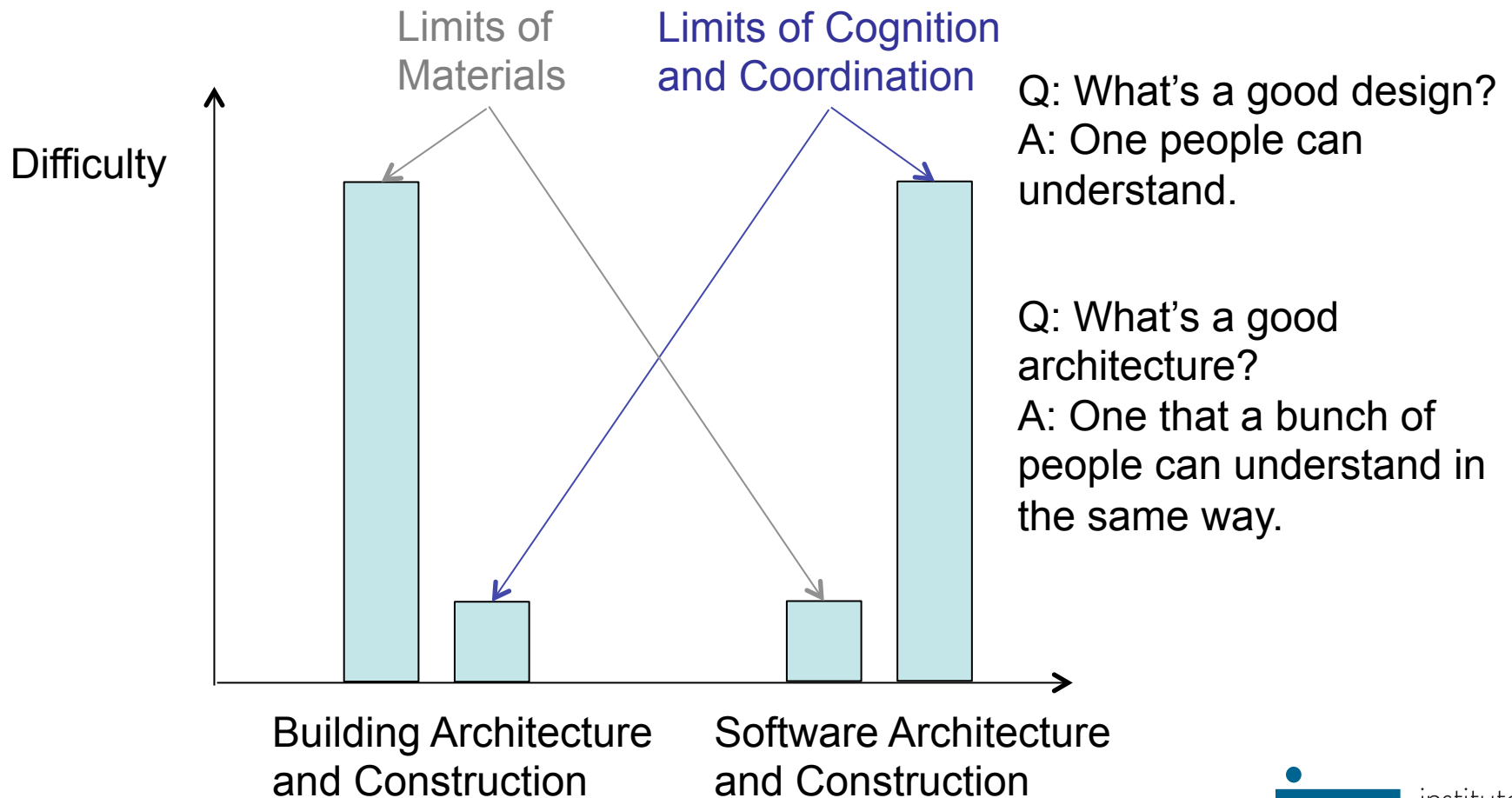
Early Days of Computing

Problem Frontier Now

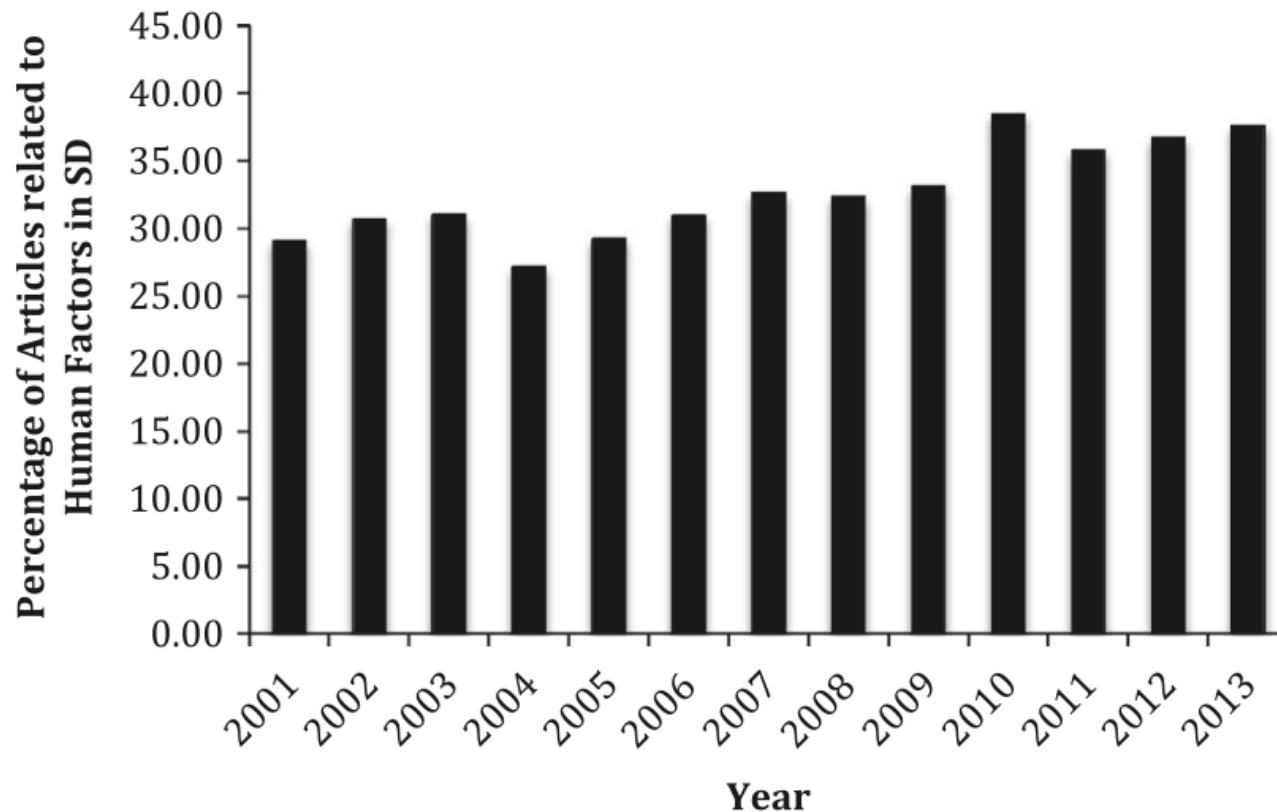


Computing Today

Problem Frontier Now

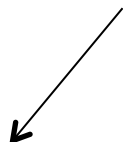


Increasing Attention to Human Factors



Amrit, C., Daneva, M., & Damian, D. (2014). *Information and Software Technology* 56 (2014) 1537–1542

