

Managing people

- ◆ Managing people working as individuals and in groups

Objectives

- ◆ To emphasize the importance of people in the software engineering process.
- ◆ To describe fundamental cognitive factors which managers should be aware of.
- ◆ To discuss group working and group organization.
- ◆ To explain why the working environment for software engineers is important.

Topics covered

- ◆ Cognitive fundamentals
- ◆ Management implications
- ◆ Project staffing
- ◆ Group working
- ◆ Working environments

People in the process

- ◆ People are an organization's most important assets.
- ◆ The tasks of a manager are essentially people oriented. Unless there is some understanding of people, management will be unsuccessful.
- ◆ Software engineering is primarily a cognitive activity.

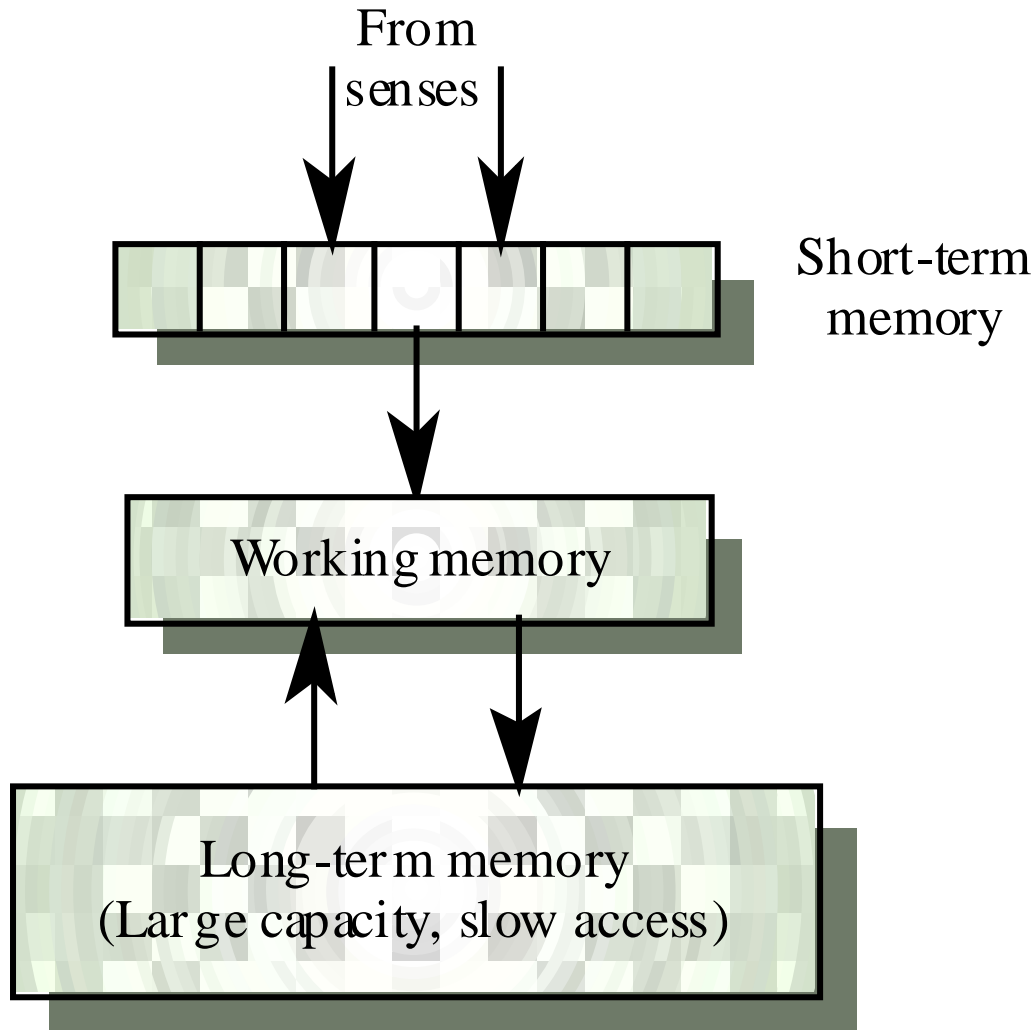
Management activities

- ◆ Problem solving (using available people)
- ◆ Motivating (people who work on a project)
- ◆ Planning (what people are going to do)
- ◆ Estimating (how fast people will work)
- ◆ Controlling (people's activities)
- ◆ Organizing (the way in which people work)

Cognitive fundamentals

- ◆ People don't all think the same way but everyone is subject to some basic constraints on their thinking due to:
 - Memory organization
 - Knowledge representation
 - Motivation influences
- ◆ If we understand these constraints, we can understand how they affect people participating in the software process.

