Software Project Management - Risk management, Managing people, Teamwork

[Book 1 - Chapter 22]

- Software project management is an essential part of software engineering.
- Projects need to be managed because professional software engineering is always subject to organizational budget and schedule constraints.
- The project manager’s job is to ensure that the software project meets and overcomes these constraints as well as delivering high-quality software.
- Good management cannot guarantee project success

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Important goals

- ■ to deliver the software to the customer at the agreed time;
- ■ to keep overall costs within budget;
- ■ to deliver software that meets the customer’s expectations;
- ■ to maintain a coherent and well-functioning development team.

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Software engineering is different from other types of engineering in a number of ways:

- 1. **The product is intangible**

A manager of a shipbuilding or a civil engineering project can see the product being developed. If a schedule slips, the effect on the product is visible—parts of the structure are obviously unfinished. Software is intangible. It cannot be seen or touched.

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- **2. Large software projects are often "one-off" projects**
- Every large software development project is unique because every environment where software is developed is, in some ways, different from all others. Lessons learned from previous projects may not be readily transferable to new projects.
- **3. Software processes are variable and organization-specific**

The engineering process for some types of system, such as bridges and buildings, is well understood. However, different companies use quite different software development processes. We cannot reliably predict when a particular software process is likely to lead to development problems.

Important factors that affect how software projects are managed are:

- **1. Company size** Small companies have less management overhead than larger organizations.
- **2. Software customers** If the customer is an internal customer communications can be and if software is being developed for an external customer, agreement has to be reached on more formal communication channels.
- **3. Software size** Small systems can be developed by a small team and work in small room while large systems usually need multiple development teams that may be geographically distributed and in different companies.
- **4. Software type** If the software being developed is a consumer product, formal records of project management decisions are unnecessary ,else all project management decisions should be recorded and justified as these may affect the safety of the system.
- **5. Organizational culture** Some organizations have a culture that is based on supporting and encouraging individuals, while others are group focused.
- **6. Software development processes** Agile processes typically try to operate with “lightweight” management. More formal processes require management monitoring to ensure that the development team is following the defined process

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Fundamental project management activities

- **1. Project planning** Project managers are responsible for planning, estimating, and scheduling project development and assigning people to tasks. They supervise he work to ensure that it is carried out to the required standards, and they monitor progress to check that the development is on time and within budget.
- **2. Risk management** Project managers have to assess the risks that may affect a project, monitor these risks, and take action when problems arise.
- **3. People management** Project managers are responsible for managing a team of people. They have to choose people for their team and establish ways of working that lead to effective team performance.
- **4. Reporting- Project** managers are usually responsible for reporting on the progress of a project to customers and to the managers of the company developing the software. They have to be able to communicate at a range of levels, from detailed technical information to management summaries.
- **5. Proposal writing** The first stage in a software project may involve writing a proposal to win a contract to carry out an item of work. The proposal describes the objectives of the project and how it will be carried out.

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Risk management

- Risk management is one of the most important jobs for a project manager.
- You can think of a risk as something that you'd prefer not to have happen.
- Risks may threaten the project, the software that is being developed, or the organization.
- Risk management involves anticipating risks that might affect the project schedule or the quality of the software being developed, and then taking action to avoid these risks

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Risk classification

- **1. Project risks** affect the project schedule or resources. An example of a project risk is the loss of an experienced system architect.. Finding a replacement architect with appropriate skills and experience may take a long time; consequently, it will take longer to develop the software design than originally planned
- **2. Product risks** affect the quality or performance of the software being developed. An example of a product risk is the failure of a purchased component to perform as expected. This may affect the overall performance of the system so that it is slower than expected.
- **3. Business risks** affect the organization developing or procuring the software. For example, a competitor introducing a new product is a business risk. The introduction of a competitive product may mean that the assumptions made about sales of existing software products may be unduly optimistic

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Examples of common project, product, and business risks

Risk	Affects	Description
Staff turnover	Project	Experienced staff will leave the project before it is finished.
Management change	Project	There will be a change of company management with different priorities.
Hardware unavailability	Project	Hardware that is essential for the project will not be delivered on schedule.
Requirements change	Project and product	There will be a larger number of changes to the requirements than anticipated.
Specification delays	Project and product	Specifications of essential interfaces are not available on schedule.
Size underestimate	Project and product	The size of the system has been underestimated.
Software tool underperformance	Product	Software tools that support the project do not perform as anticipated.
Technology change	Business	The underlying technology on which the system is built is superseded by new technology.
Product competition	Business	A competitive product is marketed before the system is completed.

