Foundations of Software Engineering

Part 24: Teams

Michael Hilton

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administrivia

- HW5 due tonight
- HW6 released today
  - TLDR; make a contribution to an open-source project

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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.

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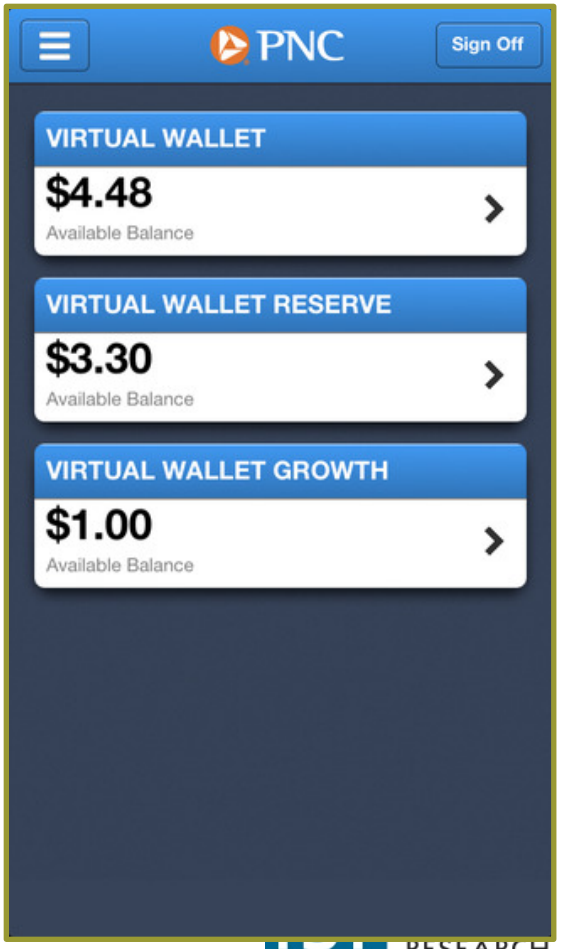
How to structure teams?

- Microblogging platform; 3 friends

How to structure teams?

- Banking app; 15 developers



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

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Teams

Necessity of Groups

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

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Team Issues

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

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Team issues: Social loafing

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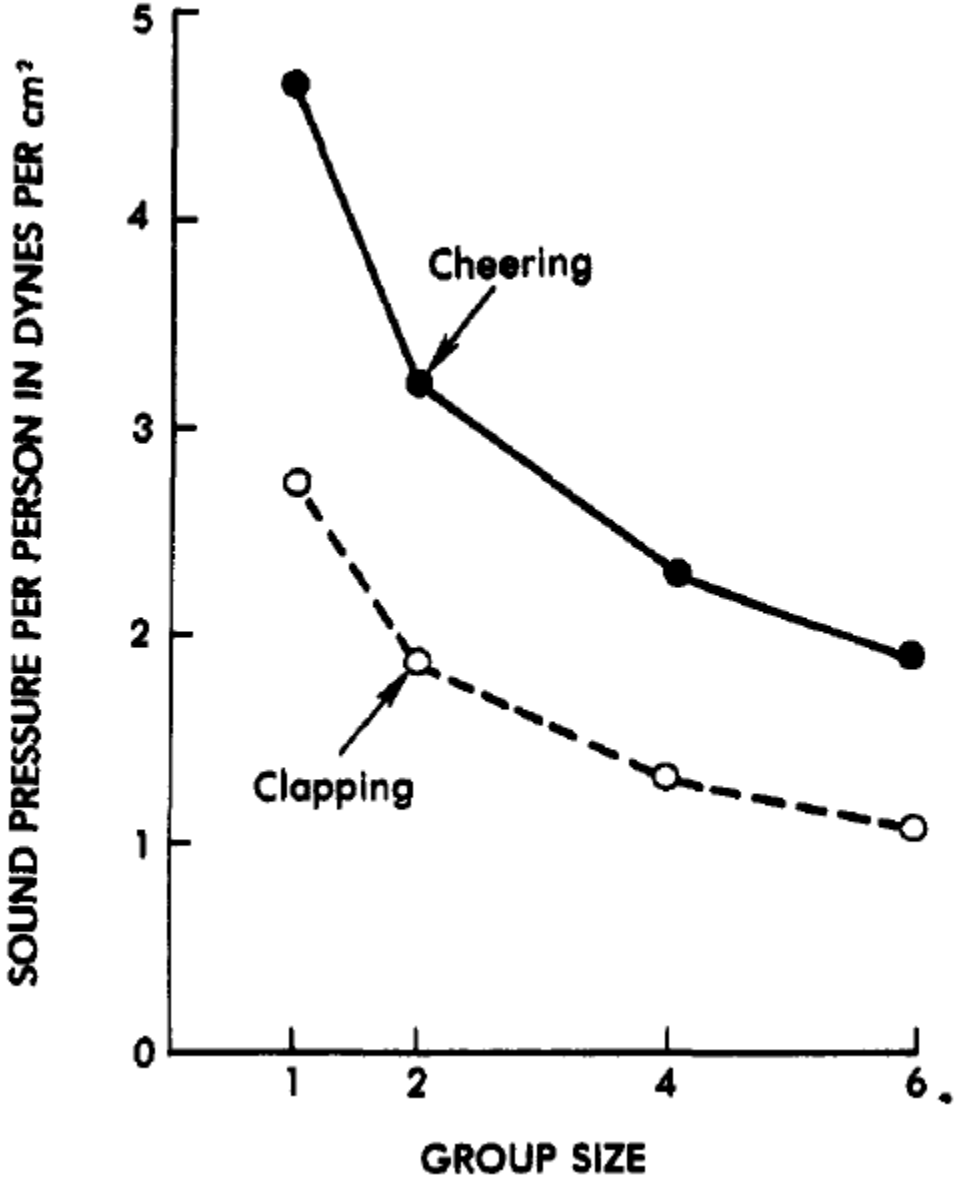

Latane, Bibb, Kipling Williams, and Stephen Harkins. "Many hands make light the work: The causes and consequences of social loafing." *Journal of personality and social psychology* 37.6 (1979): 822.

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.

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Mitigation Strategies

- Involve all team members, co-location
- 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

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Agile Practices as Mitigation?

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Responsibilities & Buy-In

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

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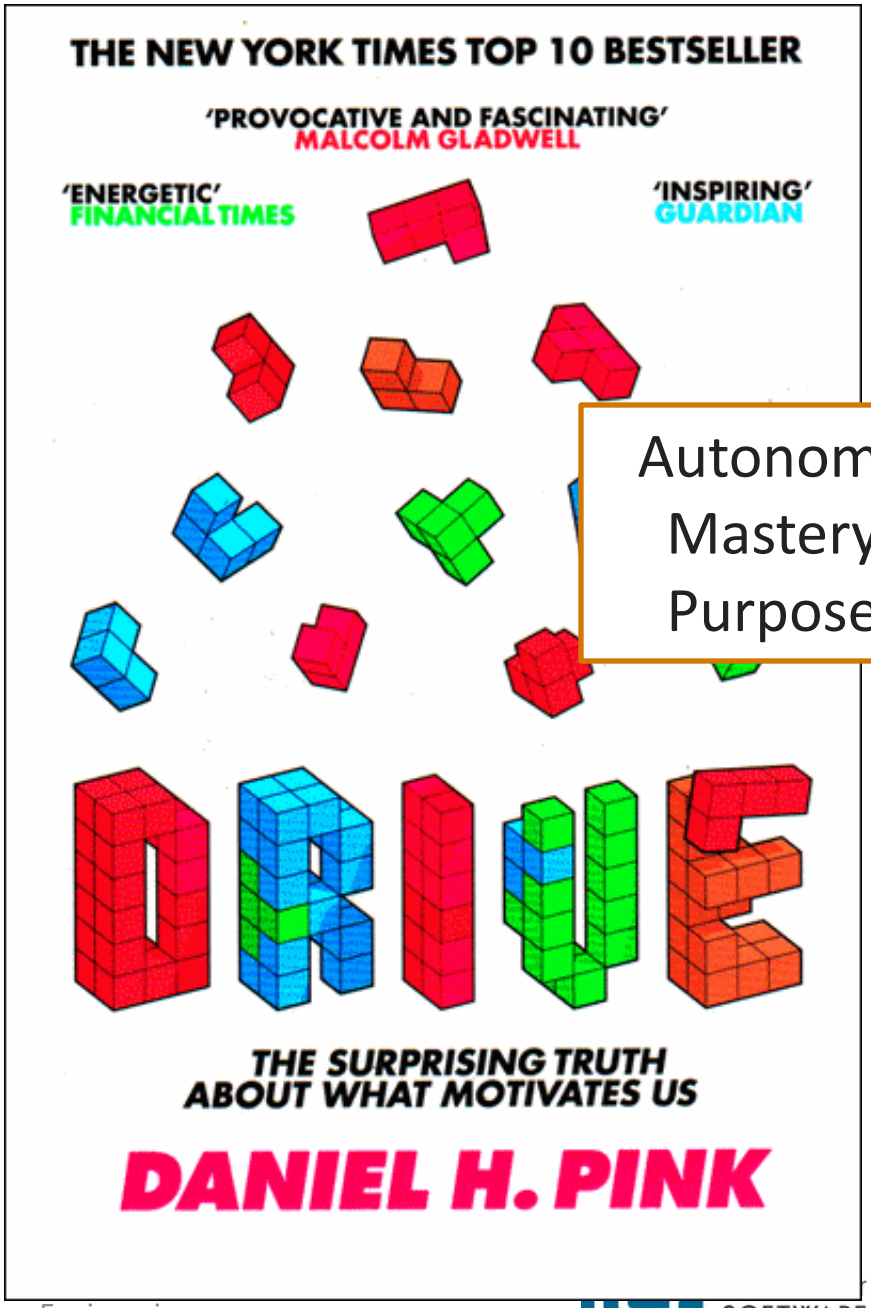

