Foundations of Software Engineering

Part 24: Teams

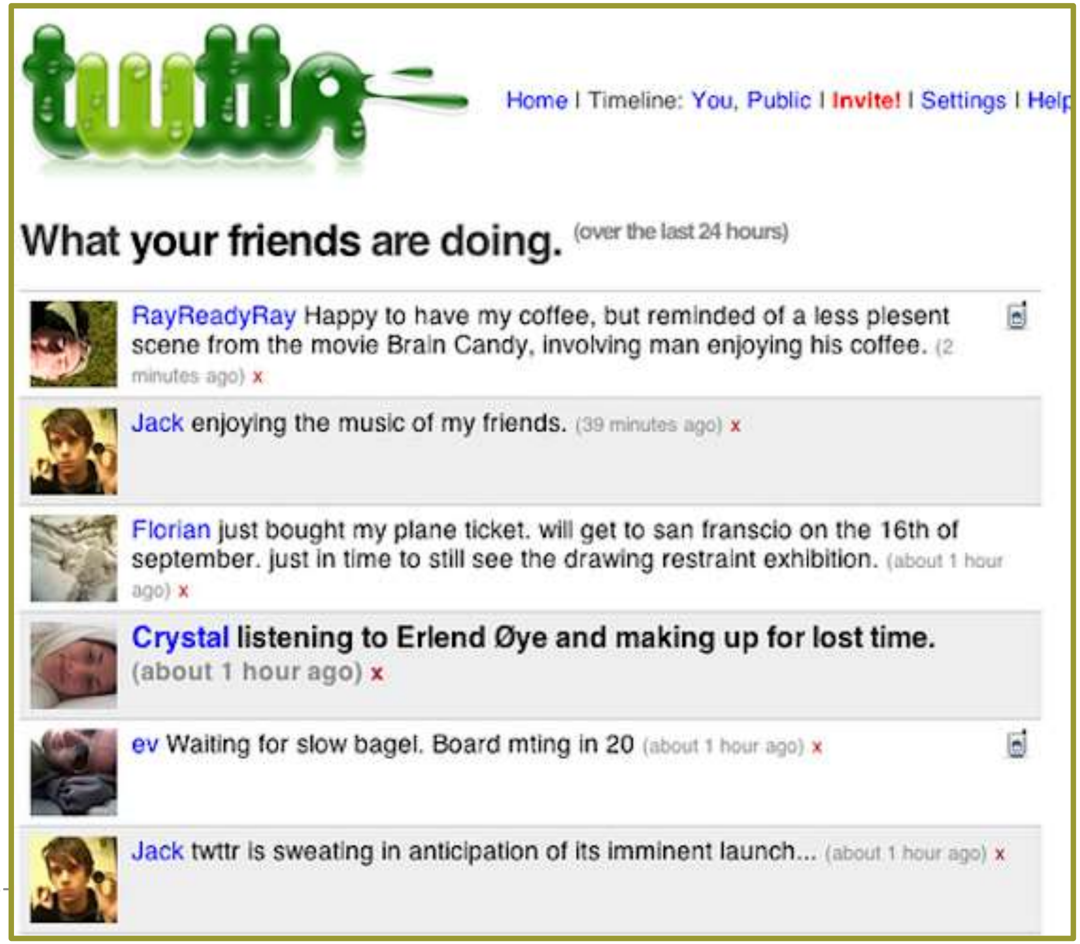
Christian Kästner

Case Studies

Disclaimer: All pictures represent abstract developer groups or products to give a sense of scale; they are not necessarily the developers of those products or developers at all.

How to structure teams?

- Microblogging platform; 3 friends



Home | Timeline: You, Public | Invite! | Settings | Help

What your friends are doing. (over the last 24 hours)

RayReadyRay Happy to have my coffee, but reminded of a less plesent scene from the movie Brain Candy, involving man enjoying his coffee. (2 minutes ago) x

Jack enjoying the music of my friends. (39 minutes ago) x

Florian just bought my plane ticket. will get to san franscio on the 16th of september. just in time to still see the drawing restraint exhibition. (about 1 hour ago) x

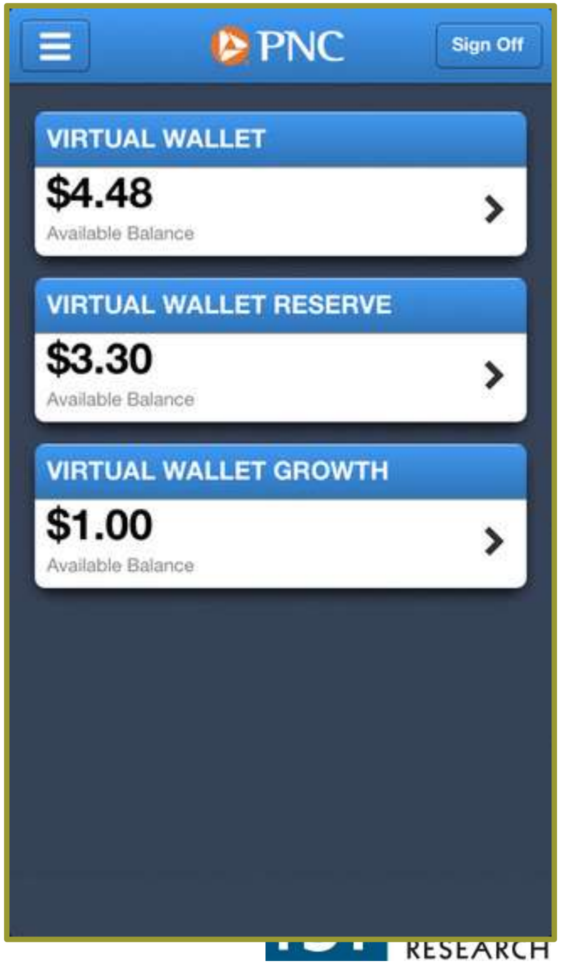
Crystal listening to Erlend Øye and making up for lost time. (about 1 hour ago) x

ev Waiting for slow bagel. Board mting in 20 (about 1 hour ago) x

Jack twttr is sweating in anticipation of its imminent launch... (about 1 hour ago) x

How to structure teams?

- Banking app; 15 developers



VIRTUAL WALLET

$4.48

Available Balance

VIRTUAL WALLET RESERVE

$3.30

Available Balance

VIRTUAL WALLET GROWTH

$1.00

Available Balance

How to structure teams?

- Mobile game;
  50ish developers;
- distributed teams?

How to structure teams?

- Mobile game;
  200ish developers

How to structure teams?

