

# Foundations of Software Engineering

Part 21: Motivation

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# Administrativa

- Michael: when is HW 5d due?
- HW 7a due end of week. We can get you feedback on your selected projects quickly.
- No class next week – Happy Thanksgiving

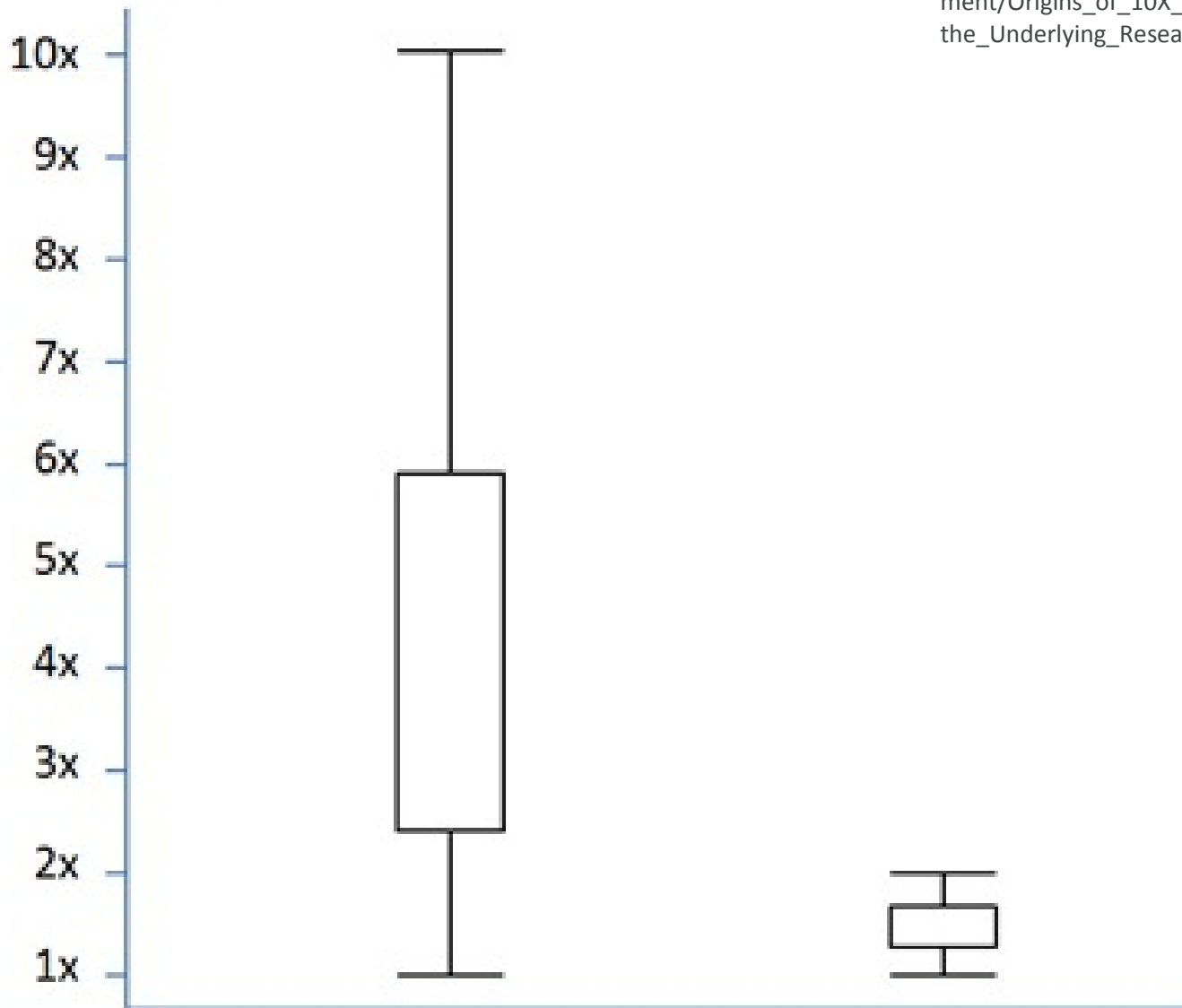
# Learning Goals

- Understand the differences among developers and implications for hiring and teamwork.
- Describe various models of motivation and their relationship to productive work environments.
- Design conditions that motivate developers.
- Understand team development and progression.