Autonomy
Mastery
Purpose

Team issues: Groupthink

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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

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Star Wars: Episode I - The Phantom Menace (1999)

55% 59%

Critics Consensus: Burdened by exposition and populated with stock characters, *The Phantom Menace* gets the *Star Wars* prequels off to a bumpy -- albeit visually dazzling -- start.

Starring: Liam Neeson, Ewan McGregor, Natalie Portman

Director: George Lucas

Star Wars: Episode VI - Return of the Jedi (1983)

80% 94%

Critics Consensus: Though failing to reach the cinematic heights of its predecessors, Return of the Jedi remains an entertaining sci-fi adventure and a fitting end to the classic trilogy.

Starring: Mark Hamill, Carrie Fisher, Harrison Ford

Director: Richard Marquand

Star Wars: Episode V - The Empire Strikes Back (1980)

95% 97%

Critics Consensus: Dark, sinister, but ultimately even more involving than *A New Hope*, *The Empire Strikes Back* defies viewer expectations and takes the series to heightened emotional levels.

Starring: Mark Hamill, Harrison Ford, Carrie Fisher

Director: Irvin Kershner

Star Wars: Episode IV - A New Hope (1977)

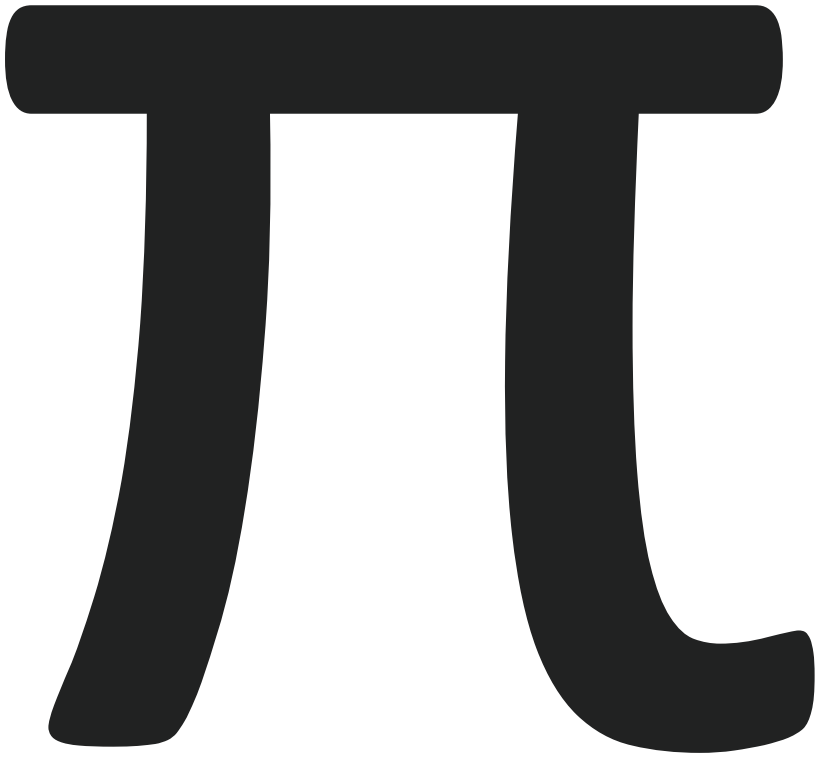
93% 96%

Critics Consensus: A legendarily expansive and ambitious start to the sci-fi saga, George Lucas opened our eyes to the possibilities of blockbuster filmmaking and things have never been the same.

Starring: Mark Hamill, Harrison Ford, Carrie Fisher

Director: George Lucas

Time and Cost Estimation



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)

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Symptoms

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

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Studies Show

- Gender-diverse management teams showed superior return on equity, debt/equity ratios, price/equity ratios, and average growth. -Rohner, U. and B. Dougan (2012)
- Gender-balanced teams were the most likely to experiment, be creative, share knowledge, and fulfill tasks. -Lehman Brothers Center for Women in Business. (2008)
- Gender diversity on technical work teams was associated with superior adherence to project schedules, lower project costs, higher employee performance ratings, and higher employee pay bonuses. -Turner, L. (2009)

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Unconscious Bias

We all have shortcuts, or “schemas,” that help us make sense of the world. But our shortcuts sometimes make us misinterpret or miss things. That’s **unconscious bias**.

Unconscious bias

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

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FastLane
www.fastlane.nsf.gov

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

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
- …

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Practical Help

Team issues: Multiple/conflicting goals

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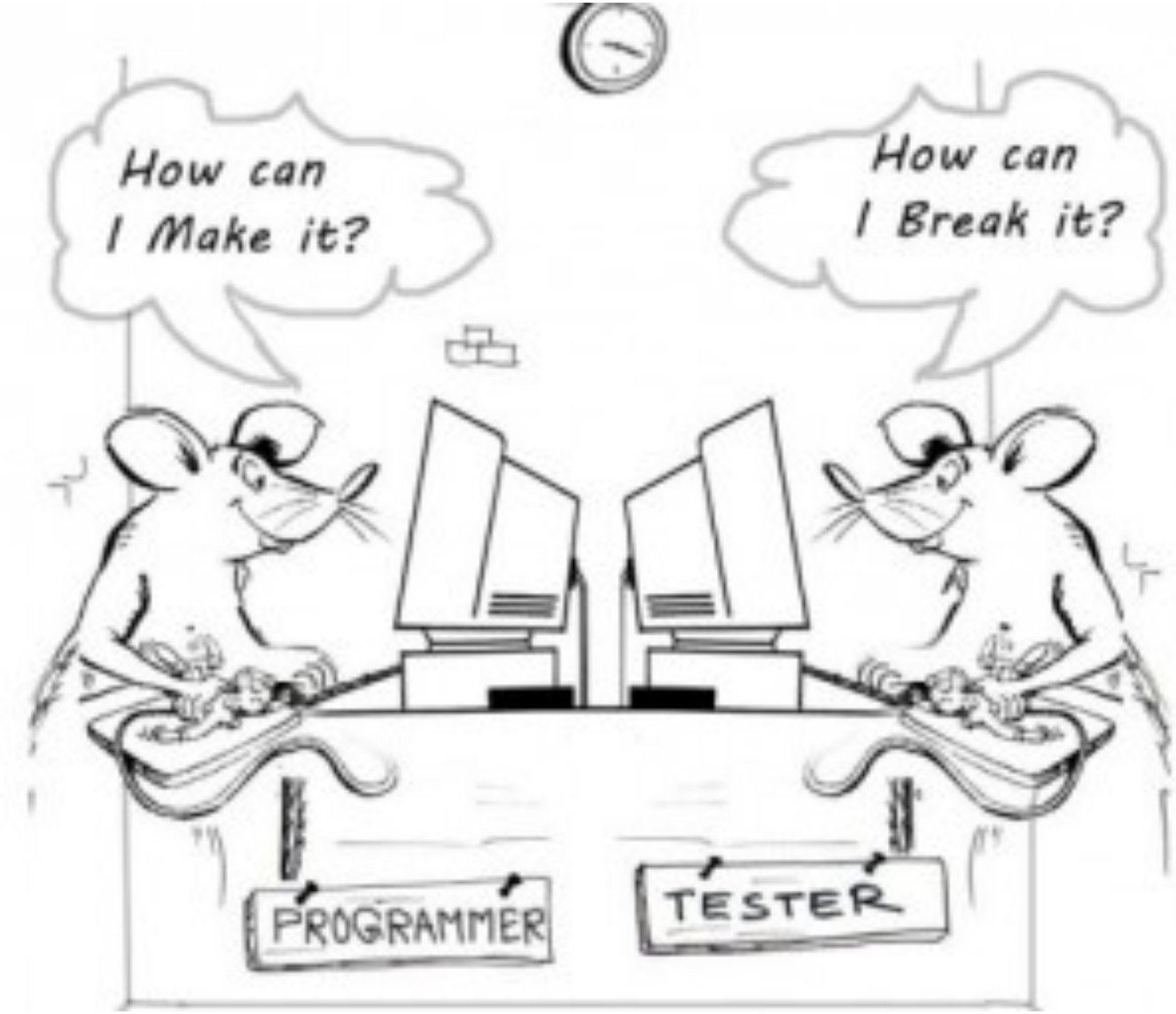
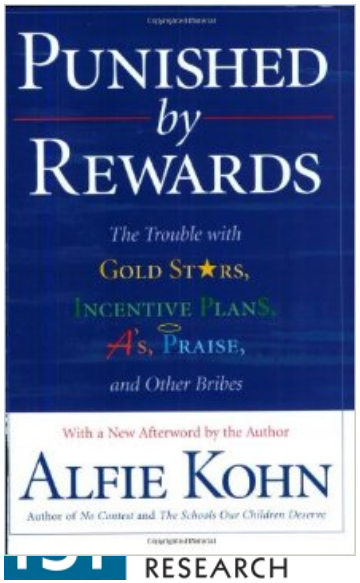