Memory organization



Short-term memory

- ◆ Fast access, limited capacity
- ◆ 5-7 locations
- ◆ Holds “chunks” of information where the size of a chunk may vary depending on its familiarity.
- ◆ Fast decay time

Working memory

- ◆ Larger capacity, longer access time.
- ◆ Memory area used to integrate information from short-term memory and long-term memory.
- ◆ Relatively fast decay time.

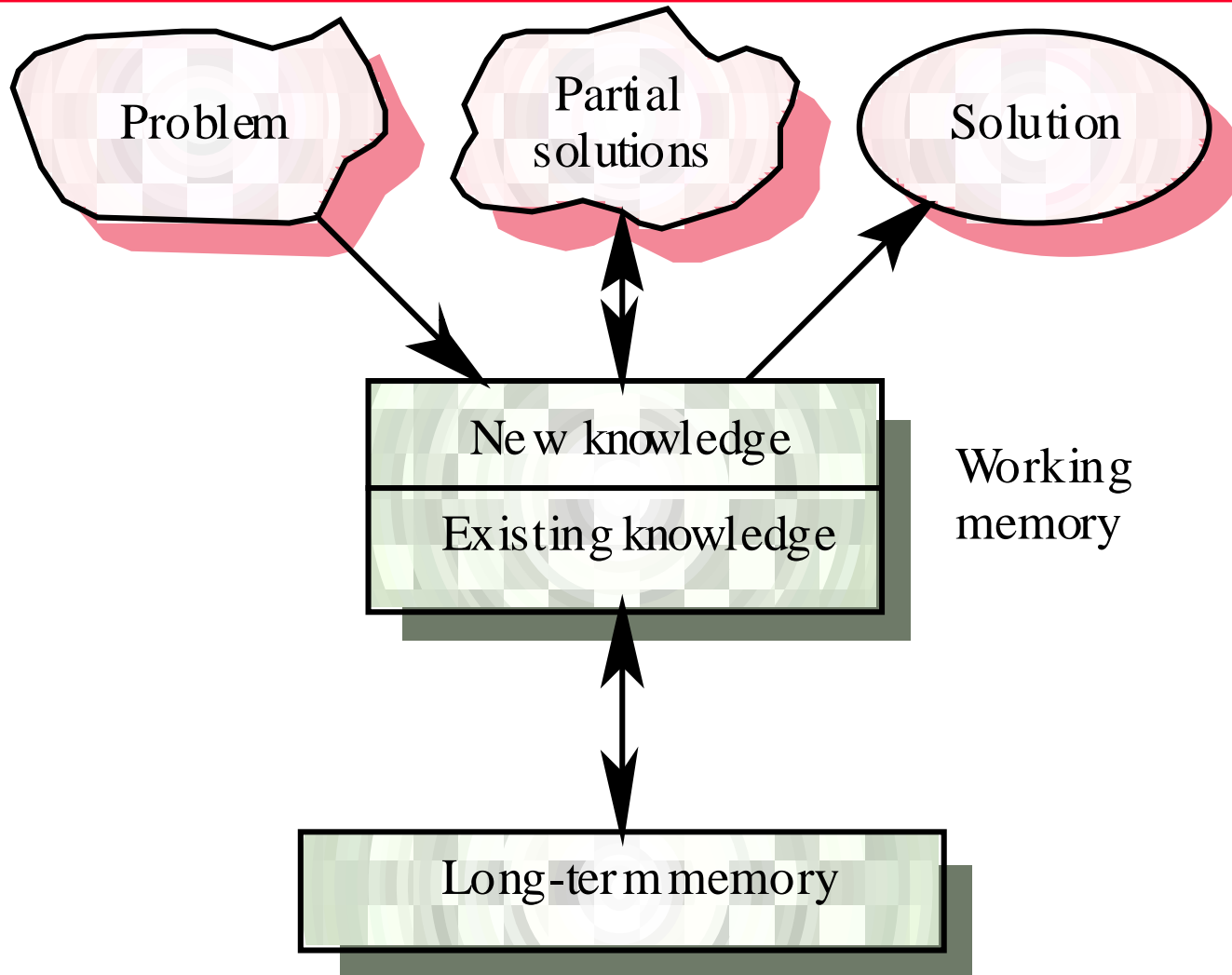
Long-term memory

- ◆ Slow access, very large capacity.
- ◆ Unreliable retrieval mechanism.
- ◆ Slow but finite decay time - information needs reinforcing.
- ◆ Relatively high threshold - work has to be done to get information into long-term memory.

Information transfer

- ◆ Problem solving usually requires transfer between short-term memory and working memory.
- ◆ Information may be lost or corrupted during this transfer.
- ◆ Information processing occurs in the transfer from short-term to long-term memory.

Problem solving



Cognitive chunking

Loop (process entire array)

Loop (process unsorted part of array)

Compare adjacent elements

Swap if necessary so that smaller comes first

Knowledge modelling

- ◆ **Semantic knowledge:** knowledge of concepts such as the operation of assignment, concept of parameter passing etc.
- ◆ **Syntactic knowledge:** knowledge of details of a representation *e.g.*, a Java while loop.

Knowledge acquisition

- ◆ Semantic knowledge is acquired through experience and active learning - the “ah” factor
- ◆ Syntactic knowledge is acquired by memorization.
- ◆ New syntactic knowledge can interfere with existing syntactic knowledge.
 - *E.g.*, problems in mixing up syntax of different programming languages

Semantic knowledge

◆ *E.g.*, **Computing concepts:**

- notion of a writable store
- iteration
- concept of an object
- ...