**10X**

# Productivity

[http://www.construx.com/10x\\_Software\\_Development/Origins\\_of\\_10X\\_%E2%80%93\\_How\\_Valid\\_is\\_the\\_Underlying\\_Research/](http://www.construx.com/10x_Software_Development/Origins_of_10X_%E2%80%93_How_Valid_is_the_Underlying_Research/)

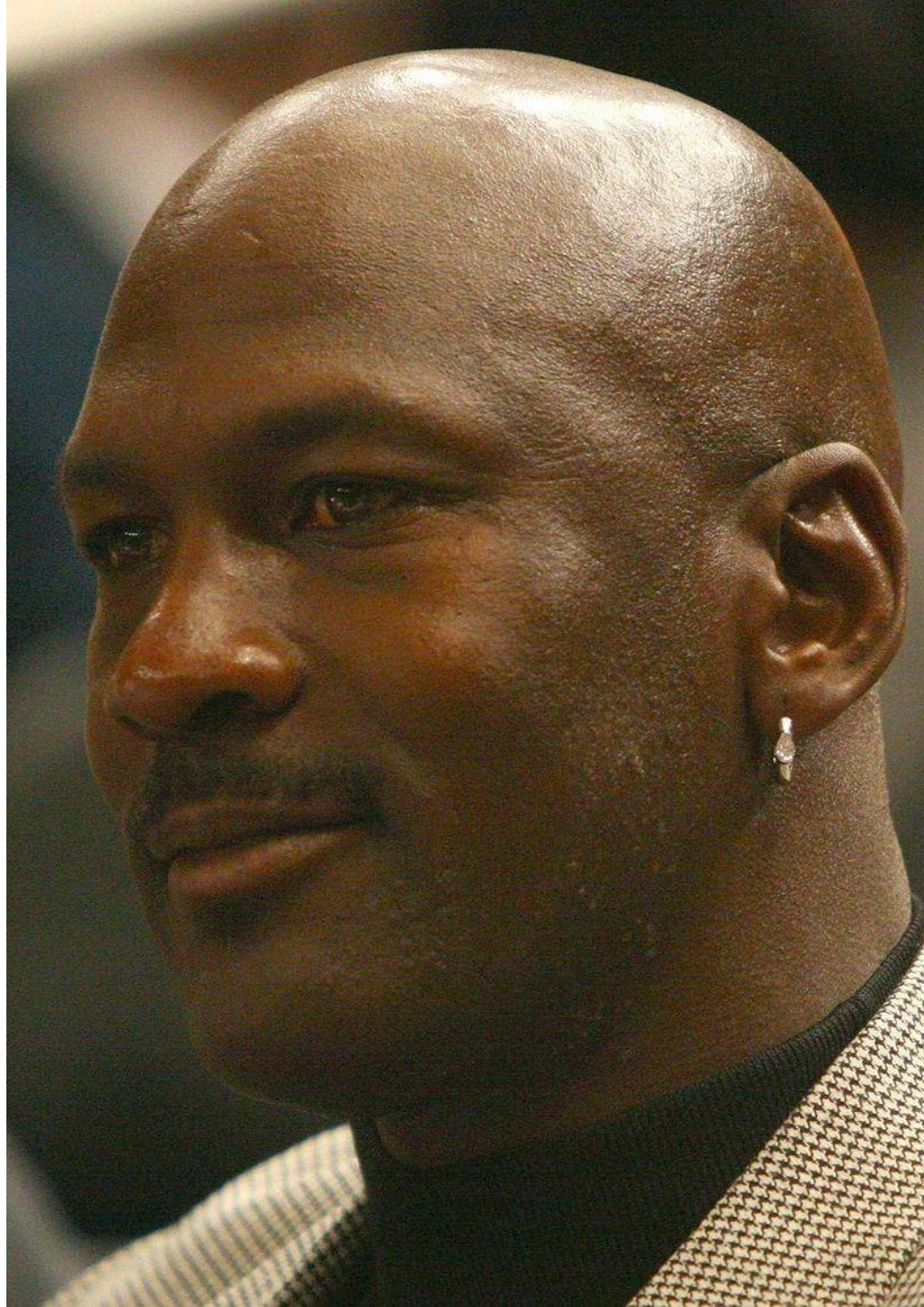


Individual  
Variation

Methodology  
Variation

# 10x

- Reported as early as 1968 (Sackman, Erickson, and Grant)
  - Coding time 20:1
  - Debugging time 25:1
  - Program size 5:1
  - Execution speed 10:1
  - No correlation to amount of experience
- "order-of-magnitude differences among programmers" repeatedly reported
- Differences not explained by
  - programming language
  - years of experience



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"During the time I was at Boeing in the mid 1980s, there was a project that had about 80 programmers working on it that was at risk of missing a critical deadline. The project was critical to Boeing, and so they moved most of the 80 people off that project and brought in one guy who finished all the coding and delivered the software on time."