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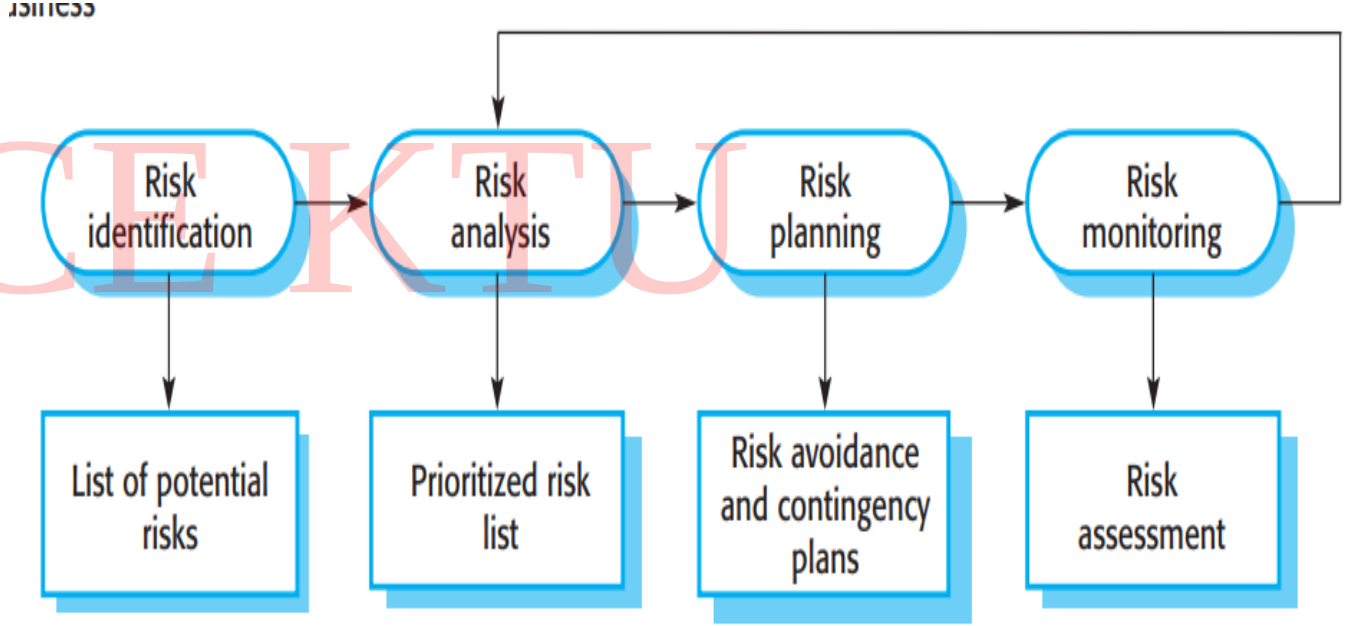
The risk management process

1.Risk identification You should identify possible project, product, and business risks.

2. Risk analysis You should assess the likelihood and consequences of these risks.

3. Risk planning You should make plans to address the risk, either by avoiding it or by minimizing its effects on the project.

4. Risk monitoring You should regularly assess the risk and your plans for risk mitigation and revise these plans when you learn more about the risk



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1 Risk identification

- Six types of risk may be included in a risk checklist
- 1. Estimation risks arise from the management estimates of the resources required to build the system.
- 2. Organizational risks arise from the organizational environment where the software is being developed.
- 3. People risks are associated with the people in the development team.
- 4. Requirements risks come from changes to the customer requirements and the process of managing the requirements change.
- 5. Technology risks come from the software or hardware technologies that are used to develop the system.
- 6. Tools risks come from the software tools and other support software used to develop the system

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Risk type	Possible risks
Estimation	1. The time required to develop the software is underestimated. 2. The rate of defect repair is underestimated. 3. The size of the software is underestimated.
Organizational	4. The organization is restructured so that different management are responsible for the project. 5. Organizational financial problems force reductions in the project budget.
People	6. It is impossible to recruit staff with the skills required. 7. Key staff are ill and unavailable at critical times. 8. Required training for staff is not available.
Requirements	9. Changes to requirements that require major design rework are proposed. 10. Customers fail to understand the impact of requirements changes.
Technology	11. The database used in the system cannot process as many transactions per second as expected. 12. Faults in reusable software components have to be repaired before these components are reused.
Tools	13. The code generated by software code generation tools is inefficient. 14. Software tools cannot work together in an integrated way.

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2 Risk analysis

- During the risk analysis process, you have to consider each identified risk and make a judgment about the probability and seriousness of that risk. There is no easy way to do so.
- You have to rely on your judgment and experience of previous projects and the problems that arose in them.
- It is not possible to make precise, numeric assessment of the probability and seriousness of each risk

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Assign the risk to one of a number of bands:

- 1. The probability of the risk might be assessed as insignificant, low, moderate, high, or very high.
- 2. The effects of the risk might be assessed as catastrophic (threaten the survival of the project), serious (would cause major delays), tolerable (delays are within allowed contingency), or insignificant.