How can
I Make it?
How can
I Break it?
PROGRAMMER
TESTER

Incentives?

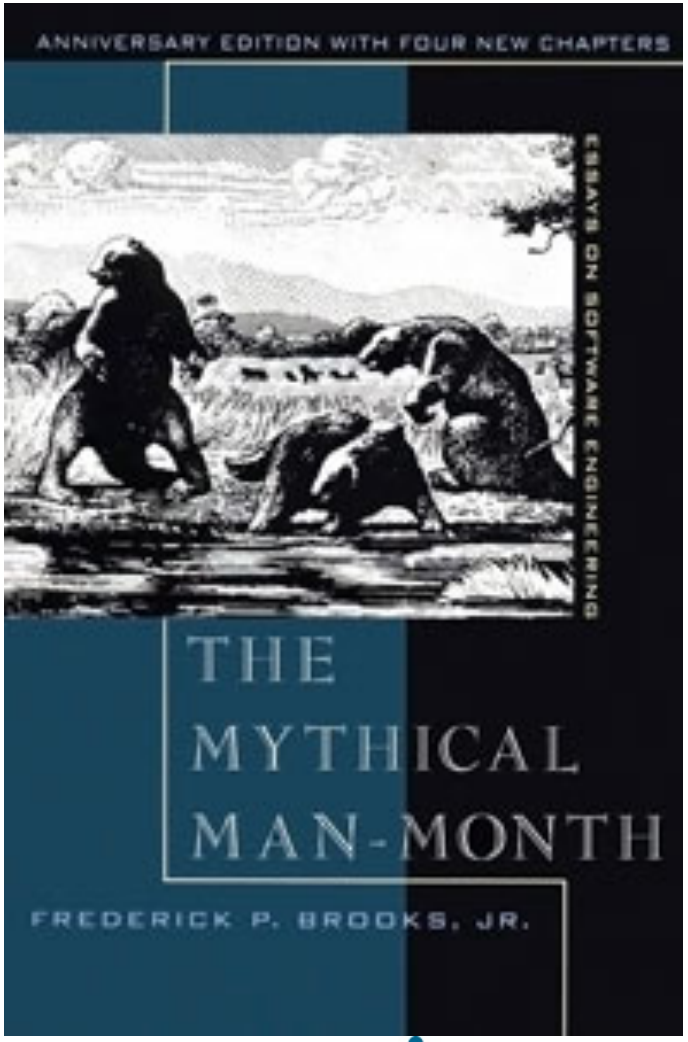
- Team incentives
- vs individual incentives?



Team issues: Process costs

Mythical Man Month

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



1975, describing experience at IBM developing OS/360

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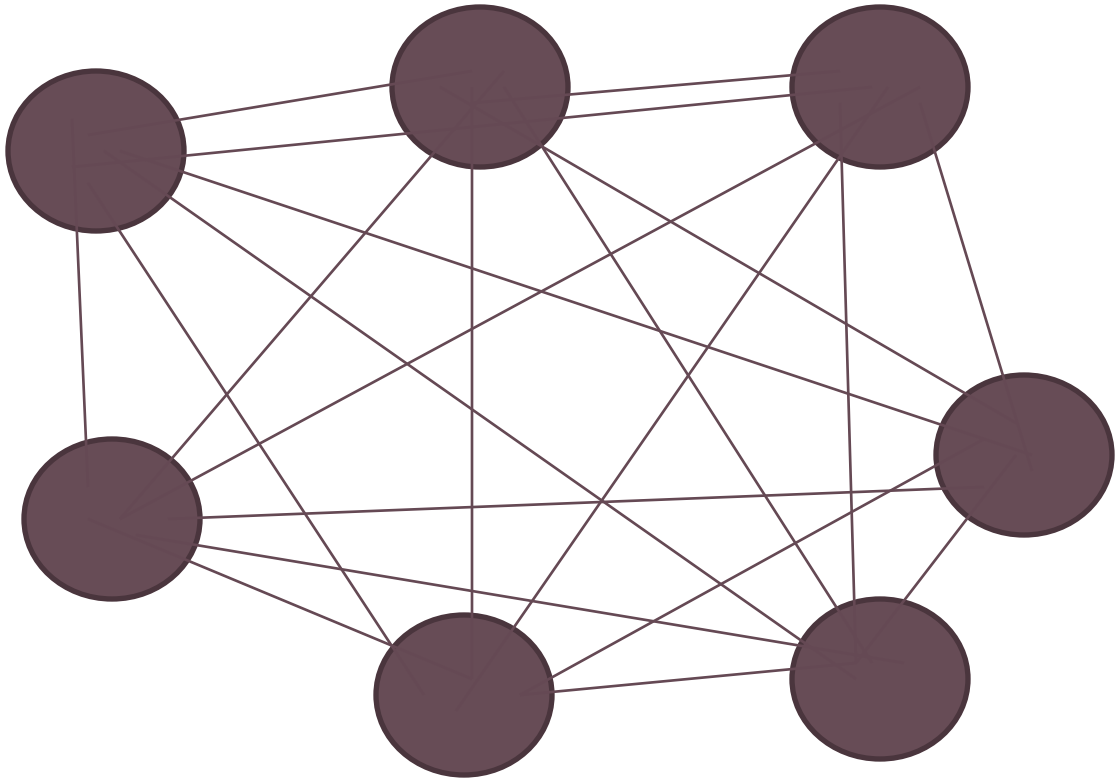
Process Costs



