CS 5150 Software Engineering

People

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Managing People

Software development staff

- Professional staff are the major cost of software

- Staff vary greatly in productivity:

  => Ability
  => Education and training
  => Motivation
  => Interaction with colleagues and leaders
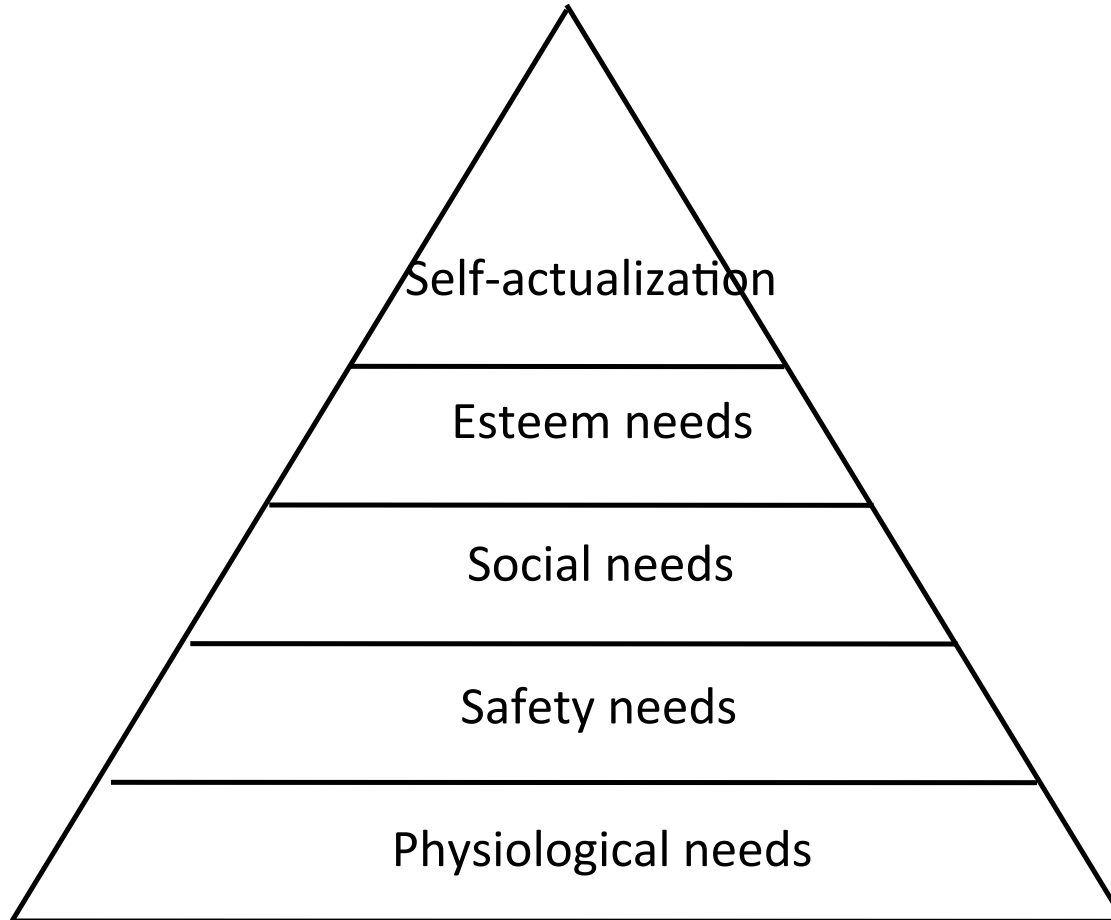
- Work environment has an impact on productivity

How do you lead, motivate, hire, reward, and retain good people?

Managing People

Theoretical

- Organizational behavior

- Industrial psychology

- Group behavior

- Cognitive fundamentals

- Economic motivation

Maslow's Hierarchy of Needs

Self-actualization

Esteem needs

Social needs

Safety needs

Physiological needs

Management Implications of Maslow's Hierarchy

Physiological needs:
Food, water, breathing, sleep

Safety needs:
Security of person, health, family

Social needs:
Friendship, colleagues, intimacy

Esteem needs:
Self esteem, confidence, achievements, respect of others

Self-actualization:
The opportunity to reach full potential.