Jim



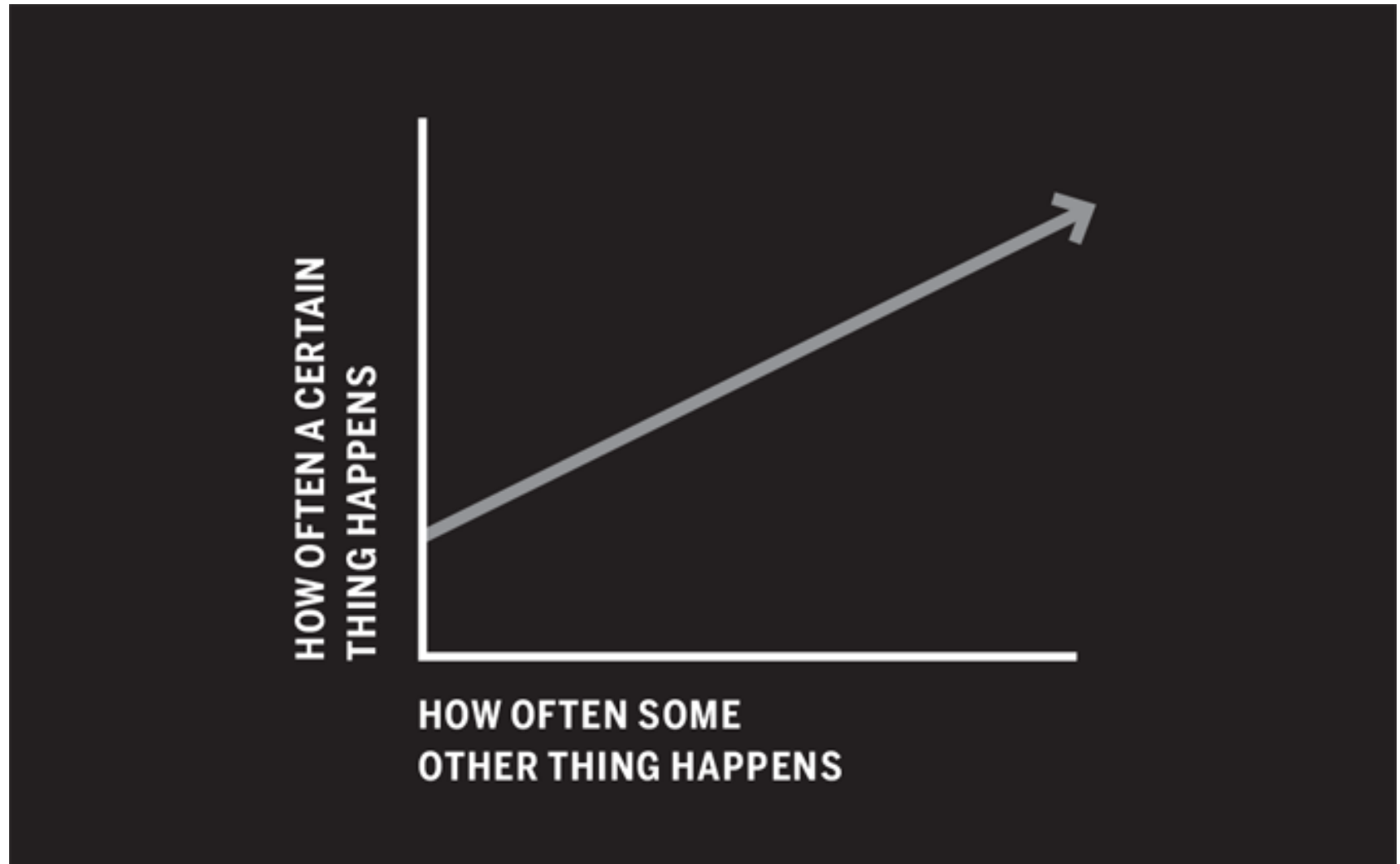
Likes to mix things up, put them on alcohol flame
See if they catch fire or (YES!) explode
Knows nothing, cares nothing about chemistry



**LDA
SVD
SVM
Etc.**



There's not much chemistry going on here!



This may be very useful. This is not science.



Photo: I, MikeGogulski

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

*Bernstein, E. S. (2012). The transparency paradox a role for privacy in organizational learning and operational control. *Administrative Science Quarterly*, 57(2), 181-216.


GitHub: Transparency

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

Example: Information Overload



GitHub

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 **ruby / ruby** ★ Star 6,269 🍴 Fork 1,880











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


🕒 37,555 commits 🌿 34 branches 📦 290 releases 👤 36 contributors


 branch: **trunk** **ruby / +** 


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


 **akr** authored 8 hours ago latest commit 2a87fdedb7


 benchmark	benchmark/bm_hash_undef_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 autogenerated 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
 