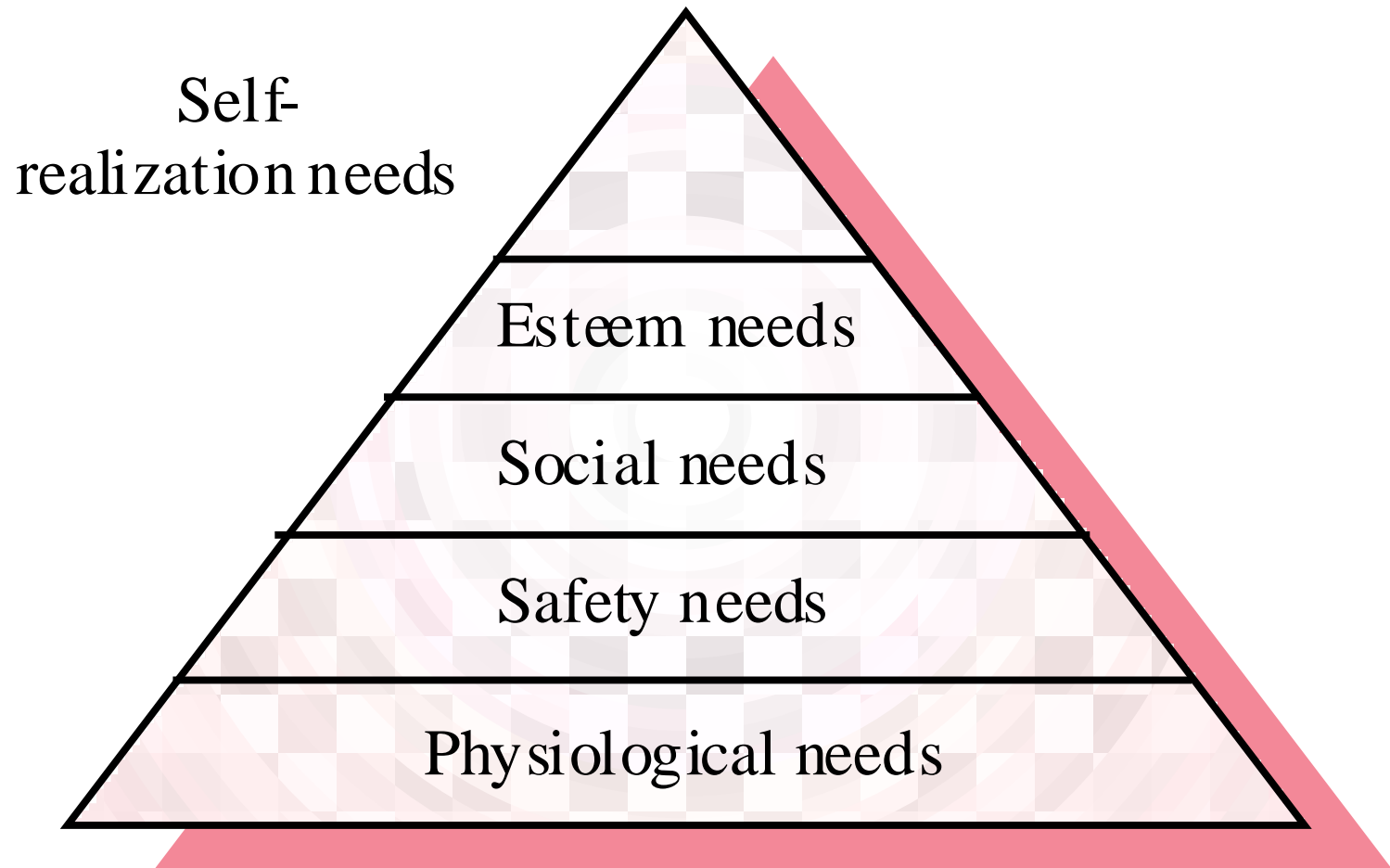
Problem solving

- ◆ **Structured programming:** Limited control structures place a lesser load on short-term and working memory.
- ◆ **Software development ability:** is the ability to integrate new knowledge with existing computer and task knowledge and hence derive creative problem solutions.
- ◆ Thus, problem solving is language independent.

Motivation

- ◆ An important role of a manager is to motivate the people working on a project.
- ◆ Motivation is a complex issue but it appears that there are different types of motivation based on:
 - Basic needs (*e.g.*, food, sleep)
 - Personal needs (*e.g.*, respect, self-esteem)
 - Social needs (*e.g.*, to be accepted as part of a group)

Human needs hierarchy



Personality types

- ◆ *Needs hierarchy* is an over-simplification.
- ◆ Must also take into account different personality types:
 - Task-oriented
 - Self-oriented
 - Interaction-oriented

Personality types

- ◆ Task-oriented.
 - The motivation for doing the work is the work itself.
- ◆ Self-oriented.
 - The work is a means to an end which is the achievement of individual goals - *e.g.*, to get rich, to play tennis, to travel etc.
- ◆ Interaction-oriented
 - The principal motivation is the presence and actions of co-workers. People go to work because they like to go to work.

Motivation balance

- ◆ Individual motivations are made up of elements of each class.
- ◆ Balance can change depending on personal circumstances and external events.

Motivation

- ◆ Motivations depend on satisfying needs.
- ◆ It can be assumed that physiological and safety needs are satisfied.
- ◆ Social, esteem and self-realization needs are most significant from a managerial viewpoint.

Need satisfaction

◆ Social

- Provide communal facilities
- Allow informal communications

◆ Esteem

- Recognition of achievements
- Appropriate rewards

◆ Self-realization

- Training - people want to learn more
- Responsibility

Training

- ◆ Language concepts should match semantic structures formed - more errors are likely to be made by low-level language programmers.
- ◆ Easy for programmers to learn a new language of the same type.
- ◆ May be more difficult for experienced programmers to learn a new language of a different type than for novices.