- Ride sharing app and self-driving cars; 1200 developers; 4 sites

Teams

Necessity of Groups

- Division of labor
- Division of expertise (e.g., security expert, database expert)

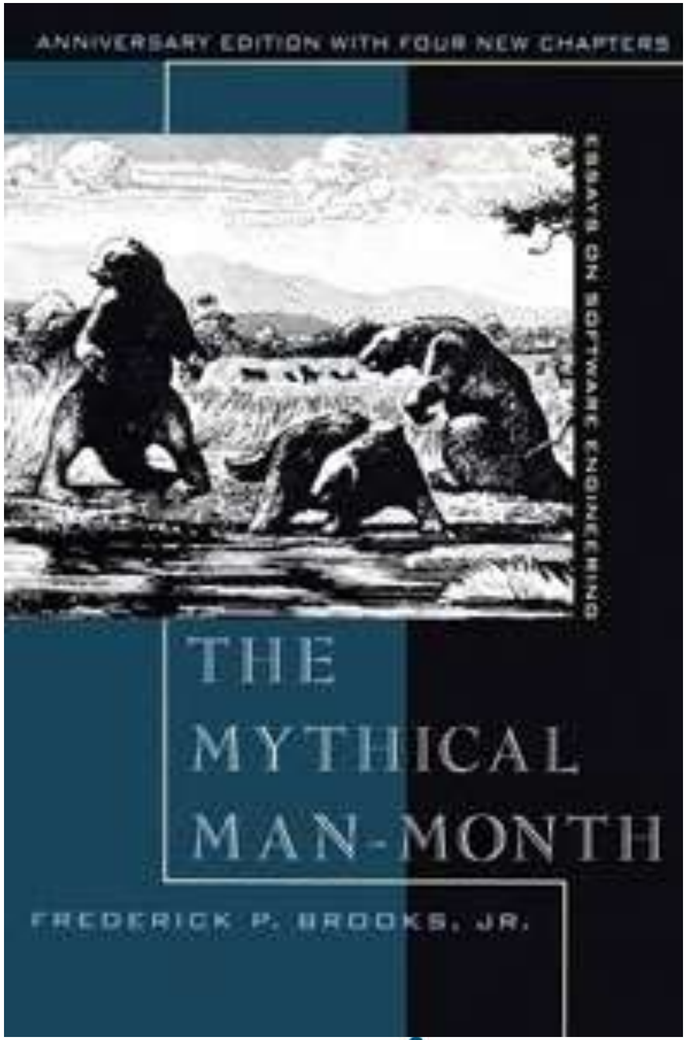
Team Issues

- Process costs
- Groupthink
- Social loafing
- Multiple/conflicting goals

Team issues: Process costs

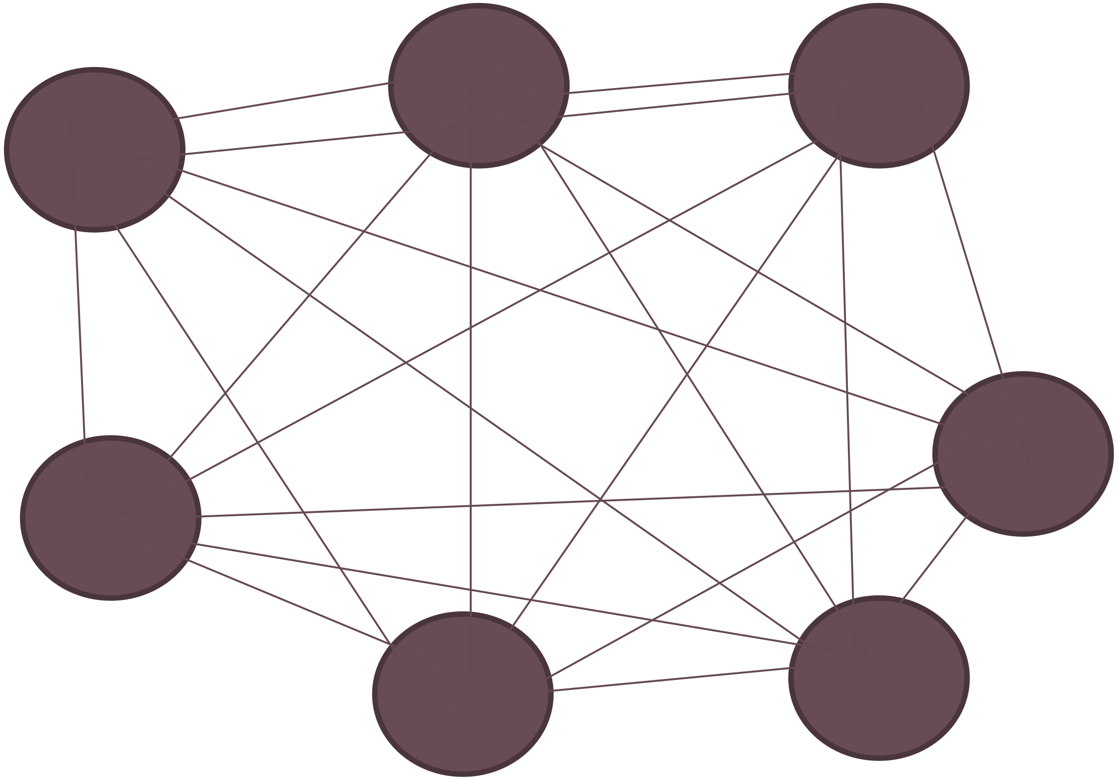
Mythical Man Month

- Brooks's law: *Adding manpower to a late software project makes it later*


ANNIVERSARY EDITION WITH FOUR NEW CHAPTERS
ESSAYS ON SOFTWARE ENGINEERING
THE MYTHICAL MAN-MONTH
FREDERICK P. BROOKS, JR.

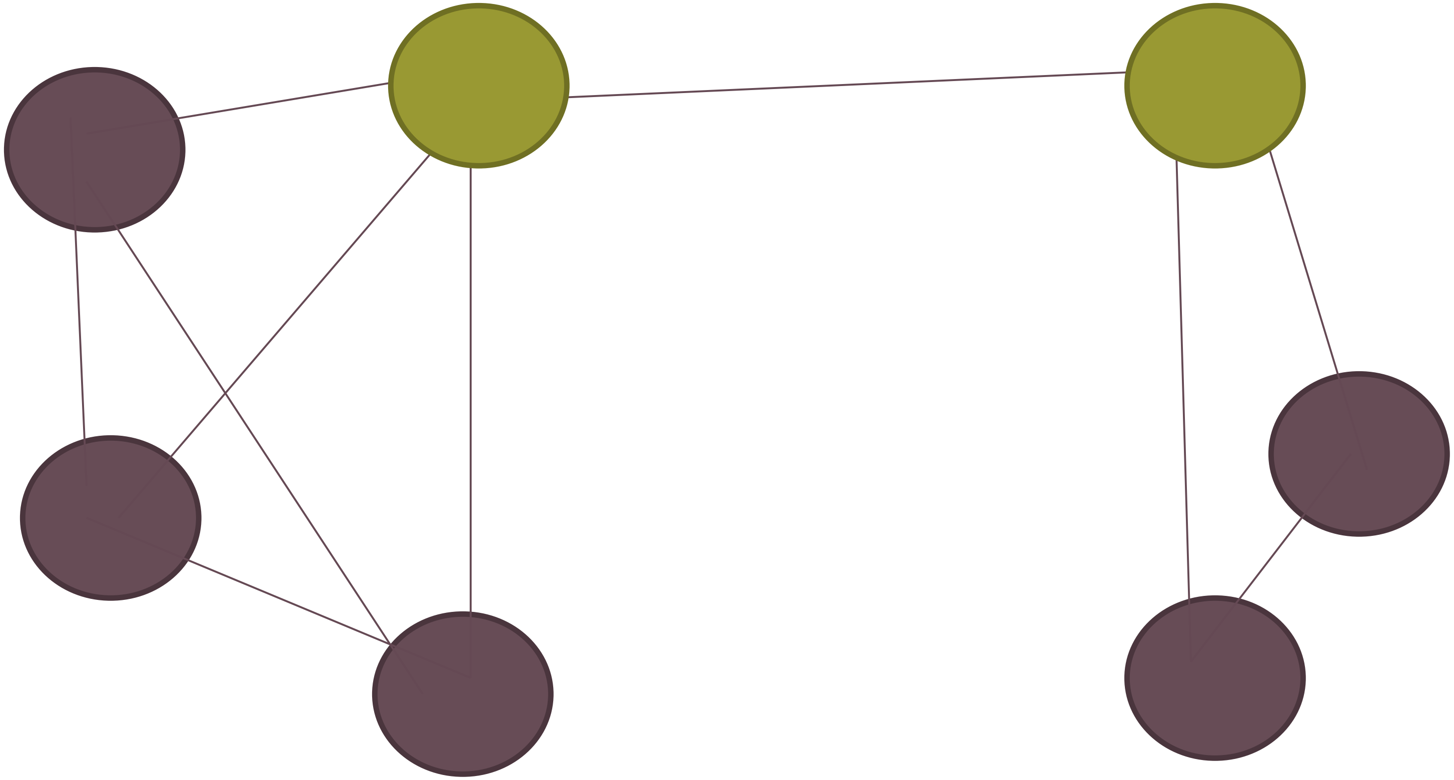
1975, describing experience at IBM developing OS/360