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 **Clone in Desktop**

 **Download ZIP**

Contributors

Commits

Code frequency

Punch card

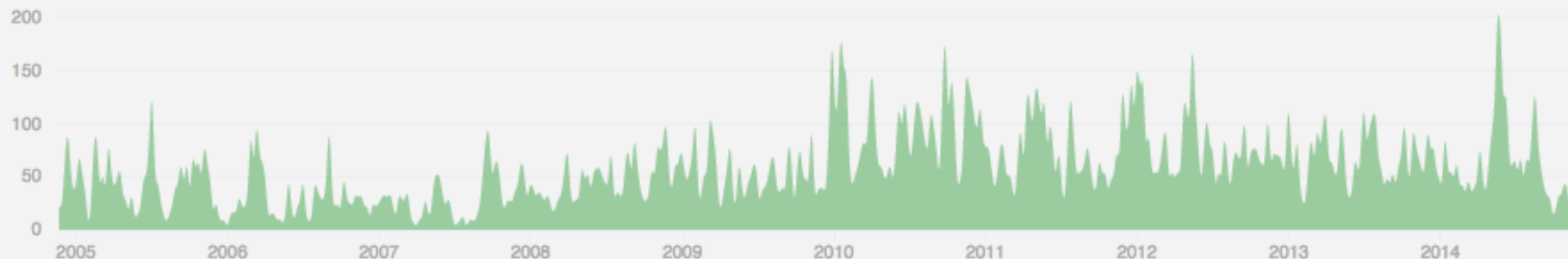
Network

Members

Nov 21, 2004 – Nov 15, 2014

Contributions: Commits ▾

Contributions to master, excluding merge commits



dhh

#1