– Steve McConnell



# 10x of Teams

- Lotus 123 version 3
- 260 staff years
- 400,000 lines of code.
- Microsoft Excel 3.0
- 50 staff years
- 649,000 lines of code

# Great programmers

according to Mantle and Lichty

- Intuitive sense for structure
- Discipline to design before code
- Write concise, clear, functional, high-quality code
- Produce the desired result
  
- -> Craftsman

# Challenge

- Find and hire 10Xers
- Motivate and coach programmers to become great programmers (“capable few”)
- Manage the rest (“merely competent”) to deliver successful results

# STAFF TURNOVER

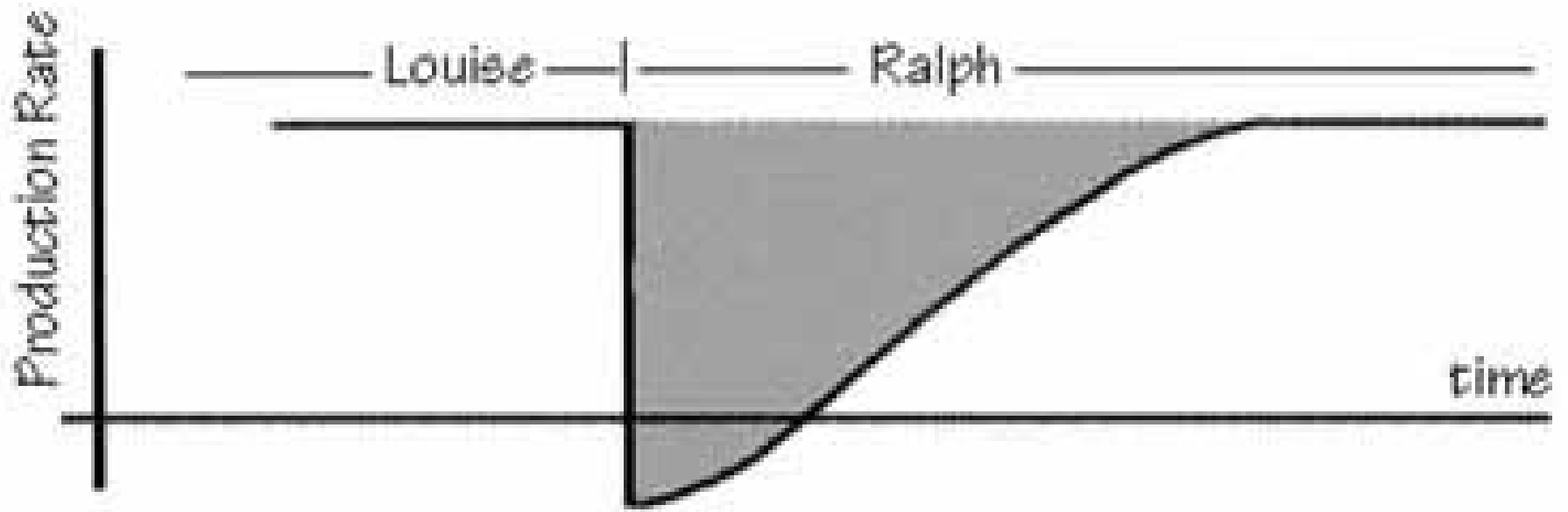
| Rank     | Employer Name  | Median Age of Employees | Median Employee Tenure | Median Pay |
|----------|--|-------------------------|------------------------|------------|
| 1        | Massachusetts Mutual Life Insurance Company                | 38                      | 0.8                    | \$60,000   |
| 2 - tie  | Amazon.com Inc   | 32                      | 1.0                    | \$93,200   |
| 2 - tie  | American Family Life Assurance Company of Columbus (AFLAC) | 38                      | 1.0                    | \$38,000   |
| 4 - tie  | Google, Inc.   | 29                      | 1.1                    | \$107,000  |
| 4 - tie  | Mosaic   | 37                      | 1.1                    | \$69,900   |
| 6 - tie  | Chesapeake Energy Corporation                              | 31                      | 1.2                    | \$60,500   |
| 6 - tie  | Group 1 Automotive, Inc.                                   | 32                      | 1.2                    | \$33,200   |
| 6 - tie  | Ross Stores, Inc   | 29                      | 1.2                    | \$23,800   |
| 6 - tie  | Wellcare Health Plans, Inc.                                | 38                      | 1.2                    | \$49,900   |
| *        |  |                         |                        |            |
| 11 - tie | Amerigroup Corporation                                     | 39                      | 1.3                    | \$54,800   |
| 11 - tie | Brightpoint North America, Inc.                            | 45                      | 1.3                    | \$42,100   |
| 11 - tie | Devon Energy Corporation                                   | 31                      | 1.3                    | \$63,200   |
| 11 - tie | Family Dollar Stores Inc                                   | 38                      | 1.3                    | \$23,400   |
| 11 - tie | Freeport-McMoRan Copper & Gold Inc                         | 36                      | 1.3                    | \$62,900   |
| 11 - tie | Paccar Corporation   | 33                      | 1.3                    | \$62,200   |

Source: <http://www.techrepublic.com/blog/career-management/tech-companies-have-highest-turnover-rate/>; payscale.com data

|          |              |    |     |           |
|----------|--------------|----|-----|-----------|
| 16 - tie | Sandisk Corp | 34 | 1.5 | \$110,000 |
| 18 - tie | Tenneco Inc  | 40 | 1.5 | \$69,900  |

# Turnover

- > 20% turnover per year typical
  - average employment 15-36 month
- Costs?
- Reasons?
- Mitigations?