Software is Built by Teams

Best size for a team is 3 to 8 people

Team members may include:

     developers (from trainee to expert)

     domain experts

     graphic or interface designers

     software librarians

     testers

     etc.

Teams must have:
     administrative leadership (manager)
     technical leadership (may be the manager)

Administration

Personnel
- Assigning tasks
- Hiring, promoting, etc.

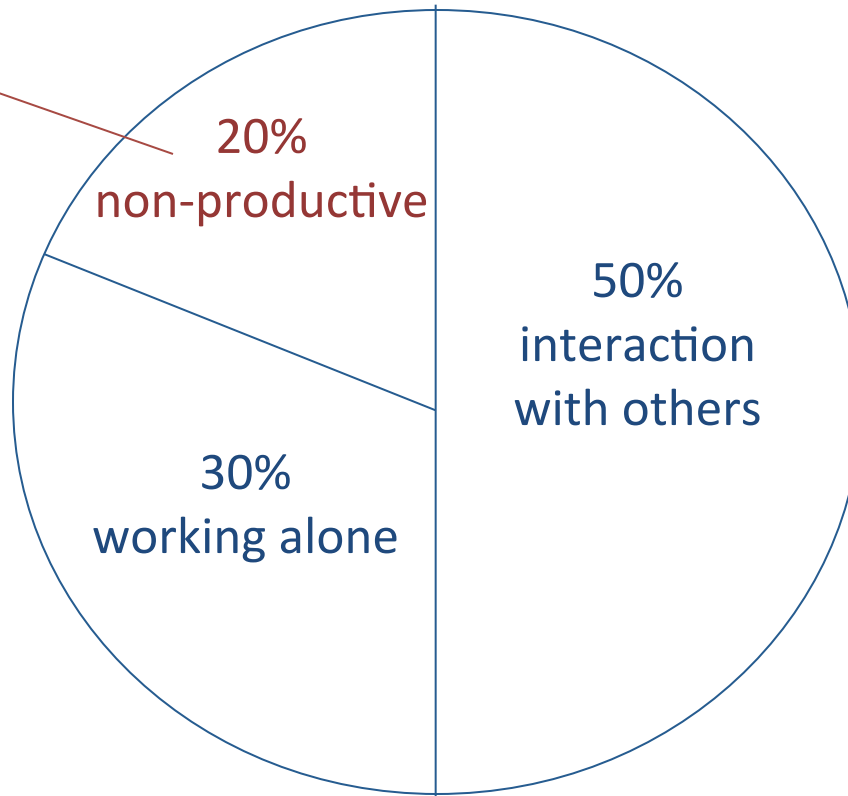**Resources**
- Budgets
- Space, facilities
- Equipment

Project management
- Relationships with other teams, management, and clients
- Project plan and schedule

Group Working

How time is spent

vacations, training,
administration, etc.

20%
non-productive

50%
interaction
with others

30%
working alone

Communication

Staff meetings (non-technical)

Technical meetings

Informal

    Kitchen, smokers' doorway, after work, etc.

    Walkabout (tours)

    Ad hoc meetings

Communication

Management of teams dispersed across locations

- Creating a team sense

    Example: Tektronics

- Face-to-face meetings

    Occasional but regular, e.g., once or twice per year
    Entire team, including support staff

- Remote meetings on a regular schedule (e.g., conference calls)

    Technical and administrative groups

- Clear division of responsibility between locations

Meetings

Meetings require leadership and a willingness to be led

- Time keeping -- do not be late; end on time or earlier

- Clear purpose for meeting, with agenda
    e.g., progress reports, design review, budget

- Preparation
    -> materials circulated in advance with time to prepare
    -> studied by all participants

- Facilitation during meeting
    -> opportunities for all to speak
    -> summing up to check agreement

- Notes taken during meeting (scribe) and circulated promptly

Meetings

For excellent advice on how to run a meeting (with highly humorous examples of how not to), see:

John Cleese and Antony Jay, *Meetings, bloody meetings*. Video Arts, 1976, revised 1976. [DVD in Hotel School Library]

There is a trailer on YouTube:

http://www.youtube.com/watch?v=ZWYnVt-umSA

Hiring

Productivity is a combination of:

- Analytic ability
- Verbal ability and communication skills
- Education
- Adaptability and inquisitiveness
- Personality and attitude

- Platform experience
- Programming language experience
- Application domain knowledge

Staff Retention

Technically interesting work

    up to date hardware and software

    opportunities to learn and experiment

Feeling of appreciation

    management recognition

    money, benefits, and promotion

Working conditions

    space, light, noise, parking

    flexibility

Organizational dynamics

Salaries

Any software developer in the USA has plenty of money to live on (food, clothing, heat, etc.).