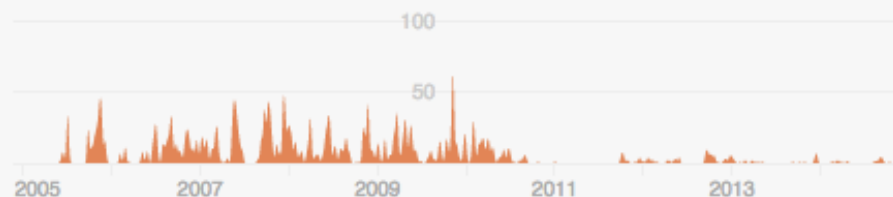
3,414 commits / 202,650 ++ / 102,798 --



jeremy

#2

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



Contributors

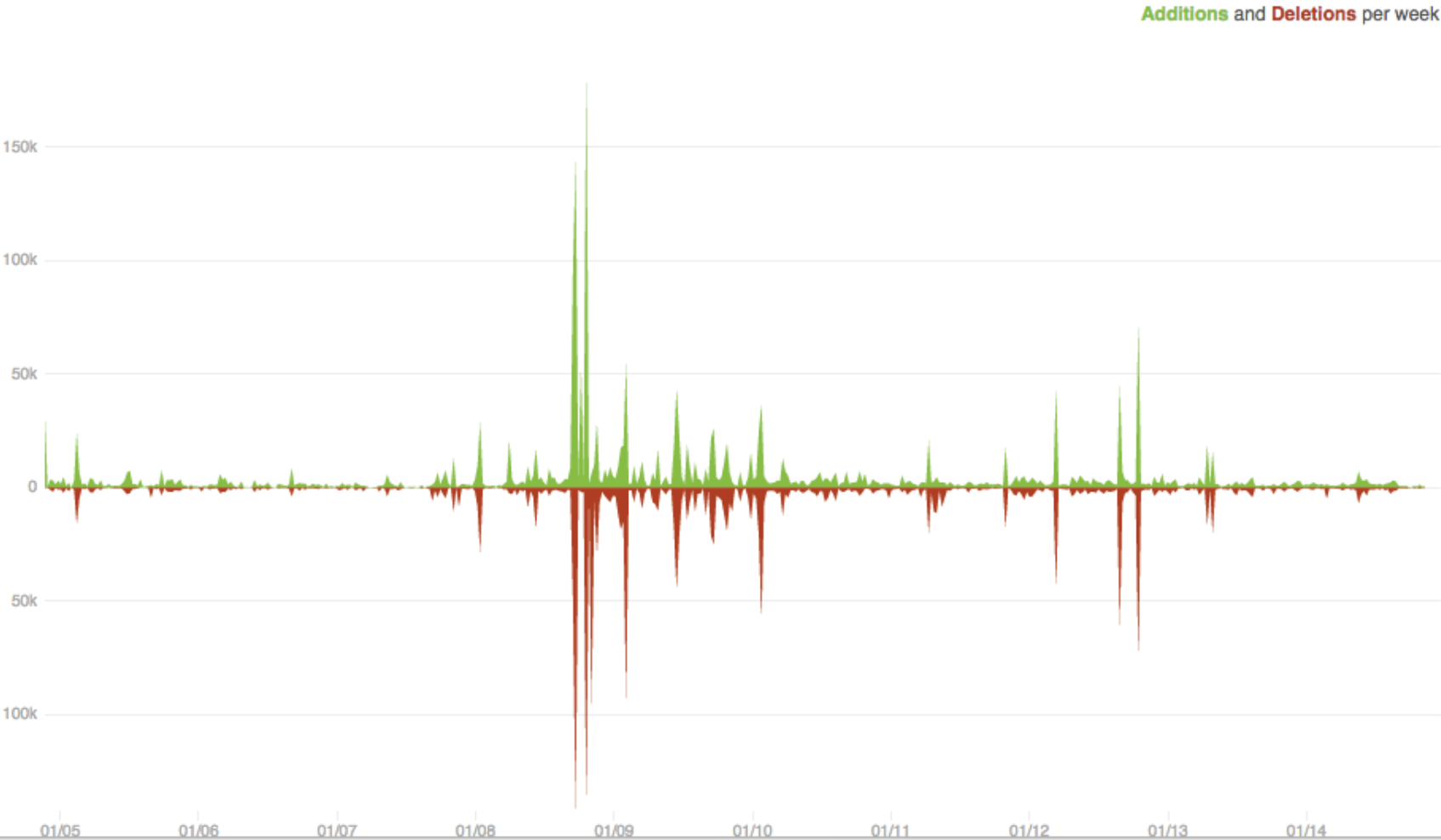
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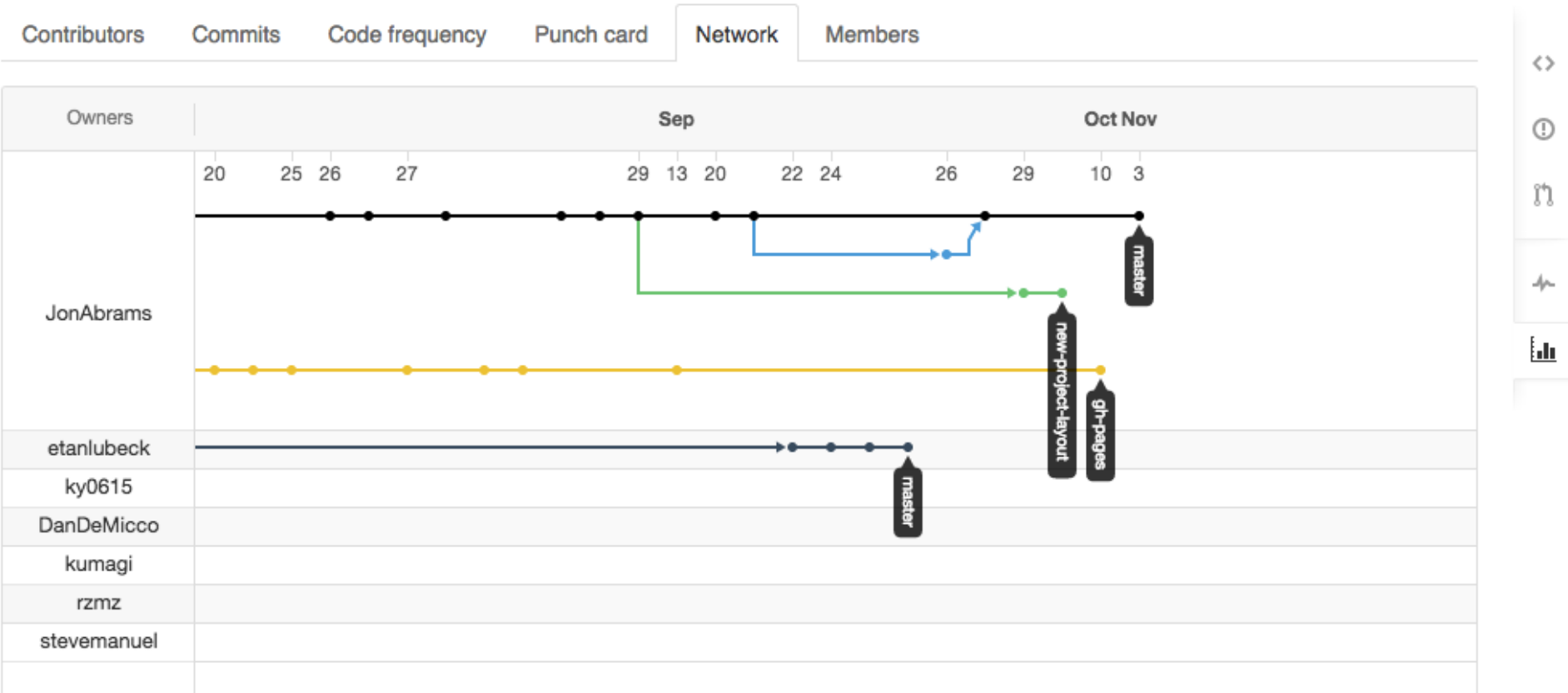
JonAbrams / synth