Process Costs



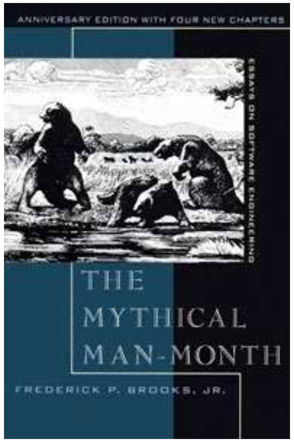
$n(n - 1) / 2$
communication links

Process Costs



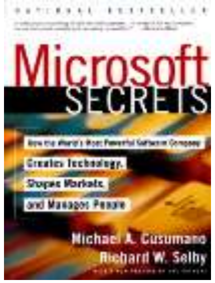
IBM 1971

Brook's Surgical Teams


ANNIVERSARY EDITION WITH FOUR NEW CHAPTERS
ESSAYS ON SOFTWARE ENGINEERING
THE MYTHICAL MAN-MONTH
FREDERICK P. BROOKS, JR.

- Chief programmer – most programming and initial documentation
- Support staff
  - Copilot: supports chief programmer in development tasks, represents team at meetings
  - Administrator: manages people, hardware and other resources
  - Editor: editing documentation
  - Two secretaries: one each for the administrator and editor
  - Program clerk: keeps records of source code and documentation
  - Toolsmith: builds specialized programming tools
  - Tester: develops and runs tests
  - Language lawyer: expert in programming languages, provides advice on producing optimal code.

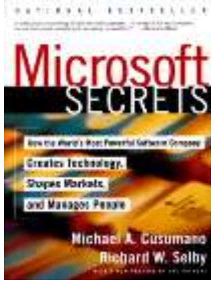
Microsoft's Small Team Practices



- Vision statement and milestones (2-4 month), no formal spec
- Feature selection, prioritized by market, assigned to milestones
- Modular architecture
  - Allows small federated teams (Conway's law)
- Small teams of overlapping functional specialists

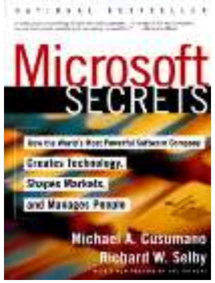
Windows 95: 200 developers and testers, one of 250 products

Microsoft's Small Team Practices



- Feature Team
  - 3-8 developers (design, develop)
  - 3-8 testers (validation, verification, usability, market analysis)
  - 1 program manager (vision, schedule communication; leader, facilitator) – working on several features
  - 1 product manager (marketing research, plan, betas)

Microsoft's Small Team Practices



- "Synchronize and stabilize"
- For each milestone
  - 6-10 weeks feature development and continuous testing
    - frequent merges, daily builds
  - 2-5 weeks integration and testing ("zero-bug release", external betas)
  - 2-5 weeks buffer

Agile Practices (e.g., Scrum)

- 7+/-2 team members, collocated
- self managing
- Scrum master (potentially shared among 2-3 teams)
- Product owner / customer representative

Mantle and Lichty

- Ideal team size: 2-3 colocated developers if possible

Large teams (29 people) create around six times as many defects as small teams (3 people) and obviously burn through a lot more money. Yet, the large team appears to produce about the same mount of output in only an average of 12 days' less time. This is a truly astonishing finding, through it fits with my personal experience on projects over 35 years.

