

Slide 4.1

Object-Oriented Software Engineering

WCB/McGraw-Hill, 2008

Stephen R. Schach
srs@vuse.vanderbilt.edu

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

CHAPTER 4

Slide 4.2

TEAMS

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Overview

Slide 4.3

- Team organization
- Democratic team approach
- Chief programmer team approach
- Beyond chief programmer and democratic teams
- Synchronize-and-stabilize teams
- Teams for agile processes
- Open-source programming teams
- People capability maturity model
- Choosing an appropriate team organization

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

4.1 Team Organization

Slide 4.4

- A product must be completed within 3 months, but 1 person-year of programming is still needed
- Solution:
 - If one programmer can code the product in 1 year, four programmers can do it in 3 months
- Nonsense!
 - Four programmers will probably take nearly a year
 - The quality of the product is usually lower

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Task Sharing

Slide 4.5

- If one farm hand can pick a strawberry field in 10 days, ten farm hands can pick the same strawberry field in 1 day
- One elephant can produce a calf in 22 months, but 22 elephants cannot possibly produce that calf in 1 month

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Task Sharing (contd)

Slide 4.6

- Unlike elephant production, it is possible to share coding tasks between members of a team
- Unlike strawberry picking, team members must interact in a meaningful and effective way

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Programming Team Organization

Slide 4.7

- Example:
 - Sheila and Harry code two modules, m_1 and m_2 , say
- What can go wrong
 - Both Sheila and Harry may code m_1 , and ignore m_2
 - Sheila may code m_1 , Harry may code m_2 . When m_1 calls m_2 it passes 4 parameters; but m_2 requires 5 parameters
 - Or, the order of parameters in m_1 and m_2 may be different
 - Or, the order may be same, but the data types may be slightly different

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Programming Team Organization (contd)

Slide 4.8

- This has nothing whatsoever to do with technical competency
 - Team organization is a managerial issue

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Communications Problems

Slide 4.9

- Example
 - There are three channels of communication between the three programmers working on a project. The deadline is rapidly approaching but the code is not nearly complete
- “Obvious” solution:
 - Add a fourth programmer to the team

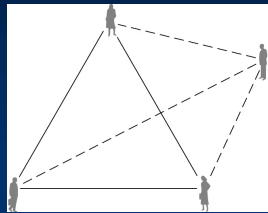


Figure 4.1

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Communications Problems (contd)

Slide 4.10

- But other three have to explain in detail
 - What has been accomplished
 - What is still incomplete
- Brooks's Law
 - Adding additional programming personnel to a team when a product is late has the effect of making the product even later

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Team Organization

Slide 4.11

- Teams are used throughout the software production process
 - But especially during implementation
 - Here, the discussion is presented within the context of programming teams
- Two extreme approaches to team organization
 - Democratic teams (Weinberg, 1971)
 - Chief programmer teams (Brooks, 1971; Baker, 1972)

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

4.2 Democratic Team Approach

Slide 4.12

- Basic underlying concept — *egoless programming*
- Programmers can be highly attached to their code
 - They even name their modules after themselves
 - They see their modules as extension of themselves

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Democratic Team Approach (contd)

Slide 4.13

- If a programmer sees a module as an extension of his/her ego, he/she is not going to try to find all the errors in "his"/"her" code
 - If there is a fault, it is termed a *bug* 🐛
 - The fault could have been prevented if the code had been better guarded against the "bug"
 - "Shoo-Bug" aerosol spray

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Democratic Team Approach (contd)

Slide 4.14

- Proposed solution
 - Egoless programming
 - Restructure the social environment
 - Restructure programmers' values
 - Encourage team members to find faults in code
 - A fault must be considered a normal and accepted event
 - The team as whole will develop an ethos, a group identity
 - Modules will "belong" to the team as whole
 - A group of up to 10 egoless programmers constitutes a *democratic team*

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Difficulties with Democratic Team Approach

Slide 4.15

- Management may have difficulties
 - Democratic teams are hard to introduce into an undemocratic environment
 - Democratic teams have to spring up spontaneously
 - An experienced programmer may resent having his/her code appraised by fellow (unexperienced) programmers

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Strengths of Democratic Team Approach

Slide 4.16

- Democratic teams are enormously productive
- They work best when the problem is difficult
- They function well in a research environment

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

4.3 Chief Programmer Team Approach

Slide 4.17

- Consider a 6-person team
 - Fifteen 2-person communication channels
 - The total number of 2-, 3-, 4-, 5-, and 6-person groups is 57
 - This team cannot do 6 person-months of work in 1 month

