# Software Engineering

Richard Bartels

University of Waterloo
Faculty of Mathematics
Department of Computer Science

October 31, 1996

# Software Personnel Management

Richard Bartels

University of Waterloo
Faculty of Mathematics
Department of Computer Science

October 31, 1996

# Outline

- Cognitive Fundamentals
- Group Dynamics
- Management Implications
- Staffing
- Team Structure

Reference:

This is material from Chapter 28 of Sommerville

## Cognitive Fundamentals

Knowledge processing and memory organization

- Limited capacity, fast-access, short-term, input component (registers)
  - Sense input and initial processing
- Larger capacity, comprehensive processing component (RAM)
  - Analysis and combination with long-term memory
- Long-term, slow-access, impermanent memory component (disk)
  - Adjustment by newly processed information
  - Slow decay

People can

- only learn so fast,
- only process so much,
- only keep track of so many things at a time,
- only remember details for so long.

## Chunking

Short-term memory can only keep track of about seven "quanta" of information at a time.

In a learning curve we try to "chunk" more complicated patterns into connected, coherant groups.

- Implications for human interface design
- Implications for planning strategy and discussion sessions
- Implications for library/class/module design
- Implications for user documentation

## Semantic vs. Syntactic Knowledge

Long-term memory stores some knowledge as a catalog of "details"

- Where the semi-colons go?
- What is the telephone number?
- Who won the Stanley cup?

Long-term memory stores other knowledge as a pattern of intuition, understanding, and paradigms

- How do you ride a bicycle?
- What is the look-and-feel of the interface?
- Which abstractions are better for certain designs?

It is difficult to pass the latter form of knowledge from person to person in a team, but it is knowledge that is "understood" rather than "formulated." Mentoring, guidance, practice, and feedback are needed.

- Implications for team training
- Implications for team structure
- Implications for team/project scheduling

## Motivation

A software company invests most of its money in its personnel. Management must ensure that this investment is maintained.

What motivates a technical employee?

**Task-oriented People**
Motivated by the intellectual challenge of solving complex problems

**Self-oriented People**
Motivated by personal success and recognition

**Interaction-oriented People**
Motivated by membership in a community or culture, or by association with co-workers

## Staffing

A software team will contain

- people with different levels of skill and background
- people with different primary career motivations

A project can easily fail if one does not pay attention to

- collective motivation and cohesion
  - team spirit
  - team identity
- group dynamics
  - compatibility
  - attitude
  - competition
  - cooperation
  - responsibility
  - leadership

## Finding Suitable People

Sometimes you may have little choice

- Availability
- Time pressure

Factors

- Experience
  - Applications domain
  - Platform
  - Language
  - Tools
- Education
- Communication ability
- Adaptability
- Attitude
- Personality
- Leadership
- Smarts

# People Expenses

## Acquisition

The current average expense to find a software professional is around $30,000. The time required may be several months.

## Maintenance

Double the salary of a software professional should be allocated for the associated costs (benefits, support staff, office, utilities, workstation, maintenance, etc.). Thus, if a software professional is hired at $60,000, another $120,000 should be counted as additional costs.

## The Wrong Management

Some software companies have become known for a "buy and burn" policy.
(In the following slides we assume that we are not interested in managing one of those companies.)

## Keeping Suitable People

Loosing to the outside

One of my first graphics MMath students worked for

- Alias
- Omnibus
- Abel
- SoftImage
- His own company
- DHD

between 1984 and 1995

Technical skills are lost.

## Keeping Suitable People

Loosing to the inside

Technical people quickly reach a career plateau

- Promotion to management is the only way to improve under standard corporate structure

Technical managers are scarce

- Promotion to management is a necessity in many companies to have any leadership at all

The rough average stay in the technical ranks of CGL graduates before being put into some team leadership role appears to be about 2 years.

Technical skills are lost.