Salaries are used to satisfy the top levels of Maslow's Hierarchy:

> self-actualization
> esteem

The absolute level of salary is less important than its relative level and how it is presented:

"The average raise is 4%, but you are getting 5%."

"Our salaries are in the top 25% of internet companies."

To Build and Maintain a Strong Team

Everybody has a different style. In my experience:

- Be consistent in how you relate to people
- Be open about problems and how you are addressing them
- Explain your decisions
- Do not have secrets
- Ask for advice and help
- Be constructive in criticism of people outside your team
- Support and attend social events

Set high standards!

Firmness

Managers must be firm when needed:

- Assignment of tasks must be equitable and open; everybody will have to tackle some of the dreary tasks

- Carrots are better than sticks, but poor performance must be addressed.

- Nobody is indispensable; nobody should be allowed to think that they are indispensable

Turning a Group Around

To turn a weak group into a strong one is the greatest challenge of leadership

- The art of the possible

- Promotion of the best over the old leaders

- Using opportunities to reorganize

- Resignations and terminations

- Respect people who try, but refuse to accept problem areas

Persistent and firm is better than brutal and abrupt

How to be Led

As a junior member of a team, what can you do to make it productive?

- Follow the team's style of working

- Understand the context of your work

- Make practical suggestions

- Ask for help if you need it

- Accept less interesting tasks

- Attend social events

- Do good work

An Old Exam Question

As leader of a software development team, you have hired two new members of staff.

(i)   The first has just graduated from the Cornell M.Eng. program in computer science, with no work experience.

(ii)   The second has five years' experience in developing advanced applications, but has never worked on this type of computer.

Some of the development tasks are more interesting than others. Some tasks are harder than others. Some are more time critical than others. What approach would you use in **allocating the tasks** to these two new members?

Bad Answers

"The Cornell graduate has more expertise to tackle the harder tasks."

"The Cornell graduate is used to time-critical tasks (course assignments)."

"The Cornell graduate should be given interesting work to make him/her keen to continue with the company."

Bad Answers

"The Cornell graduate has more expertise to tackle the harder tasks."
What makes you so superior?

"The Cornell graduate is used to time-critical tasks (course assignments)." *Sorry, that's not real.*

"The Cornell graduate should be given interesting work to make him/her keen to continue with the company." *But who cares if you leave?*

A raw graduate is still a trainee -- the most junior person -- much to learn -- no experience of production quality development.

But, hopefully, with great potential!

Good Answers

- Both should have the **potential** to produce excellent software under tight time constraints.

- Both new employees need to **learn the technical environment**. Expect them both to work slowly until they learn the environment.

- The junior (raw graduate) needs **mentoring**. The senior (experienced developer) might work **independently** or **lead a team**.

- The junior should **not** be put on **time-critical** tasks. The experienced developer might be.

- Both people should be given a **mixture** of more and less interesting tasks. **Discuss** the allocation with them.

Outsourcing

When might you contract with another organization to carry out some or all parts of the software development process?

- The other organization might have expertise that your organization lacks.

- Your organization might not have a large enough staff.

- The other organization might have lower costs (e.g., it might operate in a country, such as India, where costs are lower).

Example

Most software for the US government is built by contractors.

Outsourcing

Risks

- The other organization may not be as **skilled** as you expect

- Staff have their first **loyalty** to their own organization

- The other organization may have use different **terminology** or have a different **culture** (e.g., the organization may not report problems to the client)

- **Communication** faces geographic and cultural differences

- Unless the task is well understood, it may be difficult to write a **contract** that manages **costs** and **results** (e.g., government contracts are notorious for cost over-runs)

- If your organization contracts out all interesting work, your good **staff** will leave.