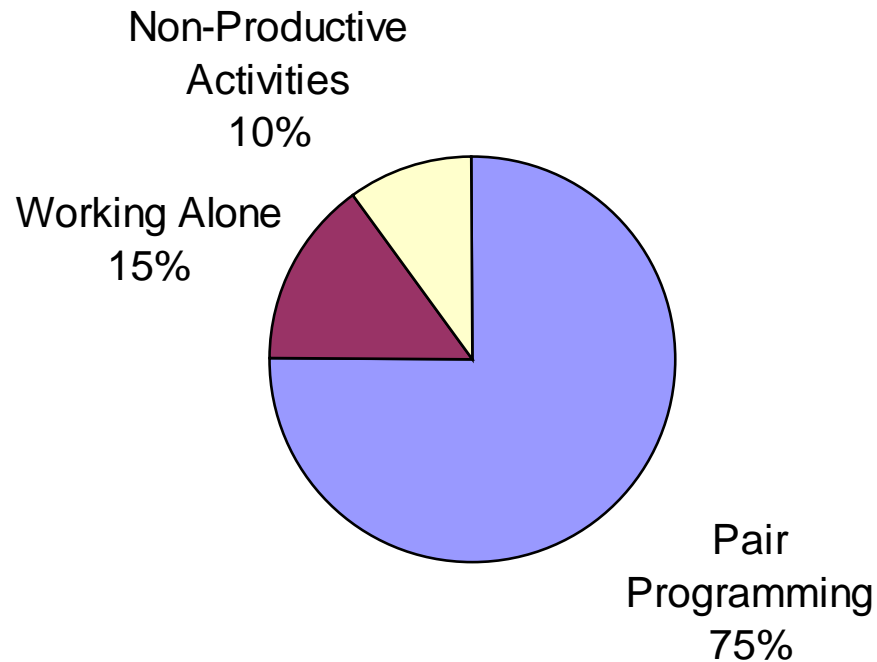
Project staffing

- ◆ Choosing people to work on a project is a major managerial responsibility.
- ◆ Appointment decisions are usually based on:
 - information provided by the candidate (their CV)
 - information gained at an interview
 - recommendations from other people who know the candidate
- ◆ Some companies use aptitude tests
 - There is no agreement on whether or not these tests are actually useful

Group working

- ◆ Software engineering is a group activity
 - The development schedule for most non-trivial software projects is such that they cannot be completed by one person working alone.
 - Group interaction is a key determinant of group performance.
- ◆ Flexibility in group composition is limited
 - Managers must do the best they can with available people

Time distribution



Group composition

- ◆ Group composed of members who share the same motivation can be problematic:
 - Task-oriented - everyone wants to do their own thing.
 - Self-oriented - everyone wants to be the boss.
 - Interaction-oriented - too much chatting, not enough work.
- ◆ An effective group has a balance of all types.
- ◆ Can be difficult to achieve because most engineers are task-oriented.

Group leadership

- ◆ Leadership depends on respect not title.
- ◆ There should be both a technical and an administrative leader.
- ◆ Democratic leadership is more effective than autocratic leadership.
- ◆ A career path based on technical competence should be supported.

Group cohesiveness

- ◆ In a cohesive group, members consider the group to be more important than any individual in it.
- ◆ Advantages of a cohesive group are:
 - Group quality standards can be developed.
 - Team members learn from each other and get to know each other's work.
 - Ego-less programming where members strive to improve each other's programs can be practiced.

Group loyalties

- ◆ Group members tend to be loyal to cohesive groups.
- ◆ “Groupthink” is preservation of group irrespective of technical or organizational considerations.
- ◆ Management should act positively to avoid groupthink by forcing external involvement with each group.

Group communications

- ◆ Status of group members
 - Higher status members tend to dominate conversations.
- ◆ Personalities in groups
 - Too many people of the same personality type can be a problem.
- ◆ Communication channels
 - Communication channeled through a central coordinator tend to be ineffective.

Team organization

- ◆ Software engineering group sizes should be relatively small (< 8 members).
- ◆ Break big projects down into multiple smaller projects.
- ◆ Small teams may be organized in an informal, democratic way.
- ◆ Chief programmer teams try to make the most effective use of skills and experience.