## Group Issues

A software professional's time on a project

- Interaction with other people: 50%
- Working alone: 30%
- Other: 20%

Issues in group composition

- Personality mix
- Technical level
- Leadership/management model

These issues are influenced by the nature of the project

- Standard, straightforward
- Leading-edge, innovative

# General Organization Models

**Random**

The "Skunk Works" paradigm: free-wheeling association of talented, creative individuals under the guidance of mutual understanding and respect.

**Closed**

The "Armed Forces" paradigm: formal, top-down association of disciplined members under centralized decision making.

**Open**

The "Commune" paradigm: commonly oriented, cooperative association of people with negotiated, consensual, group agreement.

**Synchronous**

The "Amish Barn Raising" paradigm: traditional, master-plan association of individuals who know the plan and follow it in harmony.

## Facets

Each model has

- A style of coordination
- A method of control and regularion
- A set of priorities
- A mode of decision making
- Strong and weak points
- An optimal theatre of employment
- A mode in which breakdown occurs
- An optimal set of management modes

# Closed

**Coordination**
Hierarchy

**Regulation**
Negative feedback, deviation attenuating

**Priorities**
Stability, security, continuity, readiness

**Decision making**
Formal, top-down

**Strong suit**
Stability, resource preservation

**Weak areas**
Innovation, use of individual talents

**Best applications**
Routine tactical projects

**Failure mode**
Mindless rigidity and over-control

**Management**
Objectives: rules and responsibilities
Form: Directive, formalized, group-oriented
Methods: Policy statements, practice sessions, competitions

# Random

**Coordination**
Initiative

**Regulation**
Positive feedback, deviation amplifying

**Priorities**
Variety, creativity, innovation

**Decision making**
Informal, individual, bottom-up

**Strong suit**
Creative invention, personal achievement

**Weak areas**
Dependable stability, efficient resource use

**Best applications**
Creative breakthroughs

**Failure mode**
Chaotic disconnectedness, destructive competition

**Management**
Objectives: outline guidelines, build trust, release creativity
Form: fun, freewheeling, individualized creativity
Methods: brainstorming, games, idea building, artistic informality

# Open

**Coordination**
Collaborative, adaptive, consensus building or democratic, majority rule

**Regulation**
Peer pressure, combined feedback

**Priorities**
Stability with change

**Decision making**
Negotiated, won over

**Strong suit**
Practical adaptation, information sharing

**Weak areas**
Efficient process, simple and smooth operation

**Best applications**
Complex problem solving

**Failure mode**
Endless discussions, chaotic enmeshment

**Management**
Objectives: Strategy and agenda, skill building, role clarification
Form: Cooperative and explorative, learning and practice
Methods: Joint training/learning sessions, cooperative problem solving

## Synchronous

**Coordination**
Harmonious alignment

**Regulation**
Communal uniformity and tradition

**Priorities**
Mutual identification, reinforcement, effortless coordination

**Decision making**
Predefined, implied by plan, vision, or tradition

**Strong suit**
Quiet efficiency and smooth operation

**Weak areas**
Response to change, open communication

**Best applications**
Repetitive performance

**Failure mode**
Drifting deadness

**Management**
Objectives: promote bonding, individual group indentification, precise coordination
Form: Symbolic, reflective, charismatic, visionary
Methods: Guidance, drills, ritualized practice, meditation, image building

## Structured-Open Teams

Roles are clear, but different people occupy at different times under different circumstances

- catalog of essential team roles
- form specification and institutionalization of functional roles
- defualt assignment of roles to assure essential functions are performed
- rotation of roles to promote flexibility and skills
- a structured, externalized group interface for protection
- a structured, externalized group memory for information management
- clear, simple external accountability
- technical consensus building, not majority decision making
- promotion of group ownership of work products

Chief programmer
Librarian
Validator/Testor
Pool of Experts

## Other Teams

**Structured**

One expert and a number of less experienced people;
(Structured-open, but with fixed people occupying the roles.)
Straightforward, known, commercial development
(Corel, Microsoft)

**Open**

Group of experts together;
Large, new development
(NASA Space software, Atomic Bomb project)

**Random**

A very few innovators;
(Netscape, Id)