★ Star

952

Fork

70



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)

Copyright © 2007 Pearson Education Inc., publishing as Pearson Benjamin Cummings. All rights reserved.

Avoid Colorful Snakes



a) Eastern coral snake (poisonous)

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(b) Scarlet king snake (nonpoisonous)

Conventional Signals



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

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Jim Herbsleb's Home Page

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?



I bought fake job references on the Internet—and it worked

By [Aaron Sankin](#)  [Twitter](#) on December 16, 2013

By almost any measure, I have an impeccable résumé.


I spent three years as a staff accountant at [Thomas, Pickford & Thomas](#), an equity research firm with a specialty in oil and gas. It's a small team of investment analysts, accountants, and attorneys with an office in Austin's trendy South Congress

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NIFTY
8,389.90 ▲ 32.05

GOLD (MCX) (Rs/10g.)
26,443.00 ▲ 621.00

USD/INR
61.72 ▼ 0.15

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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?




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[Check on job applicants gets deeper as hiring activity goes...](#)

November 28, 2009

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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

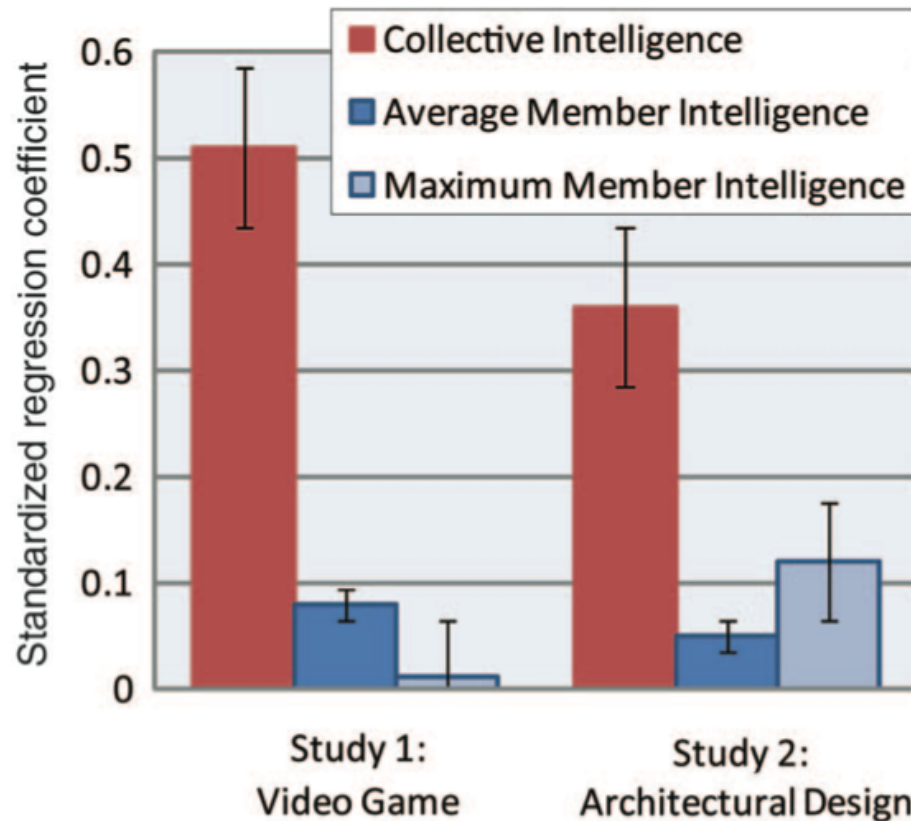
Signaling Takeaways

- 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 to perform well on others
 - This effect is much stronger than average or highest intelligence in group