- Phillip Amour, 2006, CACM 49:9

Establish communication patterns

- Avoid overhead
- Ensure reliability
- Constraint latency

- e.g. Issue tracker vs email; online vs face to face

Design opportunity

Awareness

- Notifications
- Brook's documentation book
- Email to all
- Code reviews

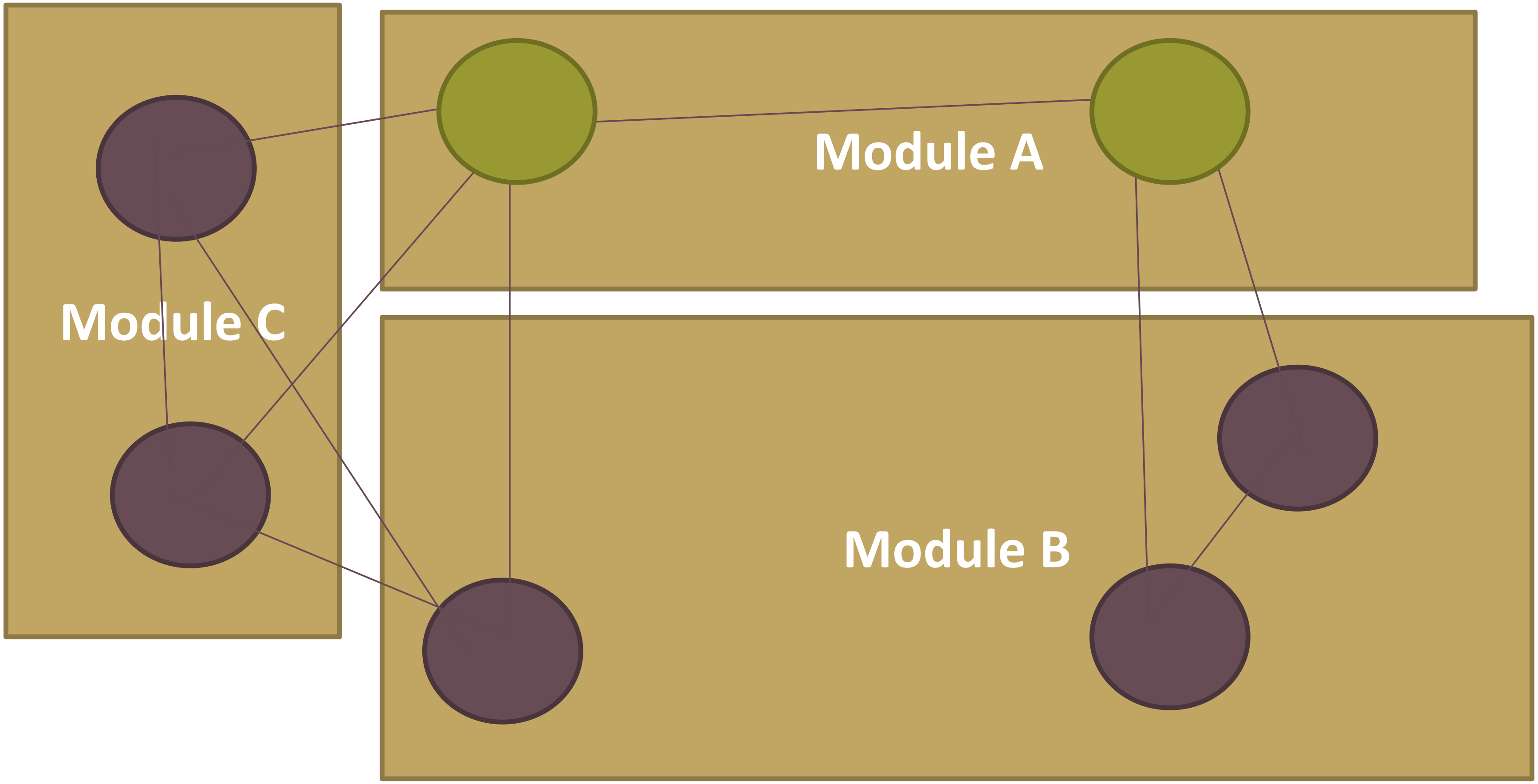
Conway’s Law

“Any organization that designs a system (defined broadly) will produce a design whose structure is a copy of the organization's communication structure.”

— *Mel Conway, 1967*

“If you have four groups working on a compiler, you'll get a 4-pass compiler.”

Congruence



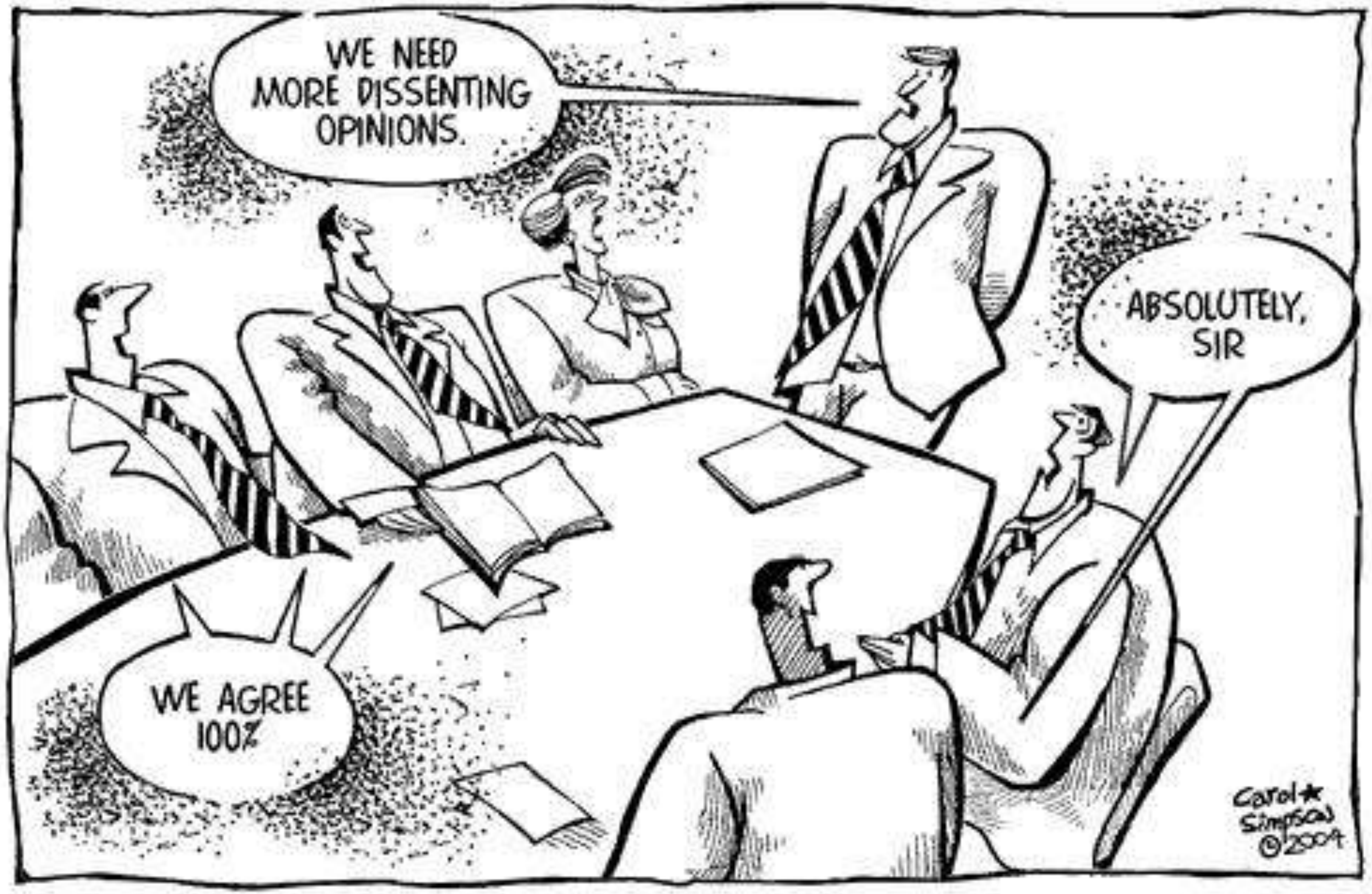
Socio-Technical Congruence

- Structural congruence
- Geographical congruence
- Task congruence
- IRC communication congruence

Teamwork Guidelines

- Respect Conway's Law
  - Code structure and team structure should align
- Seek well-defined, stable interfaces

Team issues: Groupthink


WE NEED MORE DISSENTING OPINIONS.
ABSOLUTELY, SIR
WE AGREE 100%
Carol★ Simpson ©2004

Groupthink

- Group minimizing conflict
- Avoid exploring alternatives
- Suppressing dissenting views
- Isolating from outside influences
- -> Irrational/dysfunctional decision making

Time and Cost Estimation

π

Causes of Groupthink

- High group cohesiveness, homogeneity
- Structural faults (insulation, biased leadership, lack of methodological exploration)
- Situational context (stressful external threats, recent failures, moral dilemmas)

Symptoms

- Overestimation of ability
  - invulnerability, unquestioned believe in morality
- Closed-mindedness
  - ignore warnings, stereotyping
  - innovation averse
- Pressure toward uniformity
  - self-censorship, illusion of unanimity, …

Diversity

“Men and women have different viewpoints, ideas, and market insights, which enables better **problem solving**. A gender-diverse workforce provides easier **access to resources**, such as various sources of credit, multiple sources of information, and wider industry knowledge. A gender-diverse workforce allows the company to **serve an increasingly diverse customer base**. Gender diversity helps companies **attract and retain talented women**.”