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

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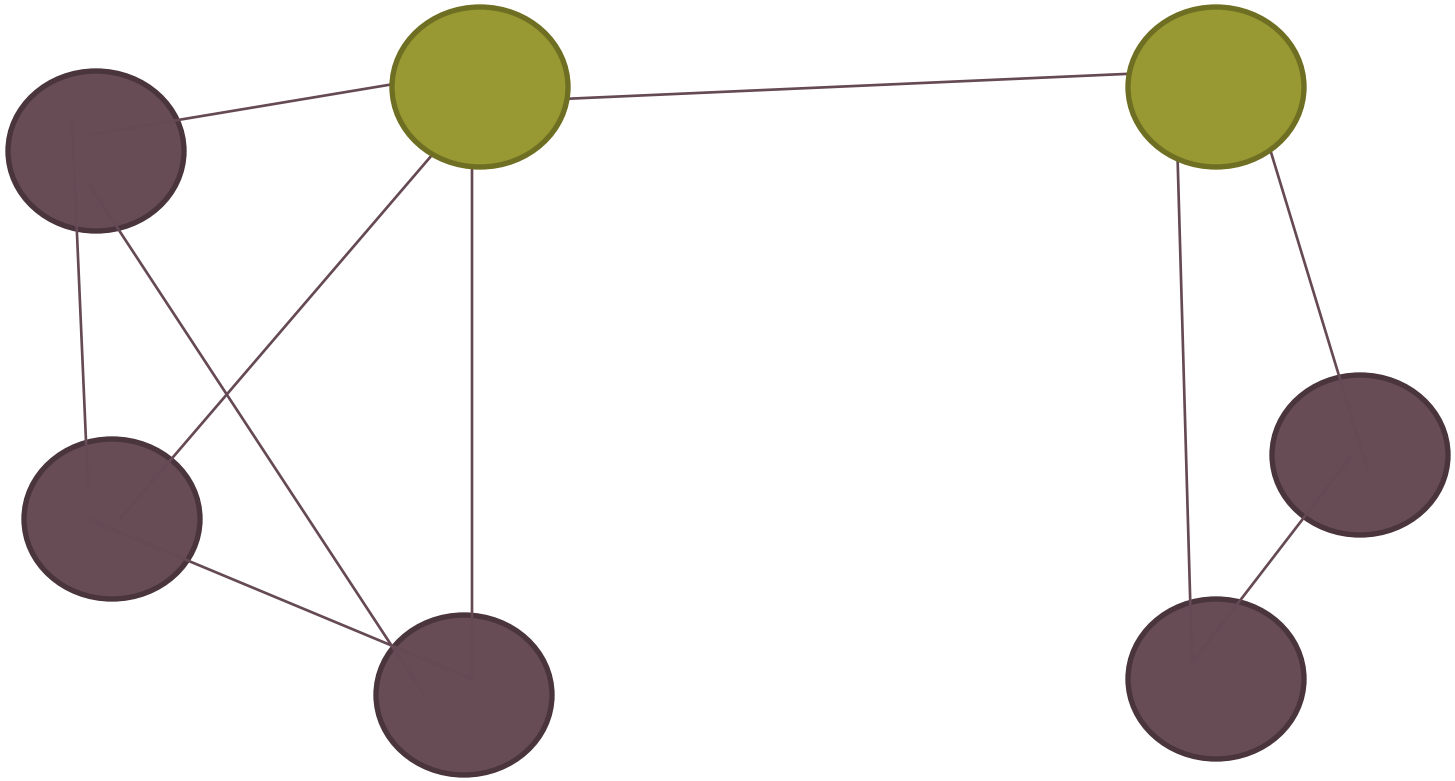
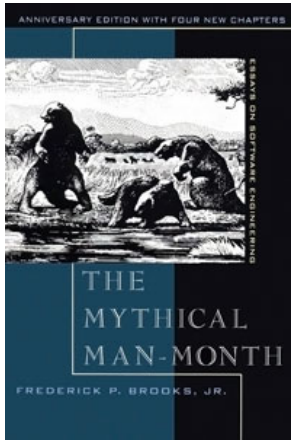
Process Costs



IBM 1971

Brook's Surgical Teams



- 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.

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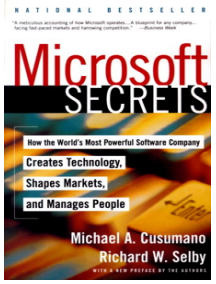
Microsoft's Small Team Practices



- 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

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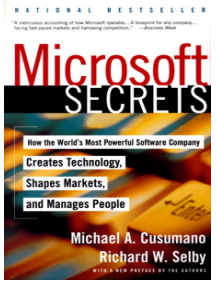
Microsoft's Small Team Practices



- 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)

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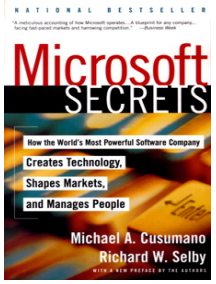
Microsoft's Small Team Practices



- "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

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Agile Practices (e.g., Scrum)

- 7+/-2 team members, collocated
- Self managing
- Scrum master (rotating role)
- Product owner / customer representative

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Mantle and Lichty

- Ideal team size: 2-3 co-located developers if possible

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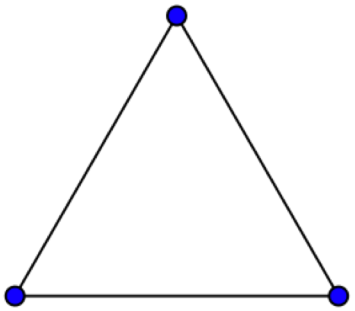
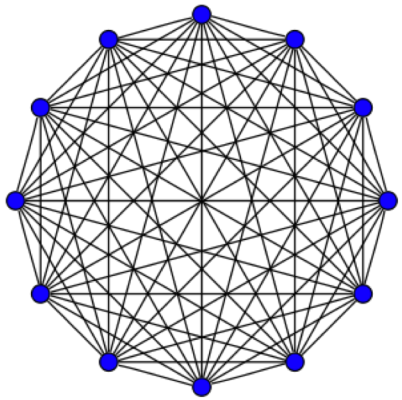
Large teams (29 people) create around six times as many defects as small teams (3 people) and obviously burn through a lot more money. Yet, the large team appears to produce about the same mount of output in only an average of 12 days' less time. This is a truly astonishing finding, through it fits with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

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Awareness

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

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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."

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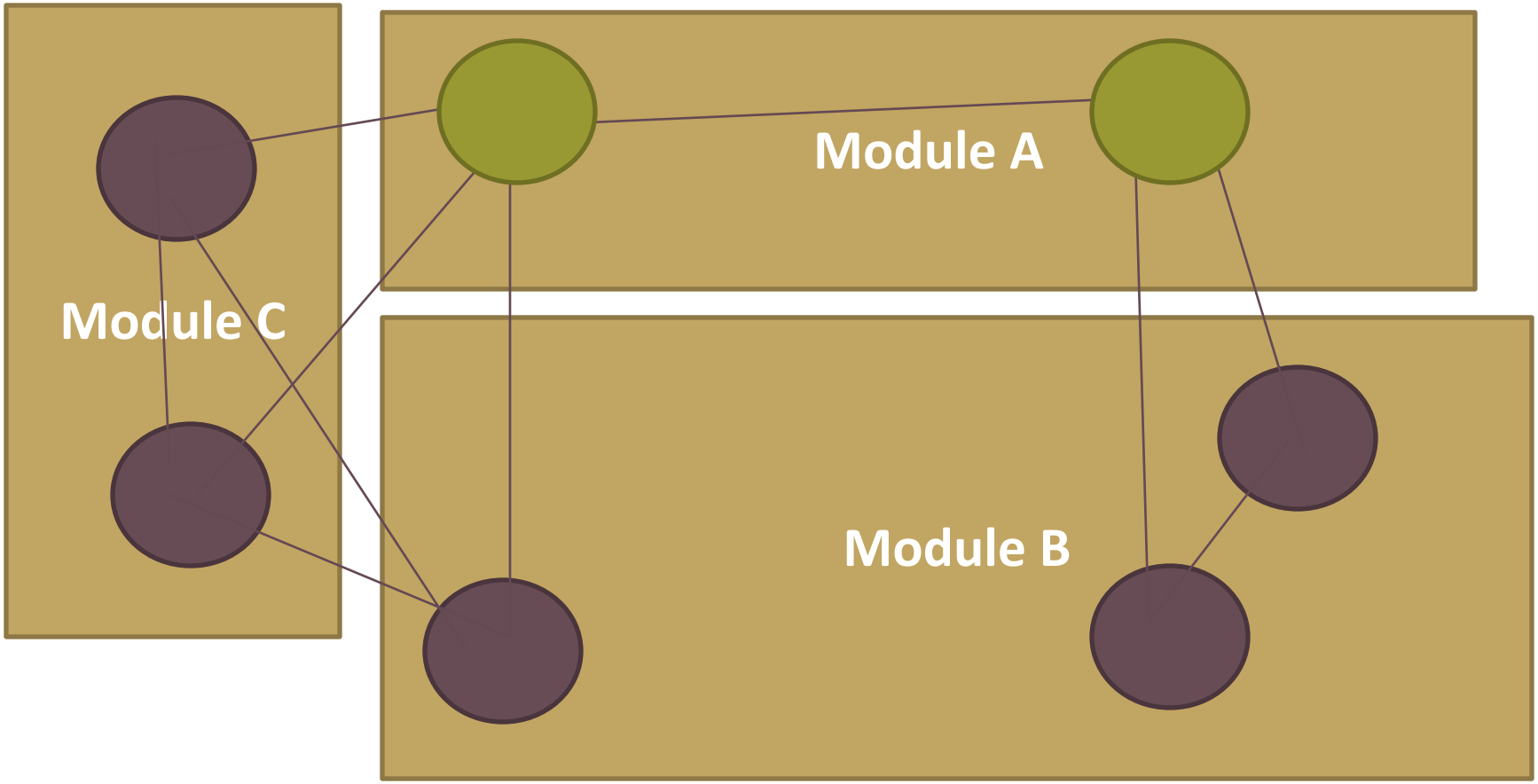
Congruence



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Socio-Technical Congruence

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

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Teamwork Guidelines

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

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Agile Practices as Mitigation?