# High turnover is expensive

- Hiring overhead
  - Costs (1.5 month salary to agency)
  - Lost productivity (interviews)
- Getting new developers up to speed
  - Unproductive time (~6 month ramp up; 2 years in some estimates)
  - Training overhead
- Overhead for maintaining abandoned code
- Tendency to short-term viewpoints
- Premature promotions
- Young inexperienced staff



# Causes of, mitigations for turnover

- Causes (from literature, caveats for tech companies):
  - Just-passing-through mentality
  - Feeling of disposability
  - “Loyalty would be ludicrous”
  - High turnover encourages turnover
    - No investment in training
    - No investment in hiring 10xers
- Mitigations:
  - Environment and culture
    - striving to be "the best"
    - teams
  - Investment in personal growth, via retraining, no dead-end jobs
- *Advice: enable appropriate processes to maintain productivity despite turnover.*

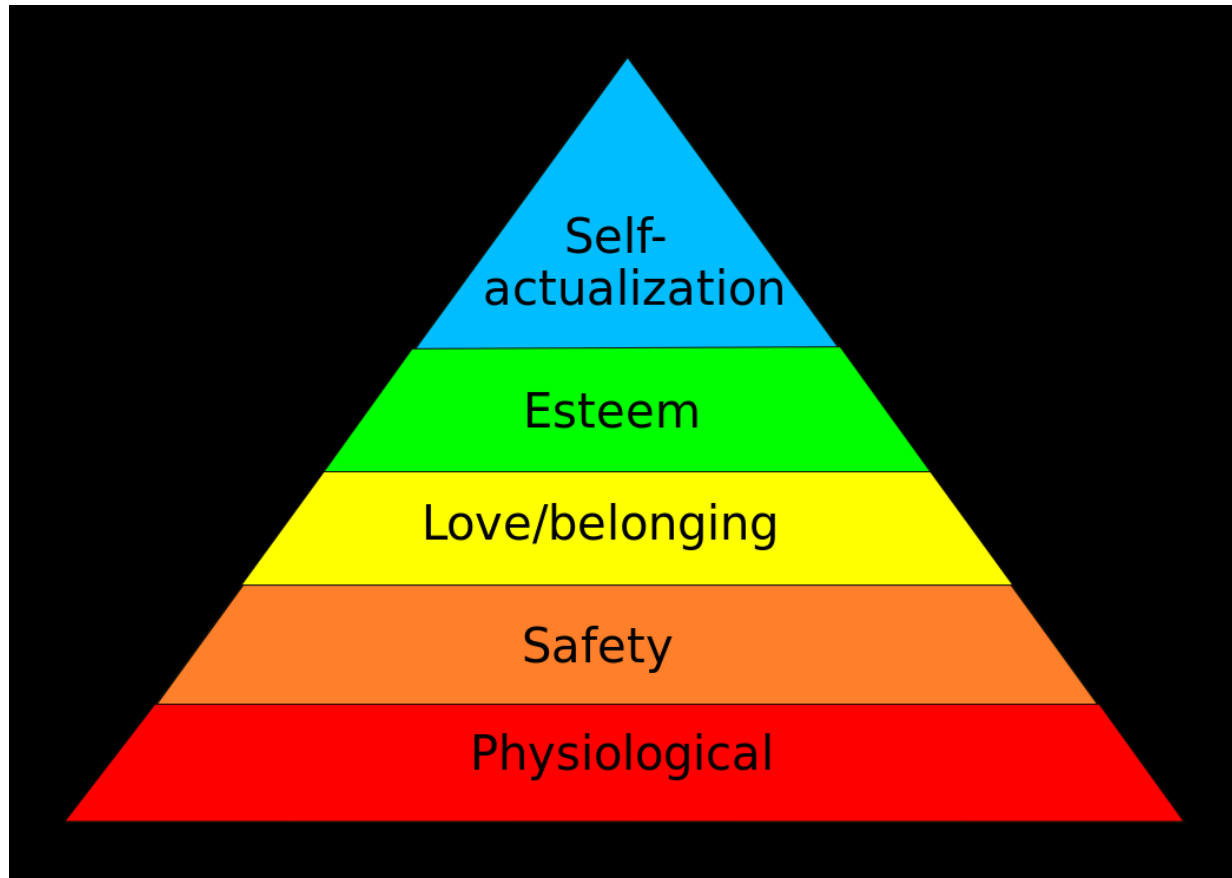
# MOTIVATING PROGRAMMERS

# Growth and Challenge

# Theories

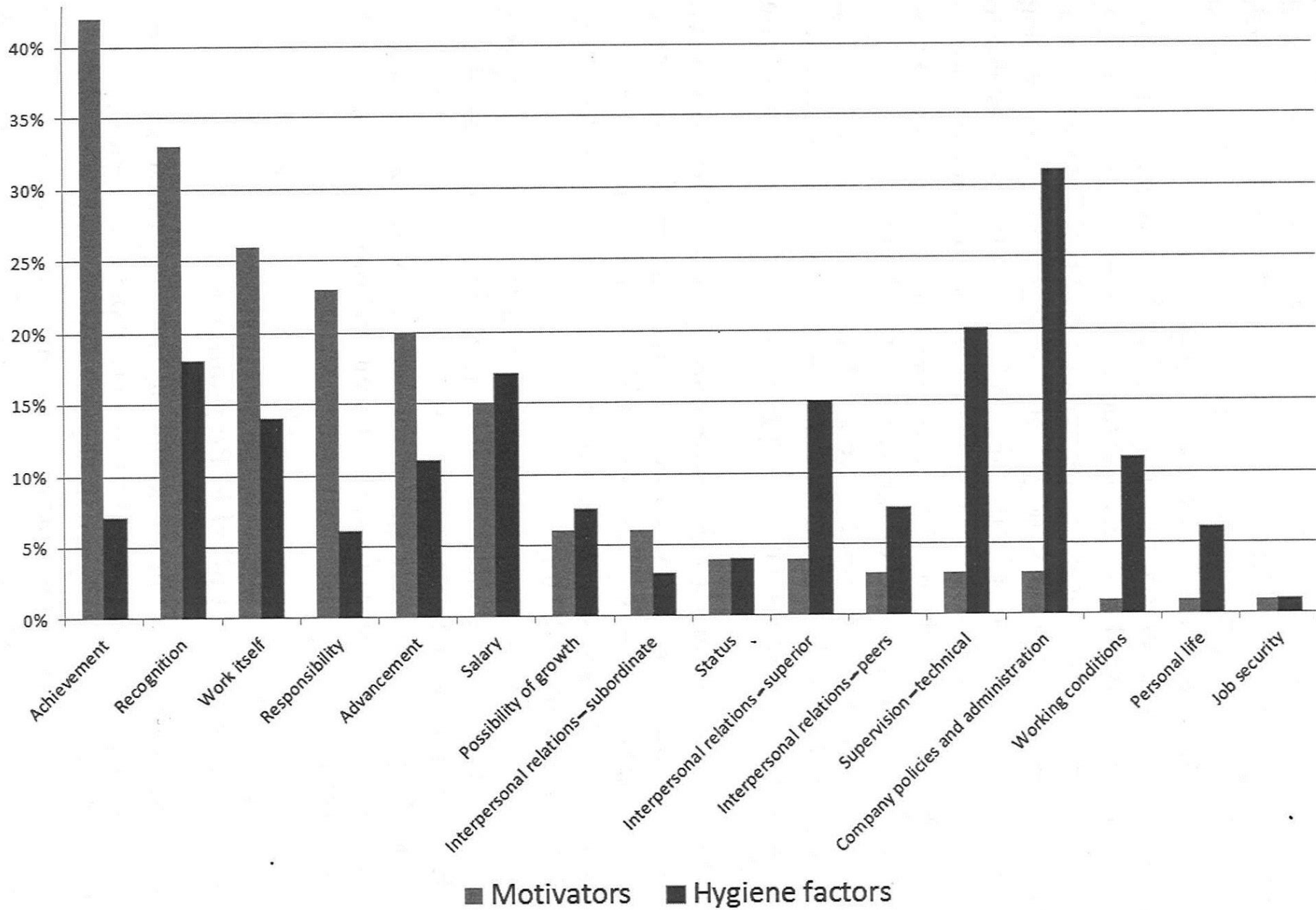
- Maslow's Hierarchy of Needs
- Herzberg's Motivation and Hygiene Factors
- Daniel Pink, Drive: The Surprising Truth About What Motivates Us.

# Maslow's hierarchy of needs (1943)



# Herzberg's Motivation and Hygiene Factors (1960s)

- (aka two-factor theory)
- Different factors for satisfaction and dissatisfaction
  - Addressing dissatisfaction does not lead to satisfaction
- Step 1: Eliminate dissatisfaction
- Step 2: Create condition for satisfaction