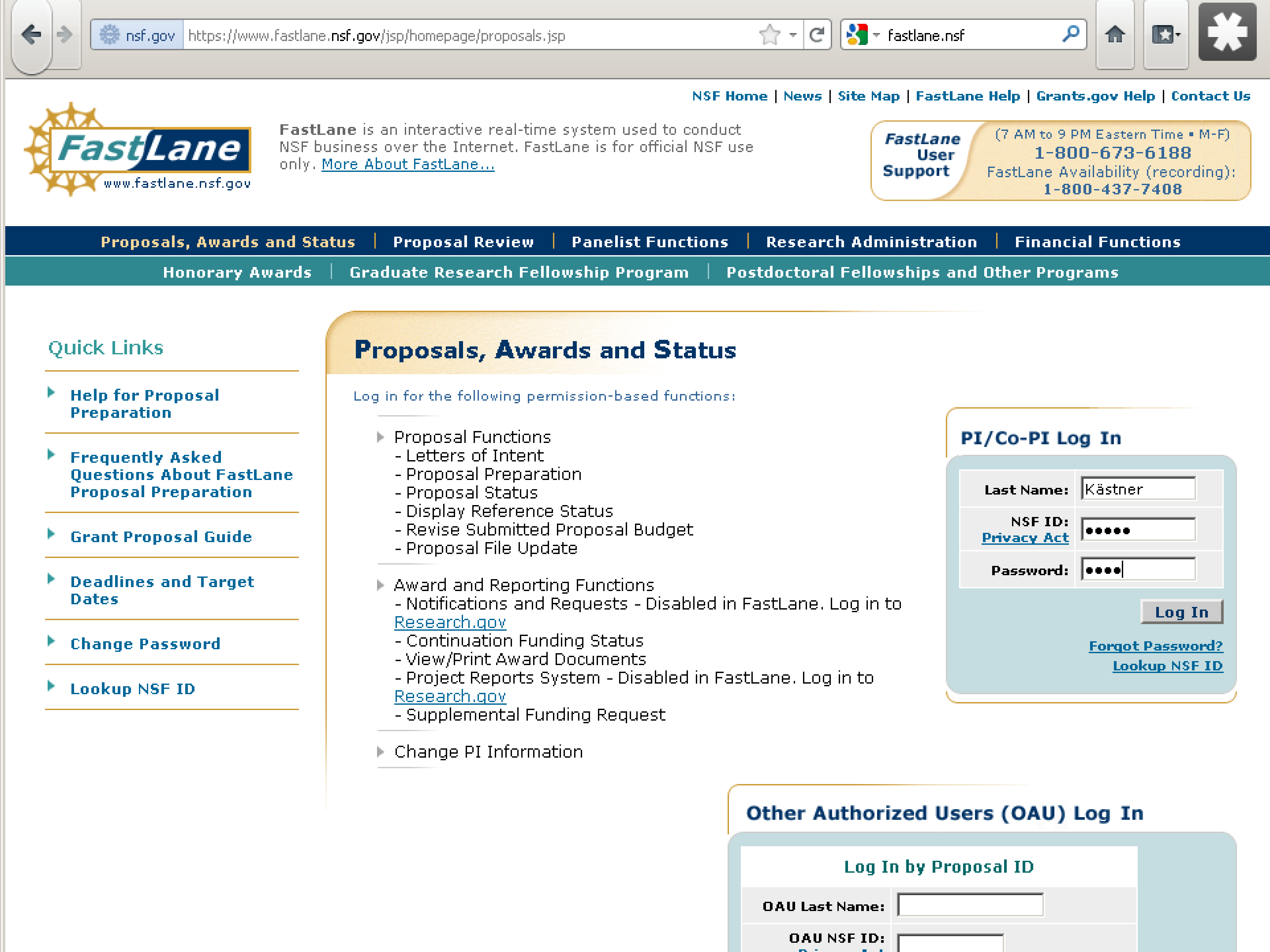
“Cultural diversity leads to **process losses** through task conflict and decreased social integration, but to **process gains** through increased creativity and satisfaction.”

http://www.gallup.com/businessjournal/166220/business-benefits-gender-diversity.aspx

Stahl, Günter K., et al. "Unraveling the effects of cultural diversity in teams: A meta-analysis of research on multicultural work groups." *Journal of international business studies* 41.4 (2010): 690-709.

Unconscious bias

- Pervasive, cultural
- Raise awareness
- Explicit goals
- Measurement



NSF Home | News | Site Map | FastLane Help | Grants.gov Help | Contact Us

FastLane is an interactive real-time system used to conduct NSF business over the Internet. FastLane is for official NSF use only. More About FastLane...

FastLane User Support
(7 AM to 9 PM Eastern Time • M-F)
1-800-673-6188
FastLane Availability (recording):
1-800-437-7408

Proposals, Awards and Status | Proposal Review | Panelist Functions | Research Administration | Financial Functions

Honorary Awards | Graduate Research Fellowship Program | Postdoctoral Fellowships and Other Programs

Quick Links

- Help for Proposal Preparation
- Frequently Asked Questions About FastLane Proposal Preparation
- Grant Proposal Guide
- Deadlines and Target Dates
- Change Password
- Lookup NSF ID

Proposals, Awards and Status

Log in for the following permission-based functions:

- Proposal Functions
  - Letters of Intent
  - Proposal Preparation
  - Proposal Status
  - Display Reference Status
  - Revise Submitted Proposal Budget
  - Proposal File Update
- Award and Reporting Functions
  - Notifications and Requests - Disabled in FastLane. Log in to Research.gov
  - Continuation Funding Status
  - View/Print Award Documents
  - Project Reports System - Disabled in FastLane. Log in to Research.gov
  - Supplemental Funding Request
- Change PI Information