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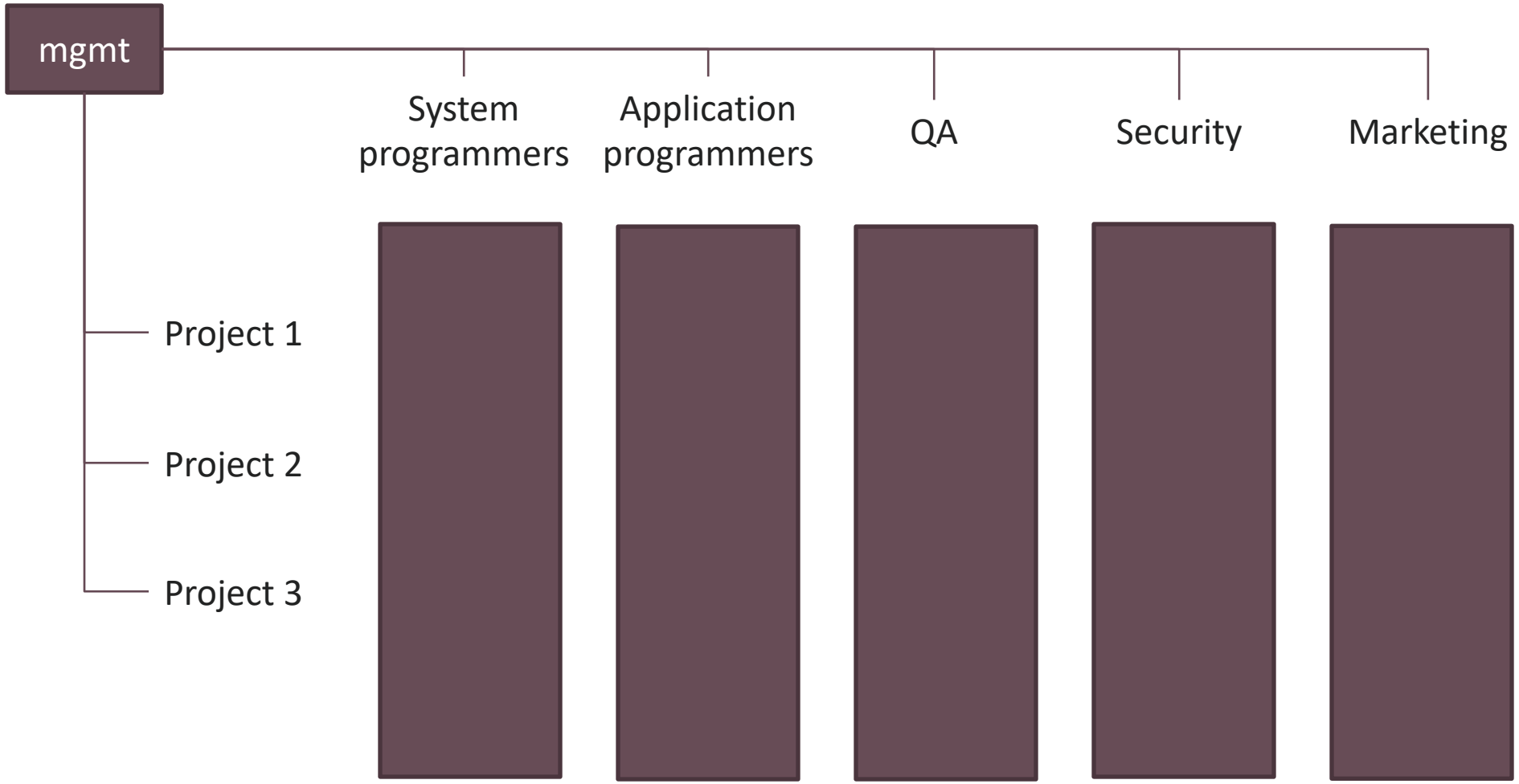
Matrix Organization



Temporary assignment to projects; flexible staffing

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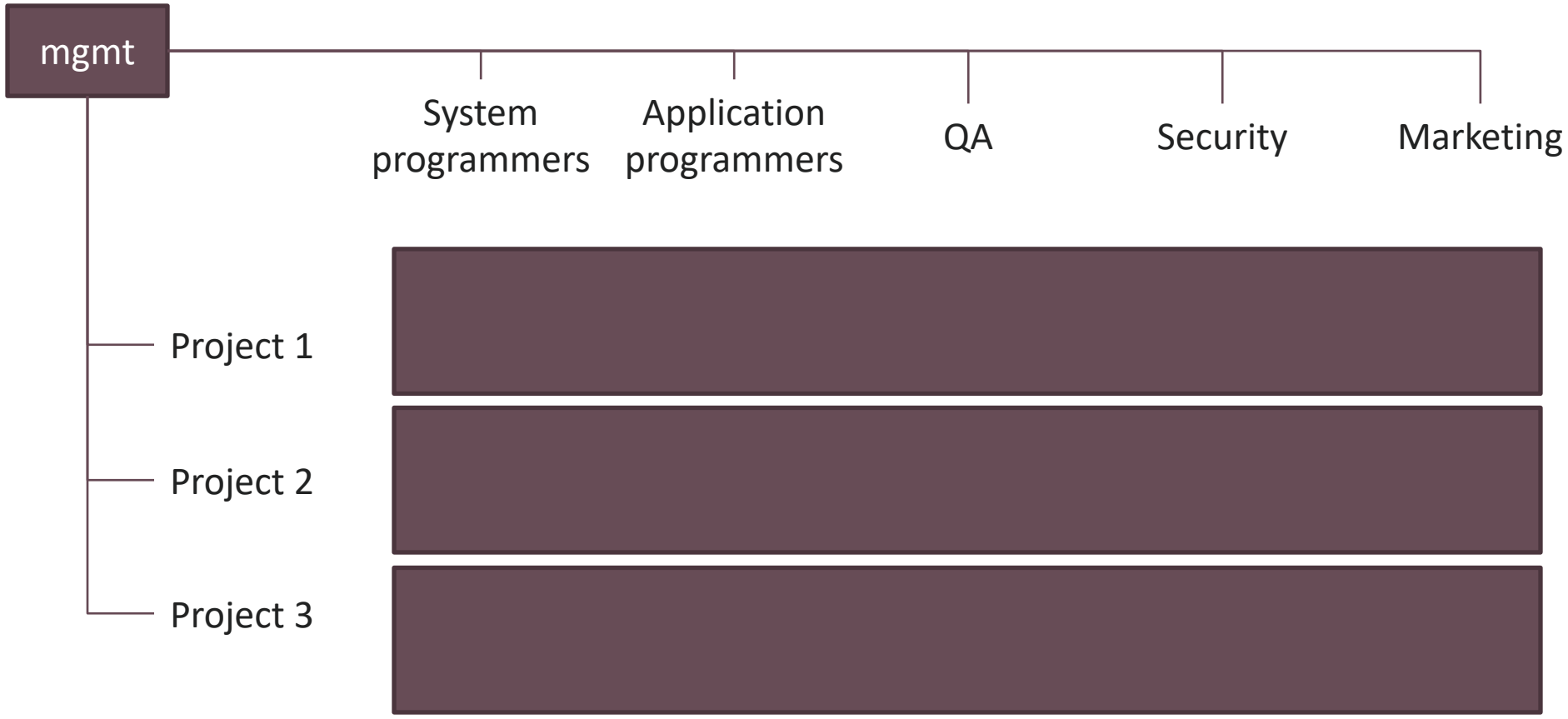
Project Organization



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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.