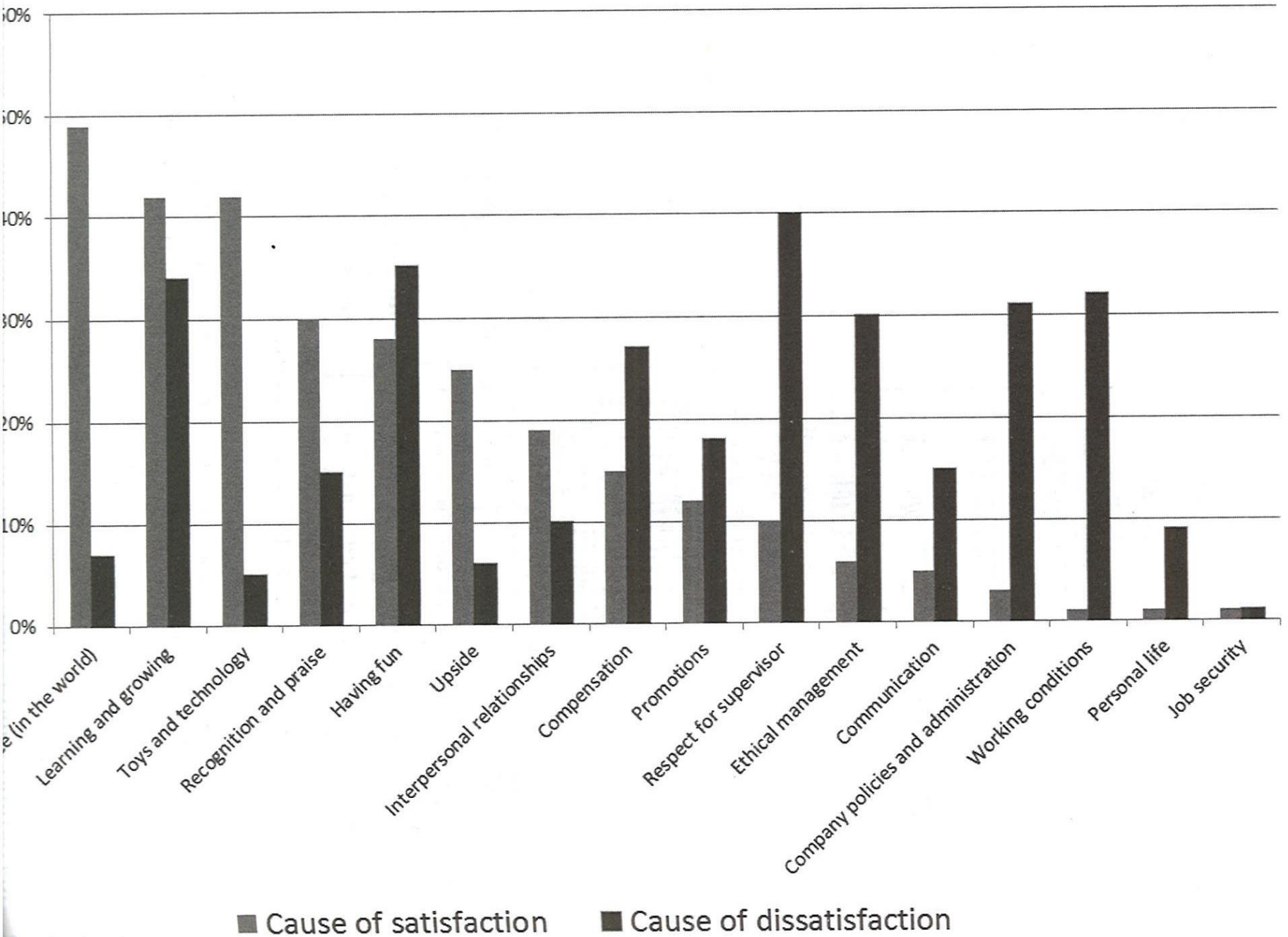


# Identify Motivation and Hygiene Factors for Programmers

- Communication
- Company policies and administration
- Compensation
- Ethical management
- Having fun
- Interpersonal relationships
- Job security
- Learning and growing
- Making a difference
- Promotions
- Recognition and praise
- Respect for supervisor
- Toys and technology
- Upside



(Observation by Mantle and Lichy, not empirical data)



# Addressing Causes of Dissatisfaction

- Respect for supervisor
- Having fun
- Learning and growing
- Good working conditions
- Sane company policies and administration
- Ethical management
- Fair compensation
  
- (often within control)

# Addressing Causes of Dissatisfaction (selective)

- Respect as supervisor
  - gain technical credit
  - respect others
  - lead by example
  - help solve technical problems
  - manage and coach
- Having fun
  - out of office play
  - celebrations of accomplishments and occasions