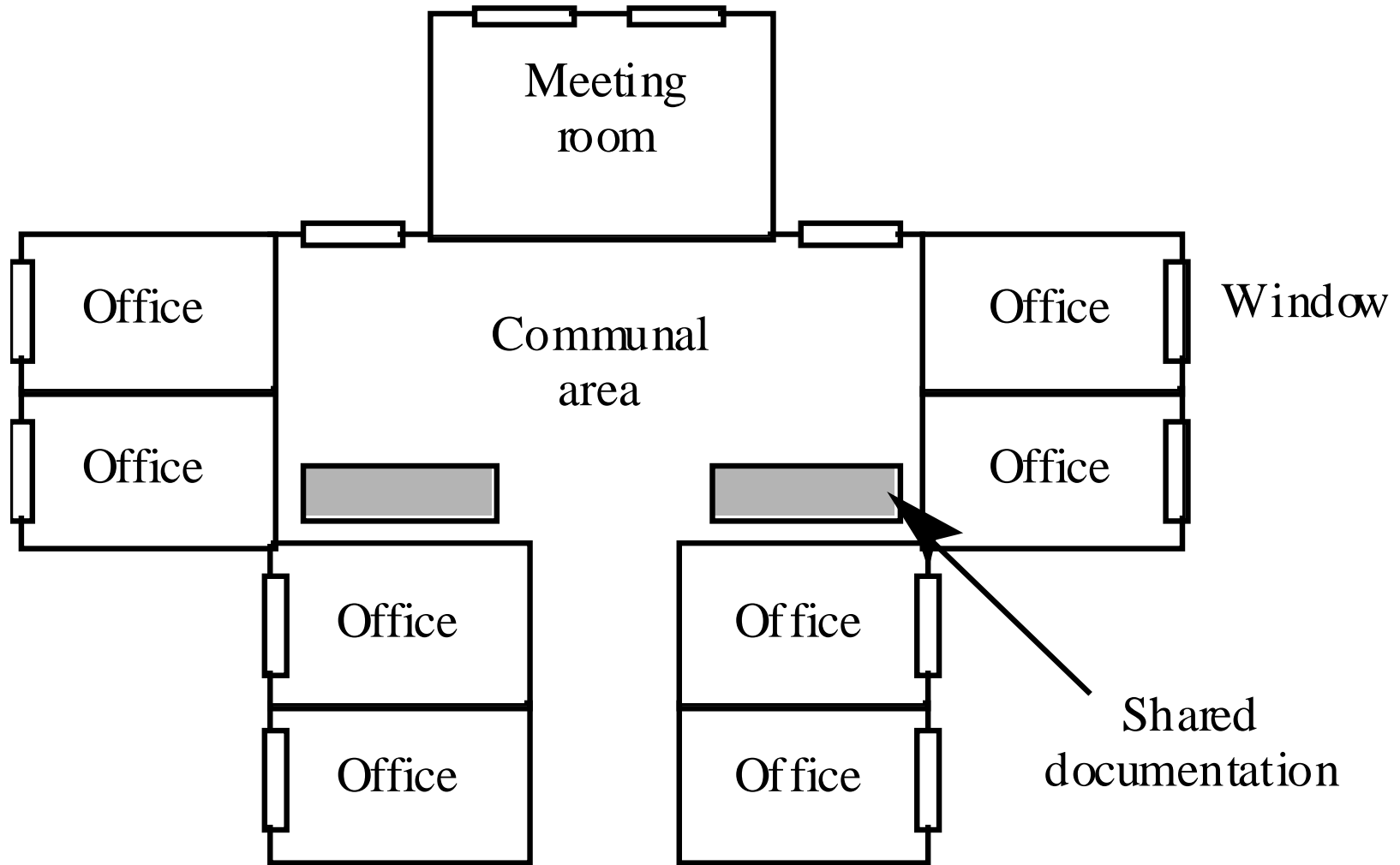
Working environments

- ◆ Physical workplace provision has an important effect on individual productivity and satisfaction:
 - Comfort
 - Privacy
 - Facilities
- ◆ Health and safety considerations must be taken into account:
 - Lighting
 - Heating
 - Furniture