PI/Co-PI Log In

Last Name:	Kästner
NSF ID: Privacy Act	●●●●●
Password:	●●●●

Log In

Forgot Password?
Lookup NSF ID

Other Authorized Users (OAU) Log In

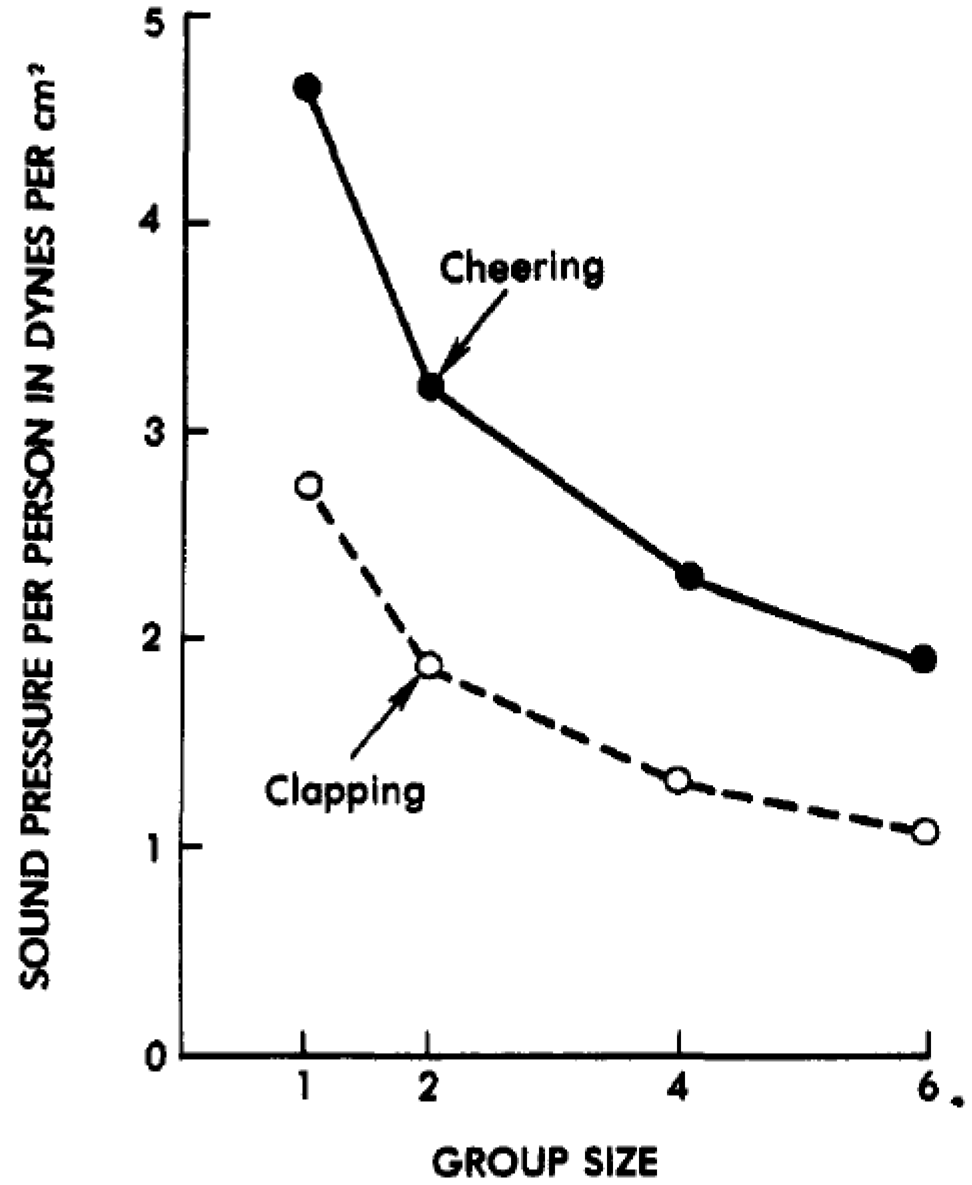
Log In by Proposal ID

OAU Last Name:	
OAU NSF ID:	

Mitigation Strategies

- Several agile techniques
  - Planning poker
  - Tests, continuous integration
  - On-site customers
- Diverse teams
- Management style
- Avoid HR evaluation by metrics
- Separate QA from development
- Outside experts
- Process reflection
- …

Team issues: Social loafing



Latane, Bibb, Kipling Williams, and Stephen Harkins. "Many hands make light the work: The causes and consequences of social loafing." *Journal of personality and social psychology* 37.6 (1979): 822.

Social loafing

- People exerting less effort within a group
- Reasons
  - Diffusion of responsibility
  - Motivation
  - Dispensability of effort / missing recognition
  - Avoid pulling everybody / "sucker effect"
  - Submaximal goal setting
- “Evaluation potential, expectations of co-worker performance, task meaningfulness, and culture had especially strong influence”

Karau, Steven J., and Kipling D. Williams. "Social loafing: A meta-analytic review and theoretical integration." *Journal of personality and social psychology* 65.4 (1993): 681.

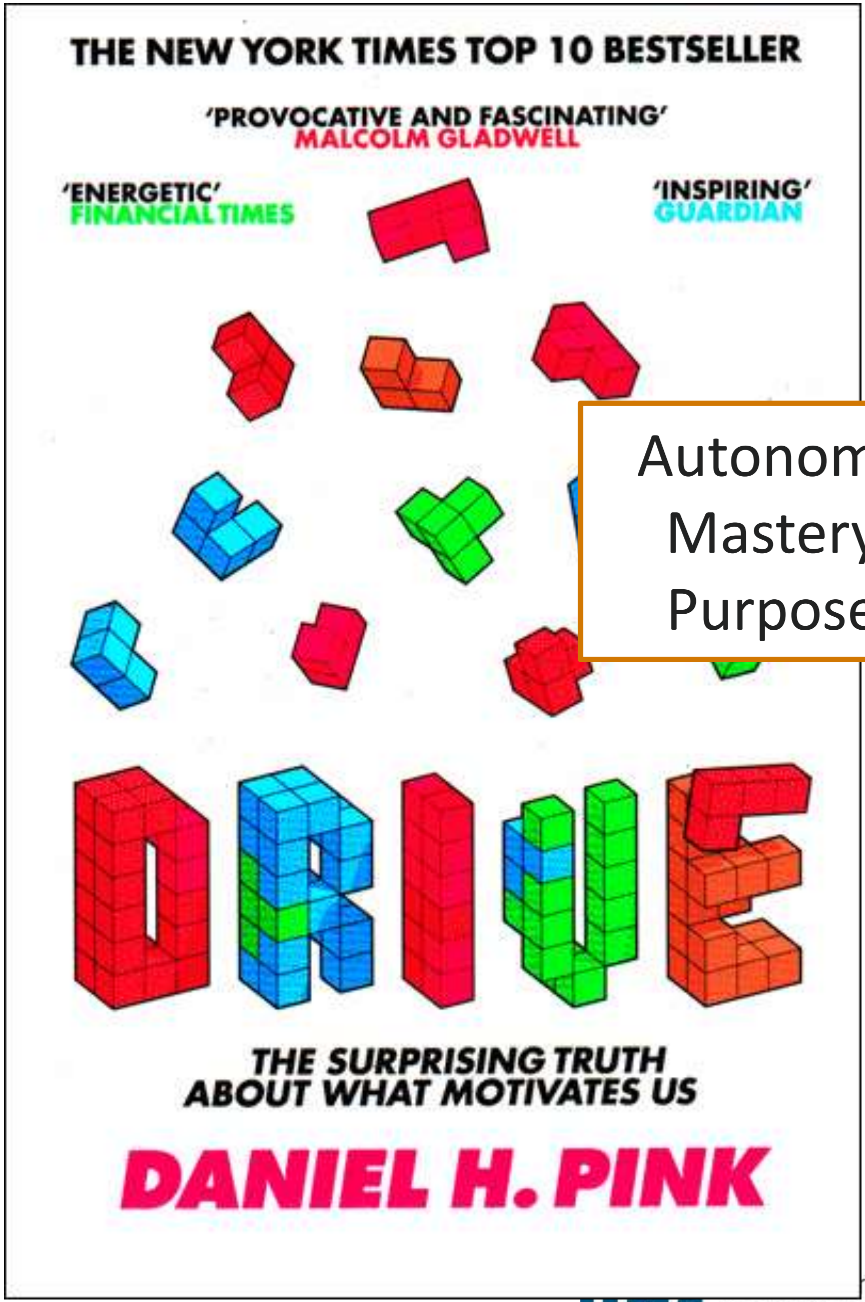
Mitigation Strategies

- Involve all team members, colocation
- Assign specific tasks with individual responsibility
  - Increase identifiability
  - Team contracts, measurement
- Provide choices in selecting tasks
- Promote involvement, challenge developers
- Reviews and feedback
- Team cohesion, team forming exercises
- Small teams

Agile Practices as Mitigation?