# Addressing Causes of Dissatisfaction (selective)

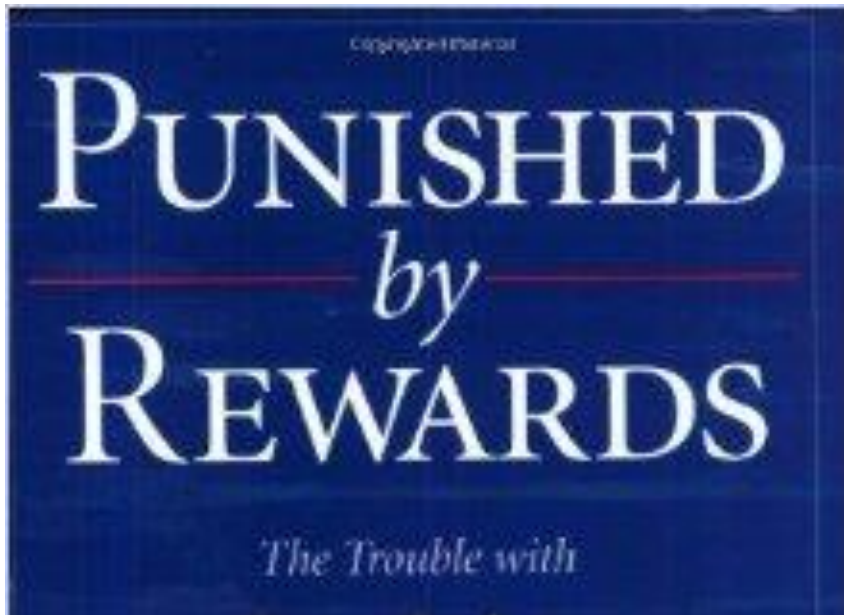
- Learning and growing
  - protect time for learning
  - explore new technologies; prototype
  - budget for attending conferences, seminars, inhouse training
  - invite guest speakers
- Good working conditions
  - plenty of whiteboards
  - room for discussions
  - Quiet space, Limit interruptions, avoid meeting culture
  - cubicles vs separate offices
  - fire “jerks”
  - free food
  - flexible hours, flexible dress, flexible space

# Addressing Causes of Dissatisfaction (selective)

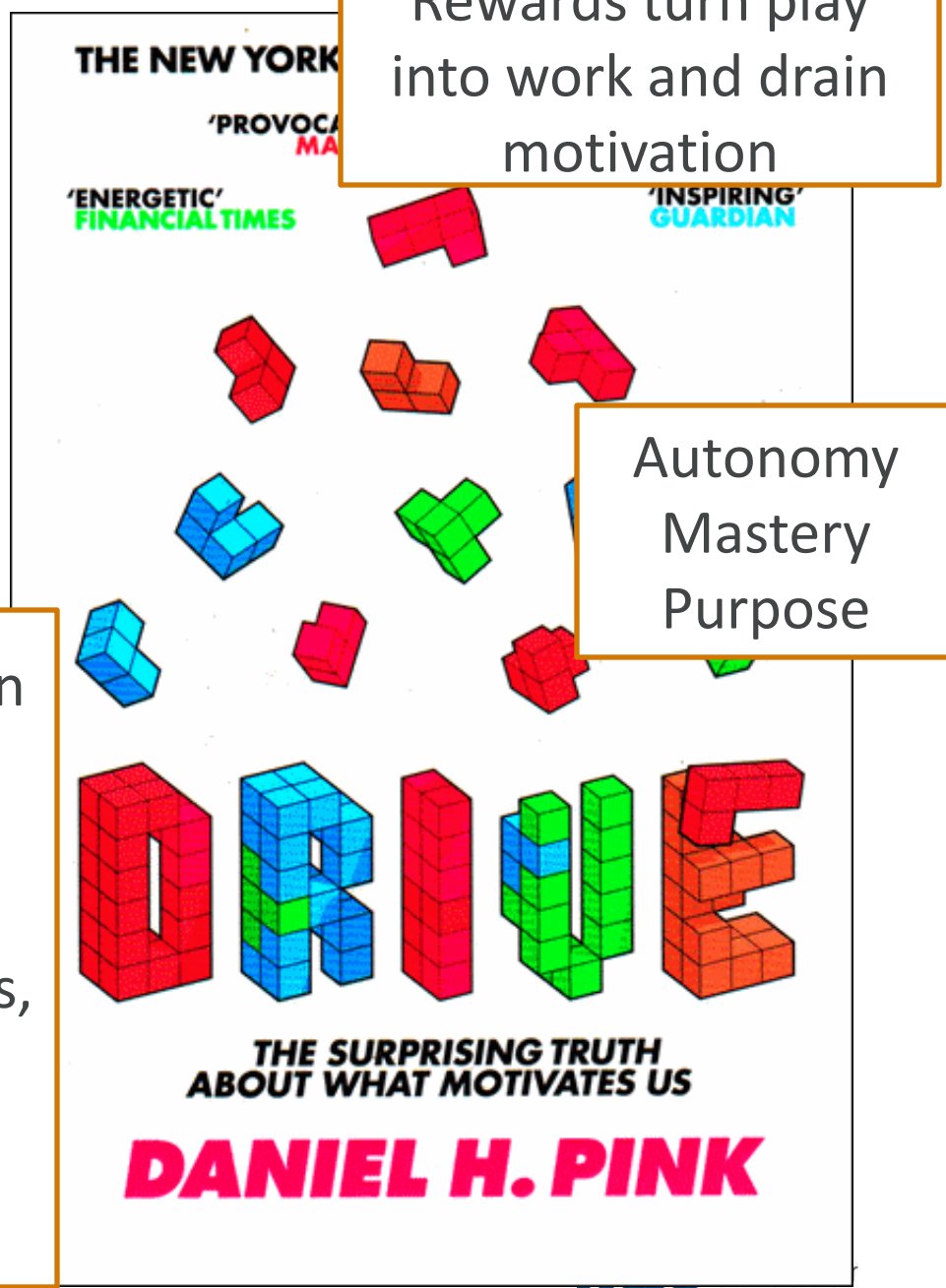
- Sane company policies and administration
  - communicate frequently (vision, intentions, requirements, schedules, ...)
  - protect staff from organizational distractions
  - protect staff from bad communication practices (establish culture)