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Case Study


Brøderbund
SOFTWARE


Broderbund Software PRESENTS...
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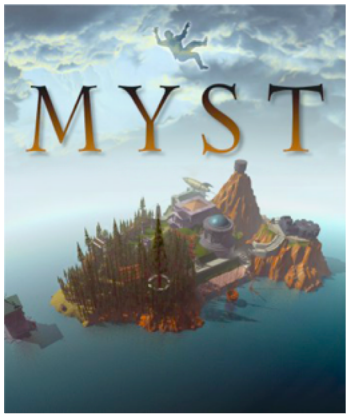
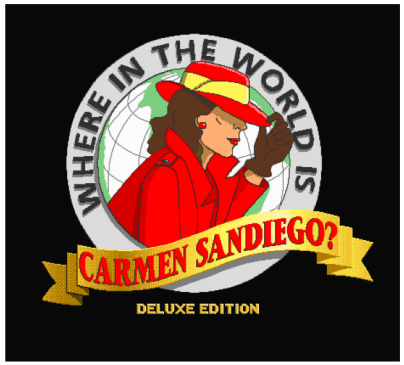

MYST


WHERE IN THE WORLD IS
CARMEN SANDIEGO?
DELUXE EDITION


PRINCE of PERSIA
©Copyright 1990 Jordan Mechner

Commitment & Accountability

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

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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

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Virtual Teams

Virtual Teams?

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

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

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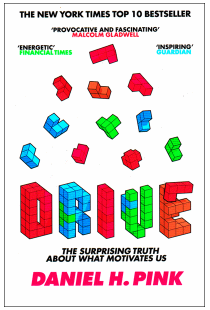
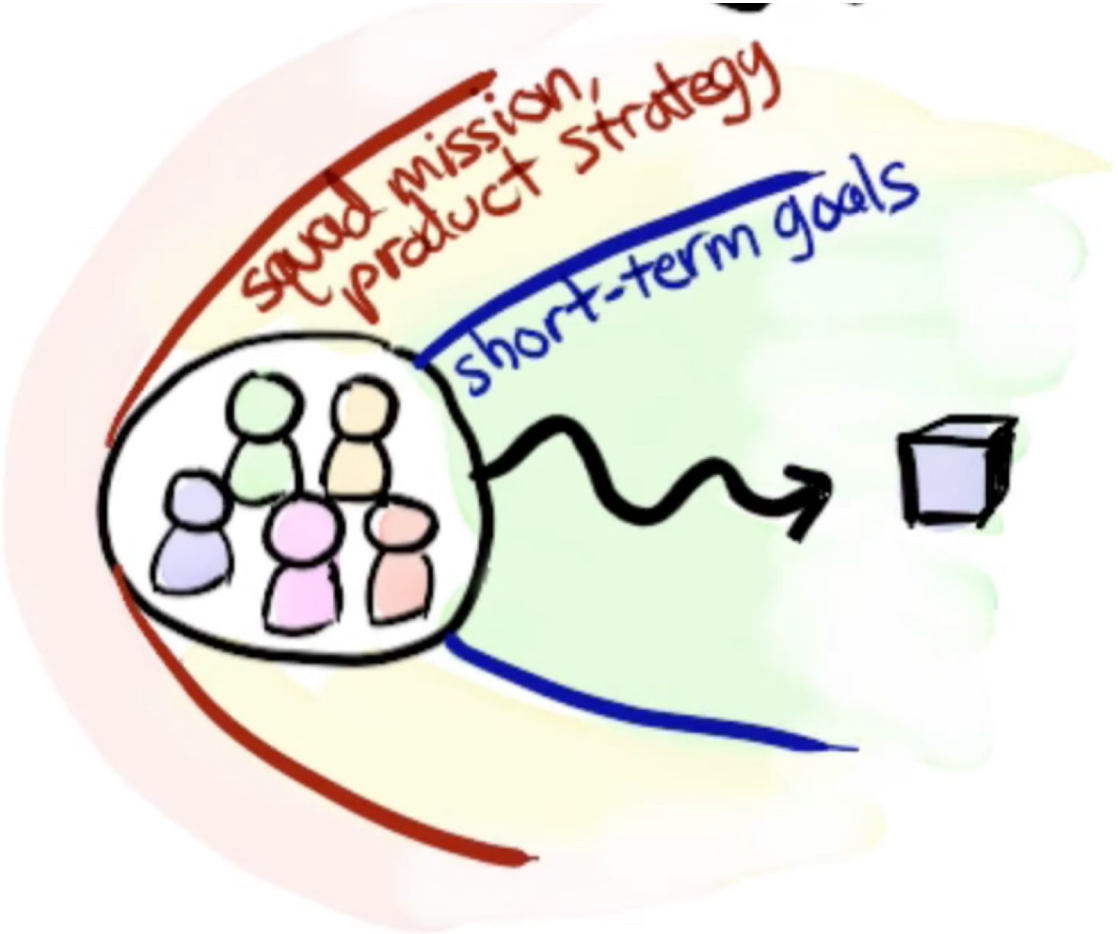
Spotify Squads

Principles

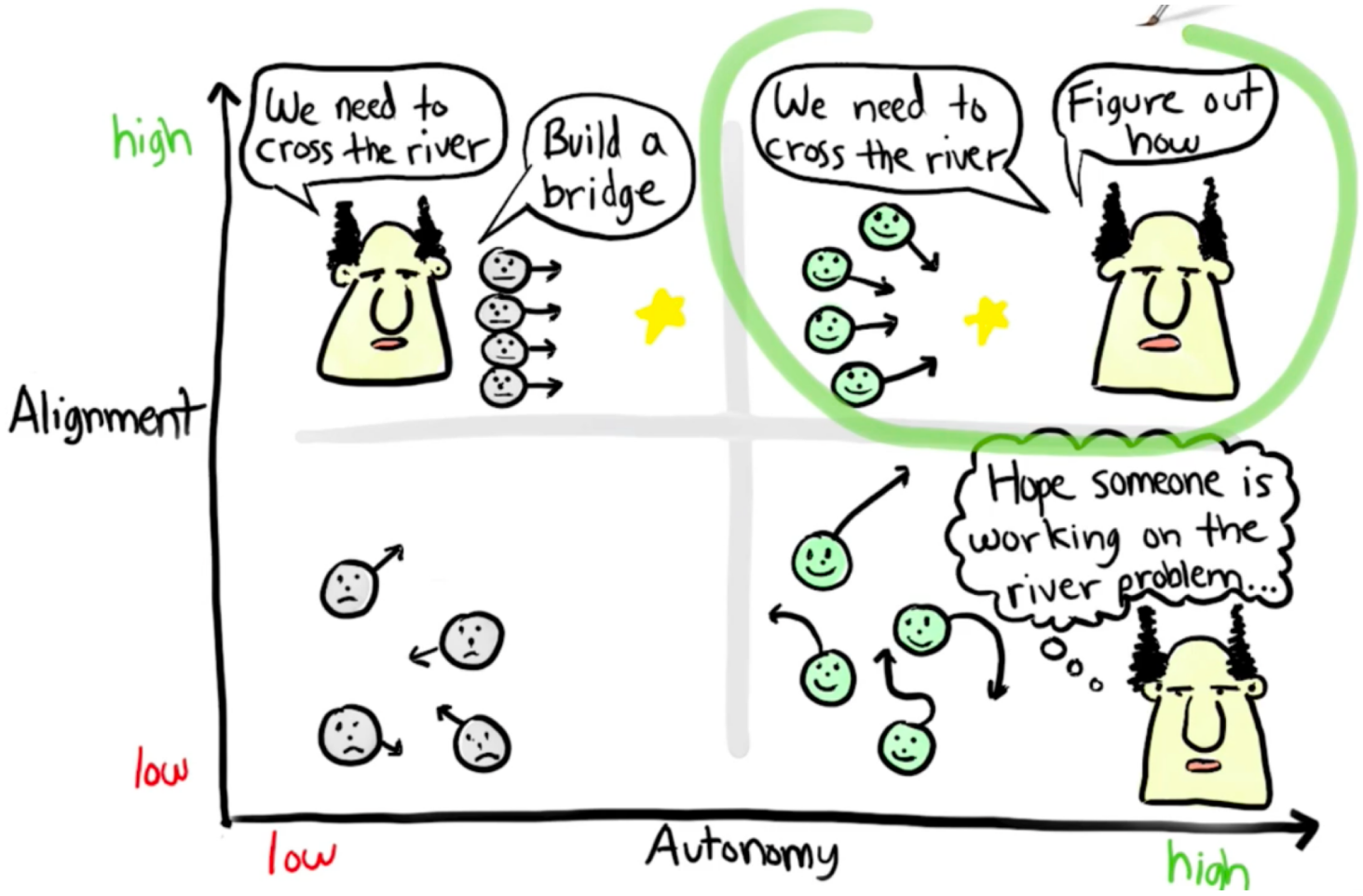
- Rules are a good start, then break them when needed
- Agile > Scrum
- Principles > Practices
- Autonomy, Mastery, Purpose
- *Be autonomous, but don't sub-optimize!*