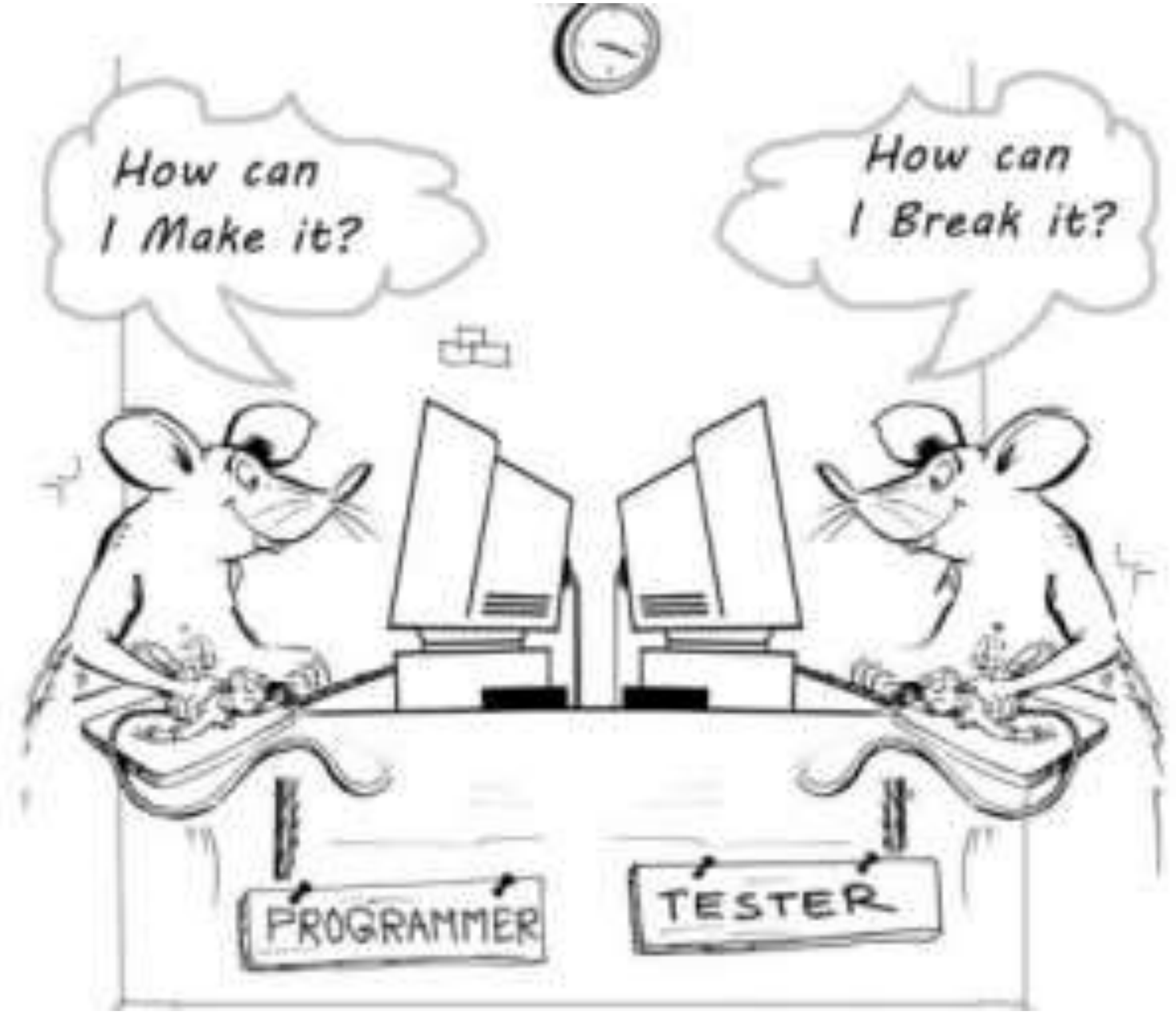
Responsibilities & Buy-In

- Involve team members in decision making
- Assign responsibilities (ideally goals not tasks)
- Record decisions and commitments; make record available


THE NEW YORK TIMES TOP 10 BESTSELLER
'PROVOCATIVE AND FASCINATING'
MALCOLM GLADWELL
'ENERGETIC'
FINANCIAL TIMES
'INSPIRING'
GUARDIAN
DRIVE
THE SURPRISING TRUTH ABOUT WHAT MOTIVATES US
DANIEL H. PINK

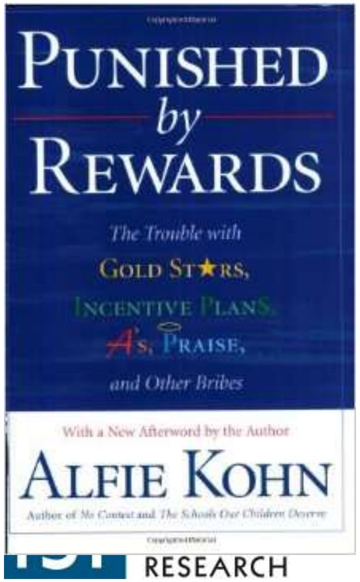
Autonomy
Mastery
Purpose

Team issues: Multiple/conflicting goals


How can I Make it?
How can I Break it?
PROGRAMMER
TESTER

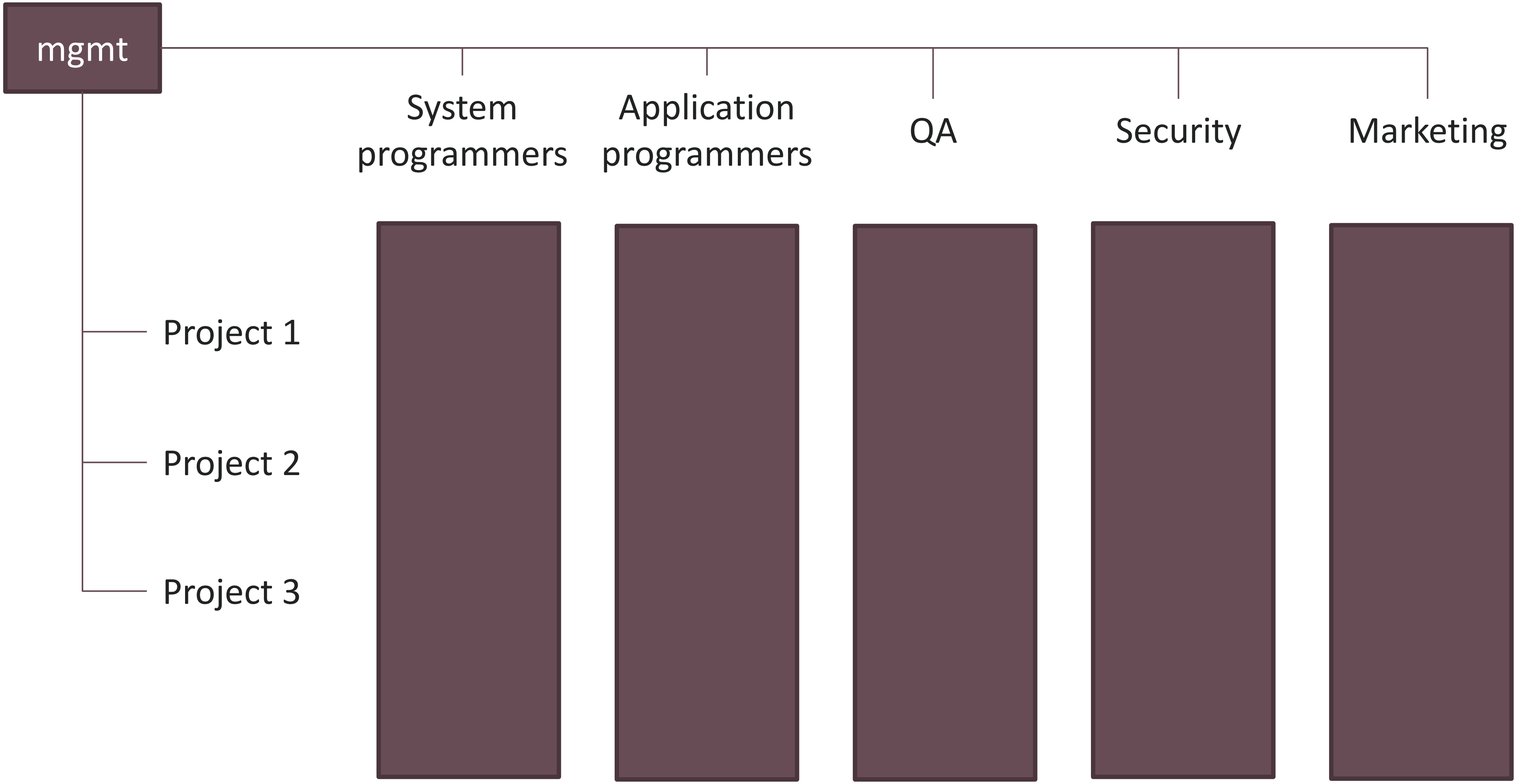
Incentives?