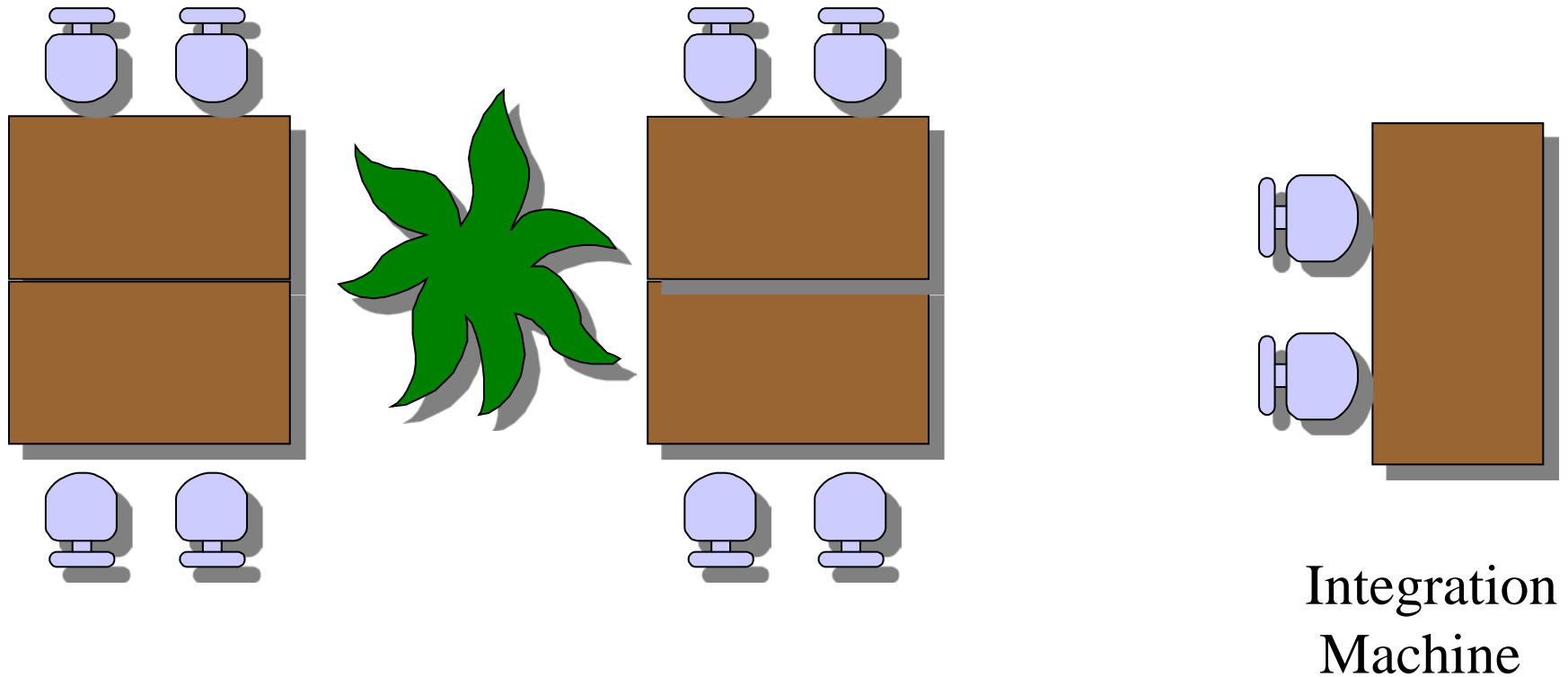
Environmental factors

- ◆ Privacy - each engineer requires an area for uninterrupted work.
- ◆ Outside awareness - people prefer to work in natural light.
- ◆ Personalization - individuals adopt different working practices and like to organize their environment in different ways.

Office grouping



Office grouping – Pair Programming



Equipment provision

◆ Computers

- Each engineer should have a personal workstation with access to software which is needed for his/her job.
- Pair Programming stations should be the fastest PCs you can get, with huge memory, and at least two large (24”++) screens
- Integration machine for continuous integration (to do the actual integration work, plus for running end-user (acceptance) tests

◆ Telecommunications

- telephone, fax, e-mail, networking facilities.
- Chat systems such as MS Messenger facilitate information sharing.
- Good telecommunications facilities can reduce travel costs drastically.

◆ “Information Radiators”

- Located all over the place to be hard to avoid seeing them
- Whiteboards, cork-walls (to hold cards), magnetic boards, etc.

Key points

- ◆ Managers must have some understanding of people if they are to be effective.
- ◆ Human cognitive structures place fundamental limits on the ways in which people work.
- ◆ The success of techniques such as structured programming and OO development is partially a consequence of cognitive structures.
- ◆ Staff selection factors include education, domain experience, adaptability and personality.

Key points

- ◆ Software development groups should be small and cohesive.
- ◆ Group communications are affected by status, size, and organization of the group.
- ◆ The working environment has a significant effect on productivity.