Outsourcing

Example

Company G was the world's leader in a specialized category of mathematical software. G had successfully implemented several packages for various manufacturers.

- A computer company H contracted with G to develop a package for its new computer system.

- The package for company H was late, performed badly and disliked by customers.

- At the same time G was developing a package for company I. This package was very successful.

What went wrong? What can we learn?

Outsourcing

When work is out-sourced, the client must be vigilant.

- The client must take responsibility for managing the relationships between the project and the client's organization.

- The client must have a management and technical team that can track the work being done, monitor quality, review changes to scope, etc.

- The contract should be explicit about expectations, deliverables, ownership of software, and mechanisms for payment.

- The client must be closely involved with user testing and must control the acceptance testing.

Careers in Computing

What will you be doing:

One year from now?

Ten years from now?

- Careers outside computing

- Careers in which you personally continue to do technical work

- Careers in which you are responsible for the technical work of others
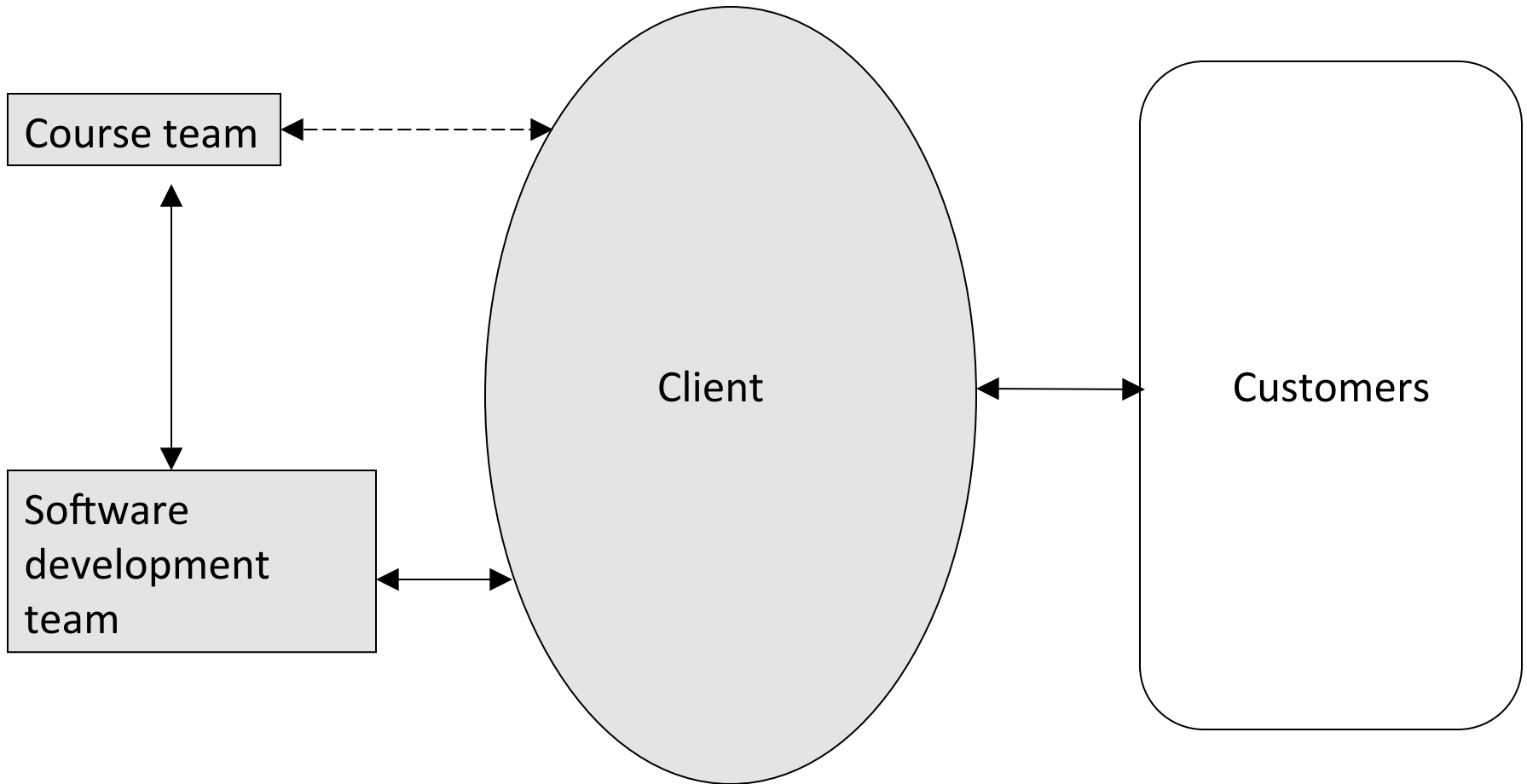
- Entrepreneur – your own company