- Team incentives
- vs individual incentives?



Agile Practices as Mitigation?

Matrix Organization



mgmt

System programmers

Application programmers

QA

Security

Marketing

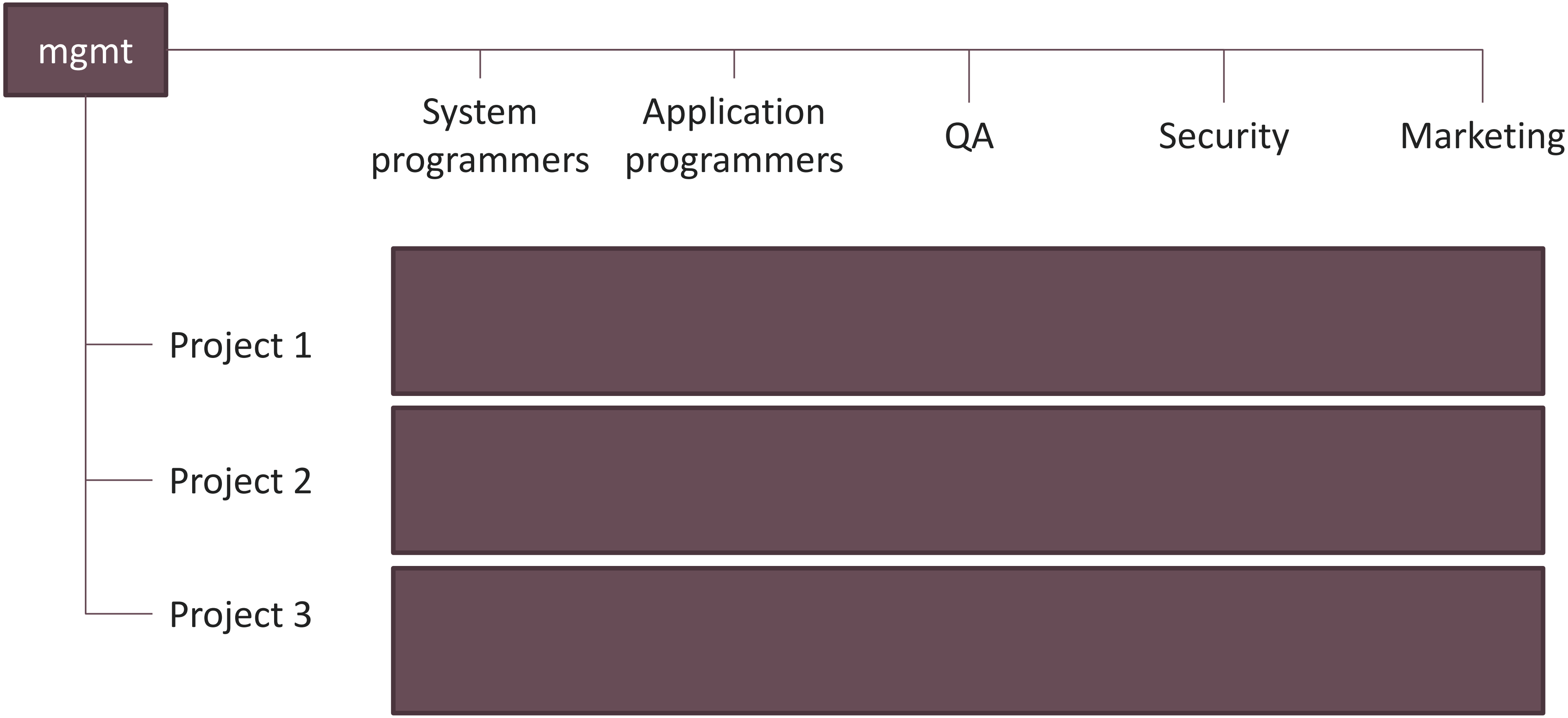
Project 1

Project 2

Project 3

Temporary assignment to projects; flexible staffing

Project Organization



Case Study: Brøderbund

- As the functional departments grew, staffing the heavily matrixed projects became more and more of a nightmare. To address this, the company reorganized itself into “Studios”, each with dedicated resources for each of the major functional areas reporting up to a Studio manager. Given direct responsibility for performance and compensation, Studio managers could allocate resources freely.
- The Studios were able to exert more direct control on the projects and team members, but not without a cost. The major problem that emerged from Brøderbund’s Studio reorganization was that members of the various functional disciplines began to lose touch with their functional counterparts. Experience wasn’t shared as easily. Over time, duplicate effort began to appear.

Commitment & Accountability

- Conflict is useful, expose all views
- Come to decision, commit to it
- Assign responsibilities
- Record decisions and commitments; make record available

Bell & Hart – 8 Causes of Conflict

- Conflicting resources.
- Conflicting styles.
- Conflicting perceptions.
- Conflicting goals.
- Conflicting pressures.
- Conflicting roles.
- Different personal values.
- Unpredictable policies.

Bell, Art. (2002). Six ways to resolve workplace conflicts. *McLaren School of Business, University of San Francisco*.

https://www.mindtools.com/pages/article/eight-causes-conflict.htm

Virtual Teams

Virtual Teams?

Computer Supported Collaborative Work (CSCW): Technology-assisted collaboration

- Many failures
- Isolated, but very significant, success
  - Jazz, Github, …

General Guidelines

Hints for team functioning

- Trust them; strategic not tactical direction
- Reduce bureaucracy, protect team
- Physical colocation, time for interaction
- Avoid in-team competition (bonuses etc)
- Time for quality assurance, cult of quality
- Realistic deadlines
- Peer coaching
- Sense of elitism
- Allow and encourage heterogenity

DeMarco and Lister. Peopleware. Chapter 23

Team Fusion

- Forming, Storming, Norming, Performing
- Preserve existing teams, resist project mobility

Elitism Case Study: The Black Team

- Legendary team at IBM in the 1960s
- Group of talented ("slightly better") testers
  - Goal: Final testing of critical software before delivery
- Improvement over first year
- Formed team personality and energy
  - "adversary philosophy of testing"
  - Cultivated image of destroyers
  - Started to dress in black, crackled laughs, grew mustaches
- Team survived loss of original members

DeMarco and Lister. Peopleware. Chapter 22

Troubleshooting Teams

- Cynicism as warning sign
- Training to improve practices
- Getting to know each other; celebrate success; bonding over meals
- "A meeting without notes is a meeting that never happened"

Further Reading

- Mantle and Lichty. Managing the Unmanageable. Addison-Wesley, 2013
  - Very accessible and practical tips at recruiting and management
- DeMarco and Lister. Peopleware. 3rd Edition. Addison Wesley, 2013
  - Anecdotes, stories, and tips on facilitating teams, projects, and environments
- Sommerville. Software Engineering. 8th Edition. Chapter 25