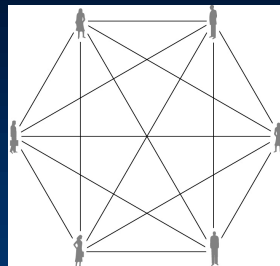


Figure 4.2

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Chief Programmer Team

Slide 4.18

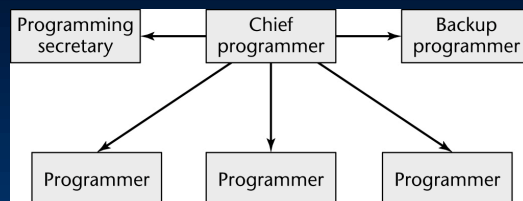


Figure 4.3

- Six programmers, but now only 5 lines of communication

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Chief Programmer Team (contd)

Slide 4.19

- The basic idea behind the concept
 - Analogy: chief surgeon directing an operation, assisted by
 - » Other surgeons
 - » Anesthesiologists
 - » Nurses
 - » Other experts, such as cardiologists, nephrologists
- Two key aspects
 - Specialization
 - Hierarchy

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Chief Programmer Team (contd)

Slide 4.20

- Chief programmer
 - Successful manager *and* highly skilled programmer
 - Does the architectural design
 - Allocates coding among the team members
 - Writes the critical (or complex) sections of the code
 - Handles all the interfacing issues
 - Reviews the work of the other team members
 - Is personally responsible for every line of code

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Chief Programmer Team (contd)

Slide 4.21

- Back-up programmer
 - Necessary only because the chief programmer is human
 - The back-up programmer must be in every way as competent as the chief programmer, and
 - Must know as much about the project as the chief programmer
 - The back-up programmer does black-box test case planning and other tasks that are independent of the design process

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Chief Programmer Team (contd)

Slide 4.22

- Programming secretary
 - A highly skilled, well paid, central member of the chief programmer team
 - Responsible for maintaining the program production library (documentation of the project), including:
 - » Source code listings
 - » JCL
 - » Test data
 - Programmers hand their source code to the secretary who is responsible for
 - » Conversion to machine-readable form
 - » Compilation, linking, loading, execution, and running test cases (this was 1971, remember!)

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Chief Programmer Team (contd)

Slide 4.23

- Programmers
 - Do nothing but program
 - All other aspects are handled by the programming secretary

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

The *New York Times* Project

Slide 4.24

- Chief programmer team concept
 - First used in 1971
 - By IBM
 - To automate the clippings data bank ("morgue") of the *New York Times*
- Chief programmer — F. Terry Baker

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

The New York Times Project (contd)

Slide 4.25

- 83,000 source lines of code (LOC) were written in 22 calendar months, representing 11 person-years
- After the first year, only the file maintenance system had been written (12,000 LOC)
- Most code was written in the last 6 months
- Only 21 faults were detected in the first 5 weeks of acceptance testing

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

The New York Times Project (contd)

Slide 4.26

- 25 further faults were detected in the first year of operation
- Principal programmers averaged one detected fault and 10,000 LOC per person-year
- The file maintenance system, delivered 1 week after coding was completed, operated 20 months before a single failure occurred
- Almost half the subprograms (usually 200 to 400 lines of PL/I) were correct at first compilation

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

The New York Times Project (contd)

Slide 4.27

- But, after this fantastic success, no comparable claims for the chief programmer team concept have been made

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Why Was the NYT Project Such a Success?

Slide 4.28

- Prestige project for IBM
 - First real trial for PL/I (developed by IBM)
 - IBM, with superb software experts, used its best people
- Extremely strong technical backup
 - PL/I compiler writers helped the programmers
 - JCL experts assisted with the job control language

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Why Was the NYT Project Such a Success?

Slide 4.29

- F. Terry Baker
 - Superprogrammer
 - Superb manager and leader
 - His skills, enthusiasm, and personality “carried” the project
- Strengths of the chief programmer team approach
 - It works
 - Numerous successful projects have used variants of chief programmer teams

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Impracticality of Chief Programmer Team Approach

Slide 4.30

- The chief programmer must be a highly skilled programmer *and* a successful manager
- There is a shortage of highly skilled programmers
- There is a shortage of successful managers
- The qualities needed to be a highly skilled programmer are unlikely to be found in a successful manager, and vice versa

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Impracticality of Chief Programmer Team Approach (contd)

Slide 4.31

- The *back-up programmer* must be as good as the chief programmer
 - But he/she must take a back seat (and a lower salary) waiting for something to happen to the chief programmer
 - Top programmers, top managers will not do that
- The *programming secretary* does nothing but paperwork all day
 - Software professionals hate paperwork
- The chief programmer team approach is impractical

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

4.4 Beyond Chief Programmer and Democratic Teams

Slide 4.32

- We need ways to organize teams that
 - Make use of the strengths of democratic teams and chief programmer teams, and
 - Can handle teams of 20 (or 120) programmers
- A strength of democratic teams
 - A positive attitude to finding faults
- Use chief programmer teams in conjunction with code walkthroughs or inspections

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Beyond Chief Programmer and Democratic Teams (contd)

Slide 4.33

- Potential pitfall
- The chief programmer is personally responsible for every line of code
 - He/she must therefore be present at reviews
- The chief programmer is also the team manager
 - He/she must therefore *not* be present at reviews!