Autonomous Squads



Aligned Autonomous squads



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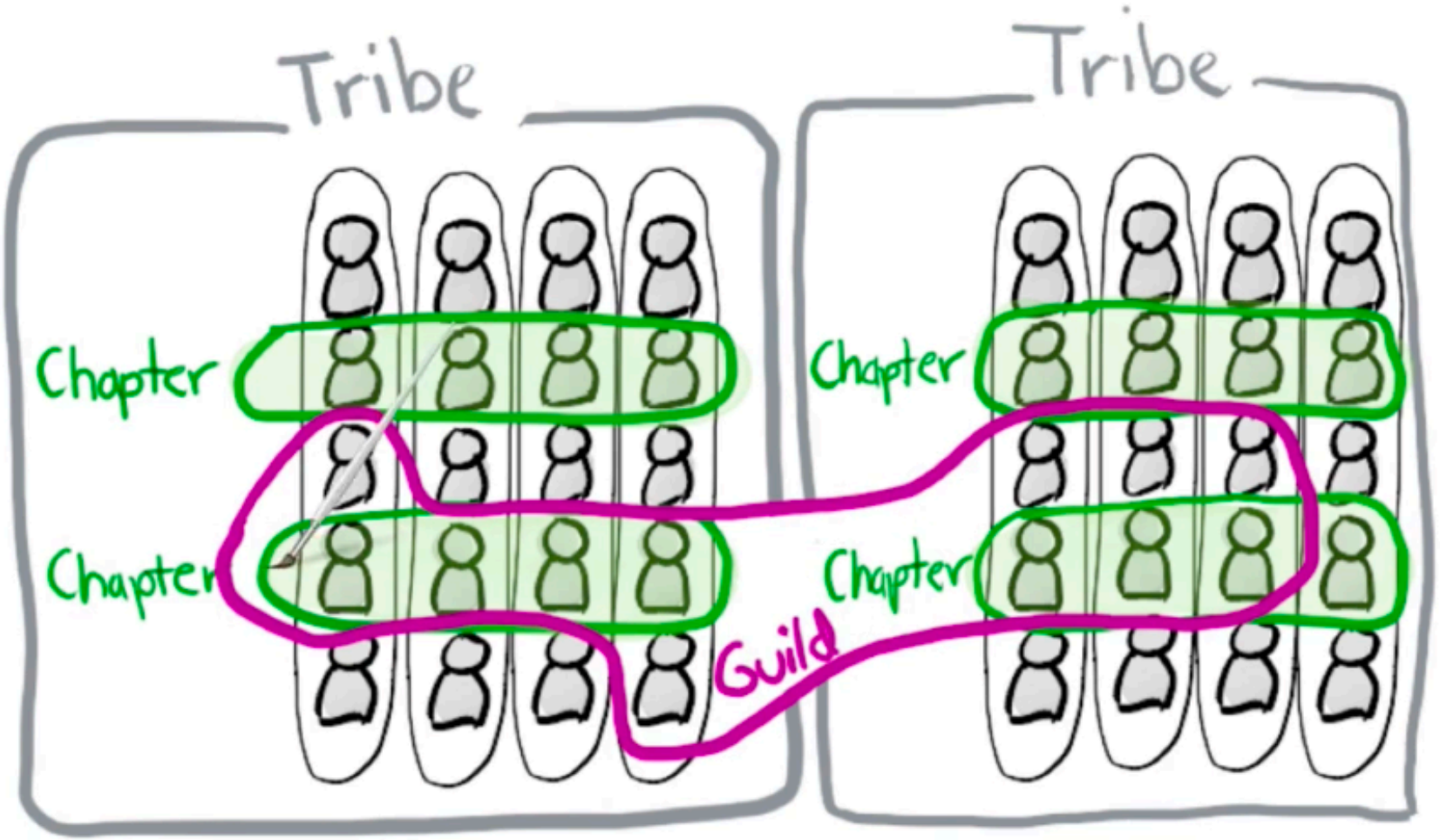
Squads, Tribes, Chapters, Guilds



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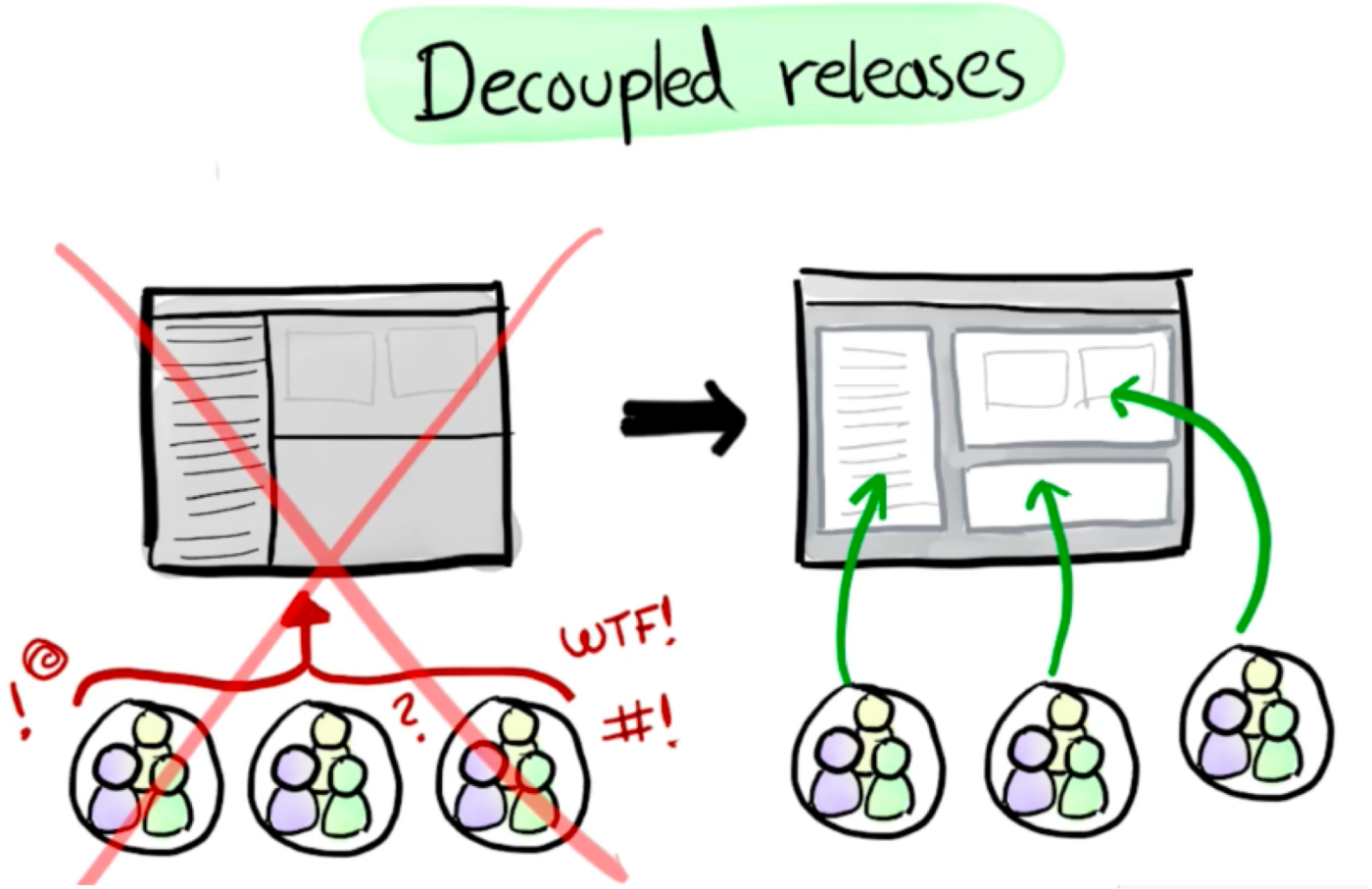
Getting into production