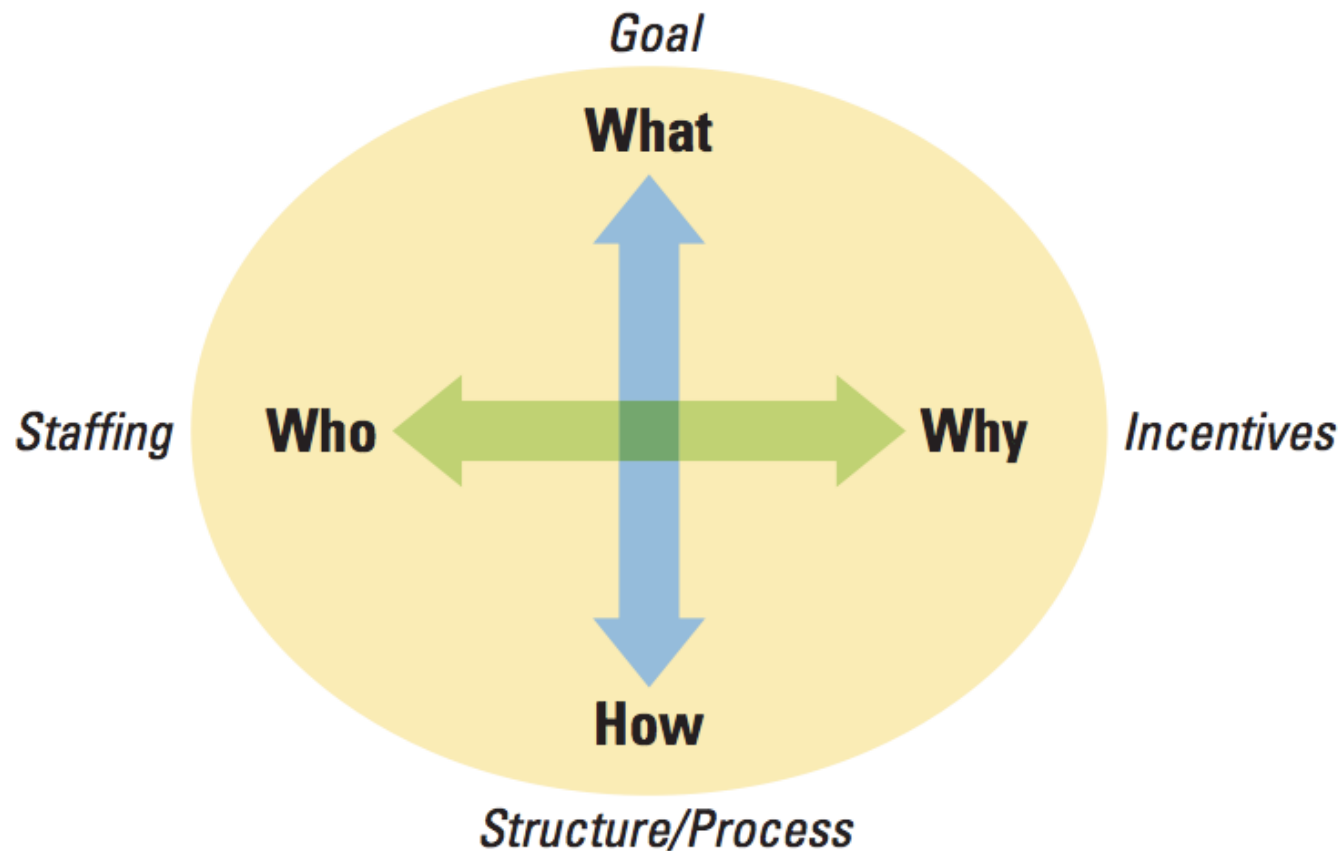
Evidence for c



- c is predicted by
- Social sensitivity
 - Equality of participation
 - Proportion of women

Woolley, A. W., Chabris, C.F., Pentland, A., Hashmi, N., & Malonge, T.W. (2010). Evidence for a Collective Intelligence Factor in the Performance of Human Groups. *Science*, 330, Oct. 2010, 686-688.

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

 } Create

 } Decide

THE COLLECTIVE INTELLIGENCE GENOME FOR WIKIPEDIA

EXAMPLE	WHAT		WHO	WHY	HOW
Create the collection of Wikipedia articles	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
Edit an existing Wikipedia article	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