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Beyond Chief Programmer and Democratic Teams (contd)

Slide 4.34

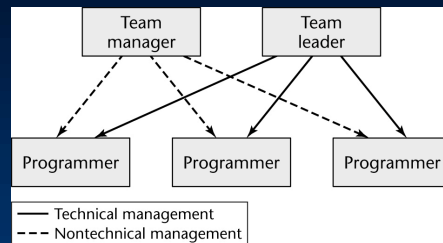


Figure 4.4

- Solution
 - Reduce the managerial role of the chief programmer

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Beyond Chief Programmer and Democratic Teams (contd)

Slide 4.35

- It is easier to find a team leader than a chief programmer
- Each employee is responsible to exactly one manager — lines of responsibility are clearly delineated
- The team leader is responsible for only technical management

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Beyond Chief Programmer and Democratic Teams (contd)

Slide 4.36

- Budgetary and legal issues, and performance appraisal are not handled by the team leader
- The team leader participates in reviews — the team manager is not permitted to do so
- The team manager participates in regular team meetings to appraise the technical skills of the team members

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Larger Projects

Slide 4.37

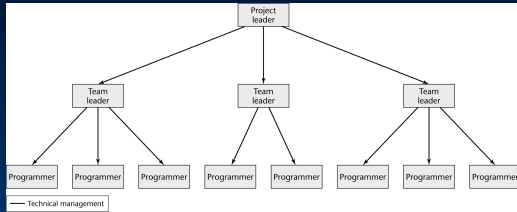


Figure 4.5

- The nontechnical side is similar
 - For even larger products, add additional layers

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Beyond Chief Programmer and Democratic Teams (contd)

Slide 4.38

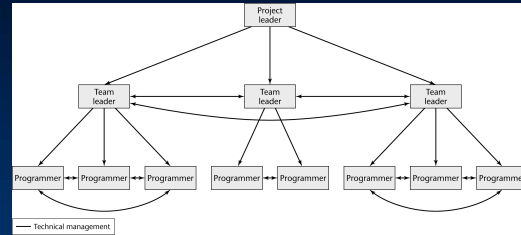


Figure 4.6

- Decentralize the decision-making process, where appropriate
 - Useful where the democratic team is good
 - One programmer draws up the test cases, the other tests the code

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

4.9 Choosing an Appropriate Team Organization

Slide 4.39

- There is no one solution to the problem of team organization
- The "correct" way depends on
 - The product
 - The outlook of the leaders of the organization
 - Previous experience with various team structures

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Choosing an Appropriate Team Organization (contd)

Slide 4.40

- Exceedingly little research has been done on software team organization
 - Instead, team organization has been based on research on group dynamics in general
- Without *relevant* experimental results, it is hard to determine optimal team organization for a specific product

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.

Choosing an Appropriate Team Organization (contd)

Slide 4.41

Team Organization	Strengths	Weaknesses
Democratic teams (Section 4.2)	High-quality code as consequence of positive attitude to finding faults Particularly good with hard problems Major success of New York Times project	Experienced staff resent their code being appraised by beginners Cannot be externally imposed Impractical
Classical chief programmer teams (Section 4.3)	Many successes	No successes comparable to the New York Times project
Modified chief programmer teams (Section 4.3.1)	Team manager/team leader structure obviates need for chief programmer Scales up Supports decentralization when needed	Problems can arise unless areas of responsibility of the team manager and the team leader are clearly delineated
Synchronize-and-stabilize teams (Section 4.5)	Encourages creativity Ensures that a huge number of developers can work toward a common goal	No evidence so far that this method can be used outside Microsoft
Agile process teams (Section 4.6)	Programmers do not test their own code Knowledge is not lost if one programmer leaves Less-experienced programmers can learn from others Group ownership of code	Still too little evidence regarding efficacy
Open-source teams (Section 4.7)	A few projects are extremely successful	Narrowly applicable Must be led by a superb motivator Requires top caliber participants

Figure 4.7

Copyright © 2008 by The McGraw-Hill Companies, Inc. All rights reserved.