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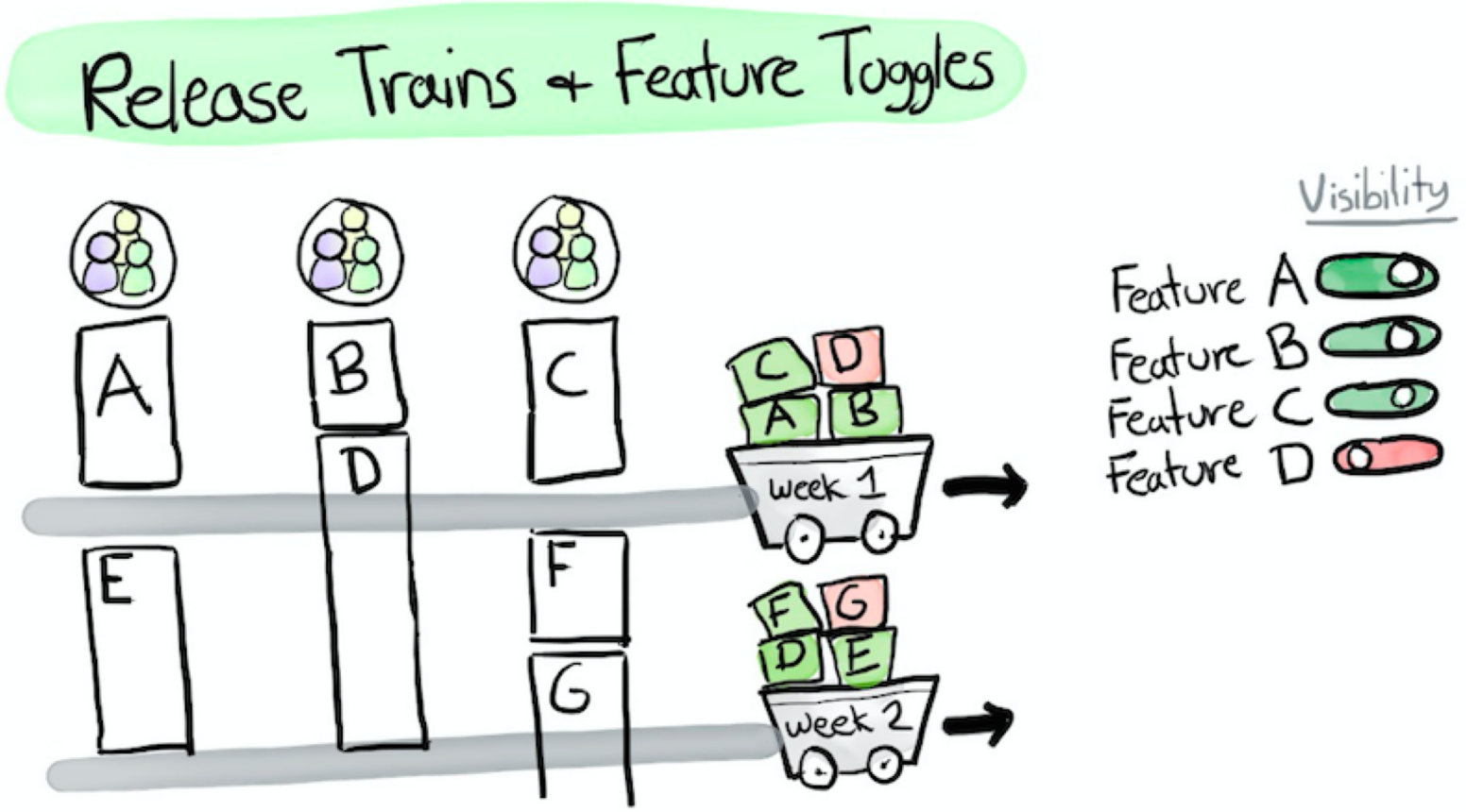
Decouple teams and releases



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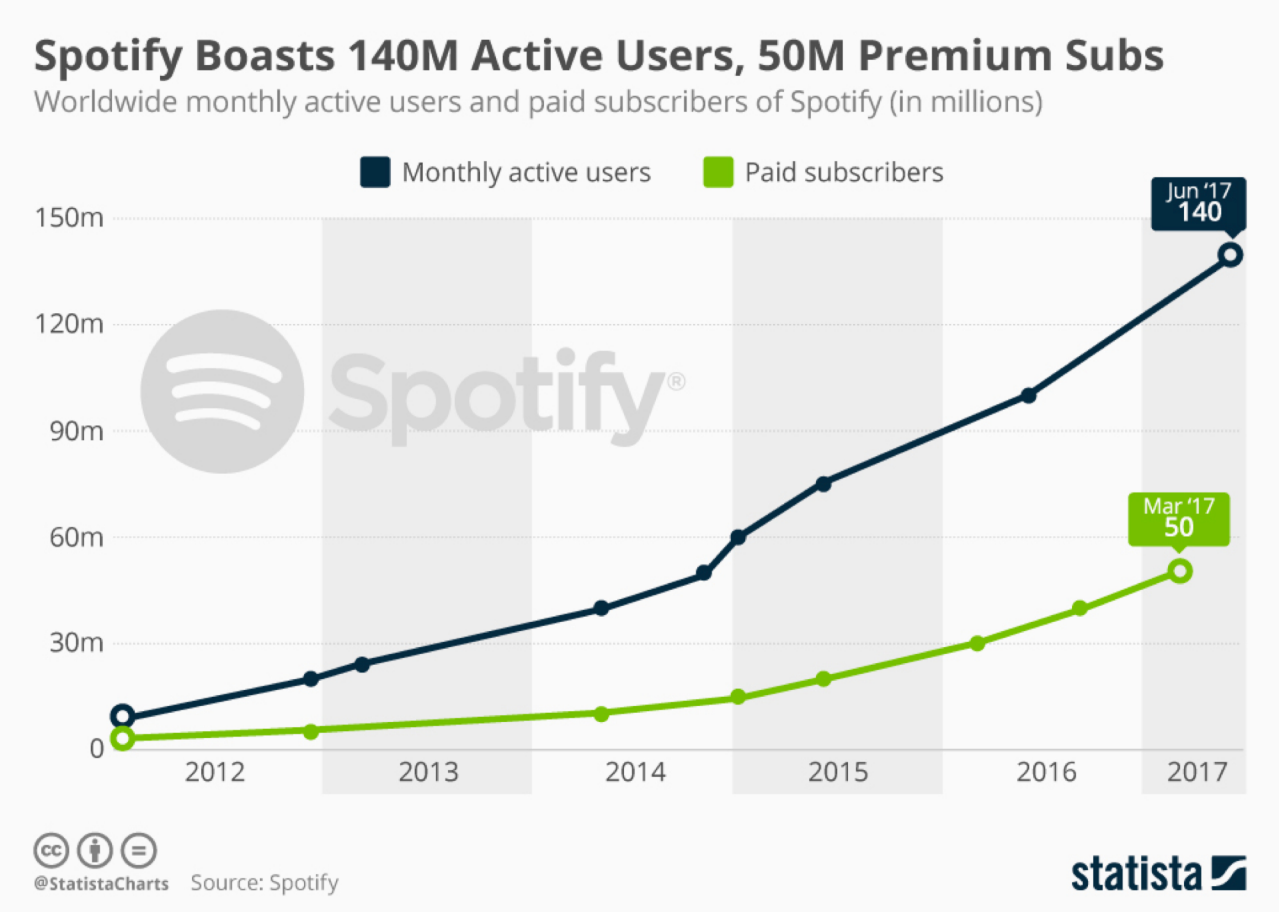
Context


Spotify Boasts 140M Active Users, 50M Premium Subs
Worldwide monthly active users and paid subscribers of Spotify (in millions)
Monthly active users
Paid subscribers
Jun '17
140
Mar '17
50
150m
120m
90m
60m
30m
0
2012
2013
2014
2015
2016
2017
Spotify®
@StatistaCharts
Source: Spotify
statista

Discussion

- Benefits?
- Challenges?
- Implementation pitfalls?

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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

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Team Fusion

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

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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

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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”

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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

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