Entrepreneur

Computer specialist have founded many of the world's great companies (Bill Gates, Larry Page, Jeff Bezos, Mark Zuckerberg, ...).

It is easier for a computer specialist to obtain management expertise than for a management generalist to become a technical expert.
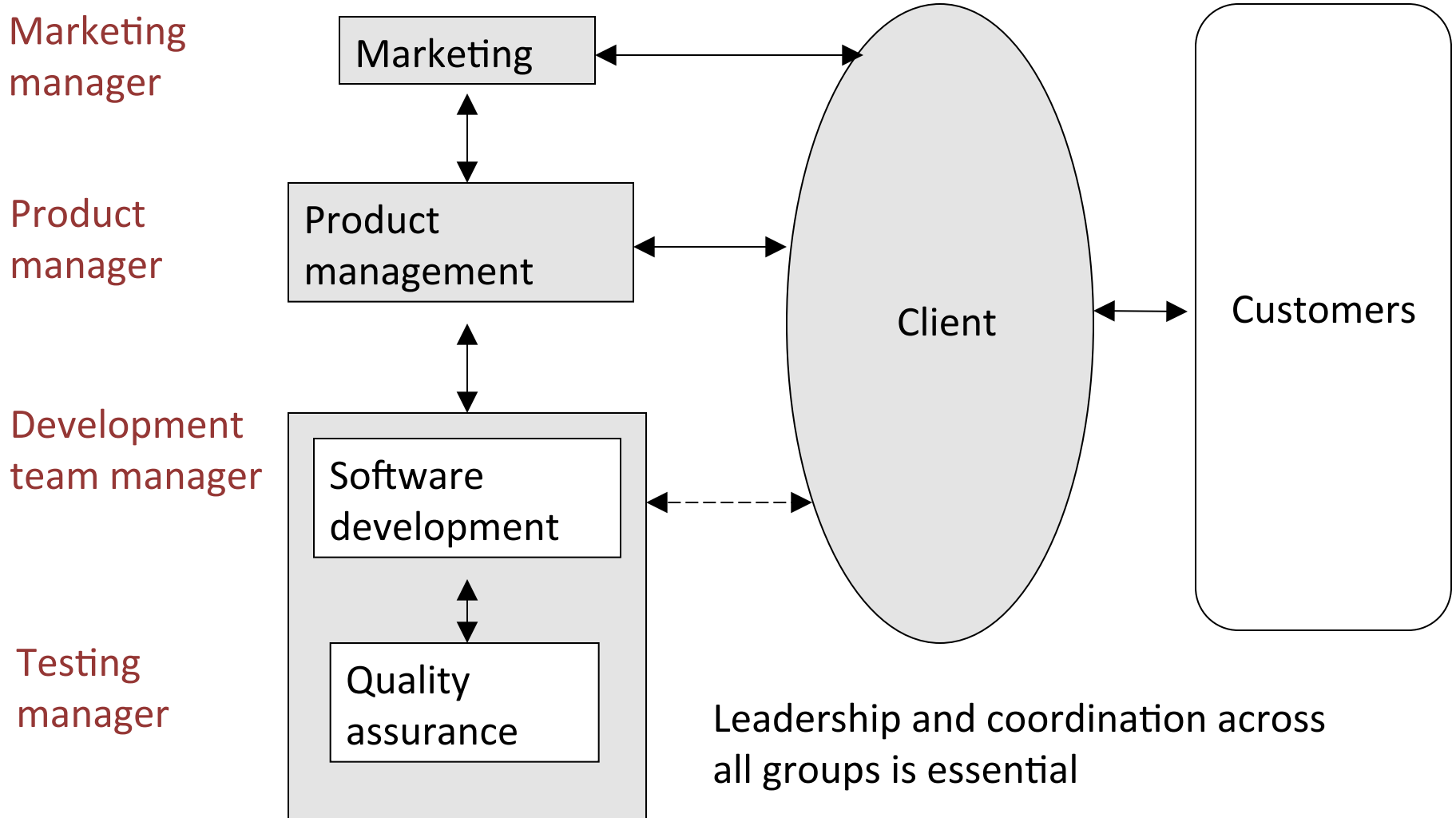
It is easier to start young before you have mortgages, children, etc.