# Addressing Motivating Factors (selective)

- Making a difference
  - worthy goals, longterm vision
  - Steve Jobs when recruiting John Scully from Pepsi:  
“Do you want to sell sugar water or change to world”
- Toys and technology
  - modern hardware, large screens, phones, ...
- Recognition and praise
  - praise loudly and specifically, blame softly/privately
  - celebrate success



- Can extinguish intrinsic motivation
- Can diminish performance
- Can crush creativity
- Can crowd out good behavior
- Can encourage cheating, shortcuts, and unethical behavior
- Can become addictive
- Can foster short-term thinking



Rewards turn play into work and drain motivation

Autonomy  
Mastery  
Purpose

The image shows the Netflix logo, which consists of the word "NETFLIX" in a white, bold, sans-serif font with a slight 3D effect, set against a solid red rectangular background.

NETFLIX



# Rewards

- Fair and adequate pay as foundation
  - Takes money issue off the table, focus on work
- Noncontingent awards
  - Reinforce extra effort and excellence if not expected

# Daytime distractions

- “You never get anything done around here between 9 and 5”
- “I get my best work done in the early morning, before anybody else arrives”
- “In one late evening, I can do two or three days’ worth of work”

# Quality

- Quality important for satisfaction and self-image
- Even if market may not pay for that level or quality
- "Under time pressure developers sacrifice quality and hate themselves for that"
- "Quality, far beyond that required by the end user, is a means to higher productivity"

# Overtime?

- Often necessary with deadlines
- Avoid over long periods
- Peak productivity at 40h/week
- Incentivize overtime
  - free food/overtime refrigerators
  - bonus pay
  - social pressure

# MANAGING PROGRAMMERS

# Programmer Characteristics

- Programmers have fun
  - Work is the primary motivator, not compensation
- Free spirited
  - Medium only “slightly removed from pure thought stuff”
- Code right away, design as they go along
- Resistance to change
- Overconfident in own ability (writing bug free code, time estimation)

# COWBOYS VS FARMERS

# Managing Developers

- Earn technical respect
- Protect staff from bureaucracy
- Set goals, avoid rewards



# Tuckman, 1965: Forming, Storming, Norming, Performing

- Forming: team meets and learns about challenges, agrees on goals, begins to work.
  - Team members: (1) Behave independently. (2) May be motivated, but relatively uninformed about goals, (3) usually on their best behavior (albeit self-involved)
- Storming: participants form opinions about one another, possibly leading to conflict.
  - May voice opinions or question leader, especially if someone shirking responsibility or attempting to dominate.
  - Disagreements and conflicts must be resolved before team can progress; may regress if new challenges arise.
  - Stage can be destructive, but can lead to a better team in the long run if effective resolution tactics established.
- Norming: Resolved conflicts leads to a spirit of co-operation.
  - Team shares a common goal for which everyone takes responsibility.
  - Tolerate one another, move on from individual challenges.
  - Danger: too much avoidance of conflict can lead to avoidance of controversial ideas.
- Performing: group members focus on achieving common goals.
  - Everyone is now competent and can make decisions without supervision. Dissent is allowed if it's through acceptable channels.
  - Supervisors are almost always participating.
- Upshot: Preserve existing teams, resist project mobility.
  - Tradeoffs? Compared to practices you've seen in companies?

# Further Reading

- Mantle and Lichty. Managing the Unmanageable. Addison-Wesley, 2013
  - Very accessible and practical tips at recruiting and management
- DeMarco and Lister. Peopleware. 3<sup>rd</sup> Edition. Addison Wesley, 2013
  - Anecdotes, stories, and tips on facilitating teams, projects, and environments
- Pink. Drive: The Surprising Truth About What Motivates Us. Riverhead 2011
  - Detailed discussion of motivating factors for creative people
- Sommerville. Software Engineering. 8<sup>th</sup> Edition. Chapter 25