Do not be afraid of failure. It is quite usual to fail at the first attempt, but succeed later.

The Connection to the Client:
CS 5150 Model

Course team

Software development team

Client

Customers

The Connection to the Client:
Typical Organization

Marketing manager

Product manager

Development team manager

Testing manager

Marketing ↔ Client

Product management ↔ Client

Software development ← – – → Client

Quality assurance

Client ↔ Customers

Leadership and coordination across all groups is essential

Technical Careers

Super-technical positions

A very few senior positions which are almost entirely technical: e.g., industrial research, universities

Even these have substantial organizational aspects

Mid-level technical positions

Numerous mid-level professional positions

Can be state-of-the-art or dead-end

Computer professionals report satisfaction with their choice of careers

Product Manager

The task of the **Product Manager** is to ensure that the right product is built and that the right trade-offs are made between timeliness, functionality, and costs.

This requires an understanding of:

- Marketing and business considerations

- Technical options and design criteria

- Communication among groups with different expertise and priorities

A good Product Manager has strong technical and management skills (e.g., a computer scientist with an MBA)

Quality Assurance

The task of **Quality Assurance** is to ensure that software products are built correctly.

• Develop tools and methodology for creating software that is:

> testable
> maintainable
> free of bugs

• Validate software by reviews, inspections, testing, etc.

On a big software project, the Quality Assurance staff may be as large as the Software Development staff.

Careers that take Responsibility for the Technical Work of Others

A common career progression is from being a technical expert to leading others who do technical work

Senior personnel must be familiar with both the strategic organizational aspects and the computing aspects of the work, e.g.,

> Entrepreneur
> Chief Information Officer
> Senior consultant

- Requires good technical insight, not detailed technical expertise

- Requires organizational, marketing, personnel, financial expertise

Product management is a good background for such positions

Chief Information Officer

The senior person in an organization responsible for technology

- Usually a vice president.

- Other job titles include Chief Technology Officer.

- Background is probably a combination of technology and management.

- May have worked as a consultant (possibly internal consultant).

Requires strategical technical expertise

Careers outside Computing

A computing background can be valuable in any career: management, government, law, medicine, philanthropy, etc.

Education in computing is an asset:

- Computing is a vital part of almost every organization

- Education in logical thinking and tackling large tasks systematically

Education in computing is a potential weakness:

- Not every problem can be solved by rational thinking alone

- Importance of skills with people, judgment, etc.

High Level Decision Making

Big software projects are of strategic importance for organizations

- The senior management have a duty to understand the strategic decisions, the cost options, and the risks.

Senior personnel requirement: individual who is familiar with both the strategic business aspects and the computing aspects of projects.

Career Flexibility

Nobody knows the future of computing, but …

If you do not learn continuously, you are going out of date fast

- Go to seminars, conferences, training courses

- Be inquisitive – discover things for yourself

Technical expertise is most valuable when combined with other skills

- Understand the organization that you are part of, e.g., budgets, marketing.

- Develop organizational skills, e.g., presentations, writing, leadership

Changing Organizations

If you change organizations, behave in a professional manner:

Show respect for the organization that you leave

- Respect trade secrets (public information is not confidential)
- Take nothing with you except personal items
- Do not poach customers and staff

Show enthusiasm for your new organization

- Embrace their culture
- Do not criticize relative to old organization