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Risk	Probability	Effects
Organizational financial problems force reductions in the project budget (5).	Low	Catastrophic
It is impossible to recruit staff with the skills required (6).	High	Catastrophic
Key staff are ill at critical times in the project (7).	Moderate	Serious
Faults in reusable software components have to be repaired before these components are reused (12).	Moderate	Serious
Changes to requirements that require major design rework are proposed (9).	Moderate	Serious
The organization is restructured so that different managements are responsible for the project (4).	High	Serious
The database used in the system cannot process as many transactions per second as expected (11).	Moderate	Serious
The time required to develop the software is underestimated (1).	High	Serious
Software tools cannot be integrated (14).	High	Tolerable
Customers fail to understand the impact of requirements changes (10).	Moderate	Tolerable
Required training for staff is not available (8).	Moderate	Tolerable
The rate of defect repair is underestimated (2).	Moderate	Tolerable
The size of the software is underestimated (3).	High	Tolerable
Code generated by code generation tools is inefficient (13).	Moderate	Insignificant

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Figure 22.4 Risk types and examples

3.Risk planning

- The risk planning process develops strategies to manage the key risks that threaten the project.
- For each risk, you have to think of actions that you might take to minimize the disruption to the project if the problem identified in the risk occurs.
- You should also think about the information that you need to collect while monitoring the project so that emerging problems can be detected before they become serious.
- In risk planning, you have to ask “what-if” questions that consider both individual risks, combinations of risks, and external factors that affect these risks.

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Strategies for managing the risks fall into three categories:

- Avoidance strategies- Following these strategies means that the probability that the risk will arise is reduced. An example of a risk avoidance strategy is the strategy for dealing with defective components shown in Figure.
- Minimization strategies- Following these strategies means that the impact of the risk is reduced. An example of a risk minimization strategy is the strategy for staff illness shown in Figure
- Contingency plans- Following these strategies means that you are prepared for the worst and have a strategy in place to deal with it.

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Risk	Strategy
Organizational financial problems	Prepare a briefing document for senior management showing how the project is making a very important contribution to the goals of the business and presenting reasons why cuts to the project budget would not be cost-effective.
Recruitment problems	Alert customer to potential difficulties and the possibility of delays; investigate buying-in components.
Staff illness	Reorganize team so that there is more overlap of work and people therefore understand each other's jobs.
Defective components	Replace potentially defective components with bought-in components of known reliability.
Requirements changes	Derive traceability information to assess requirements change impact; maximize information hiding in the design.
Organizational restructuring	Prepare a briefing document for senior management showing how the project is making a very important contribution to the goals of the business.
Database performance	Investigate the possibility of buying a higher-performance database.
Underestimated development time	Investigate buying-in components; investigate use of automated code generation.

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Figure 22.5 Strategies to help manage risk

4. Risk monitoring

- Risk monitoring is the process of checking that your assumptions about the product, process, and business risks have not changed.
- You should regularly assess each of the identified risks to decide whether or not that risk is becoming more or less probable.
- You should also think about whether or not the effects of the risk have changed.
- To do this, you have to look at other factors, such as the number of requirements change requests, which give you clues about the risk probability and its effects.
- These factors are obviously dependent on the types of risk.

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Risk type	Potential indicators
Estimation	Failure to meet agreed schedule; failure to clear reported defects.
Organizational	Organizational gossip; lack of action by senior management.
People	Poor staff morale; poor relationships among team members; high staff turnover.
Requirements	Many requirements change requests; customer complaints.
Technology	Late delivery of hardware or support software; many reported technology problems.
Tools	Reluctance by team members to use tools; complaints about software tools; requests for faster computers/more memory, and so on.

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Figure 22.6 Risk indicators

2.Managing people

- The people working in a software organization are its greatest assets. It is expensive to recruit and retain good people, and it is up to software managers to ensure that the engineers working on a project are as productive as possible.
- In successful companies and economies, this productivity is achieved when people are respected by the organization and are assigned responsibilities that reflect their skills and experience.
- It is important that software project managers understand the technical issues that influence the work of software development.
- Good software engineers are not always good people managers.
- Software engineers often have strong technical skills but may lack the softer skills that enable them to motivate and lead a project development team.
- As a project manager, you should be aware of the potential problems of people management and should try to develop people management skills

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Four critical factors that influence the relationship between a manager and the people that he or she manages:

- 1. **Consistency**
  - All the people in a project team should be treated in a comparable way.
- **2. Respect**
  - Different people have different skills, and managers should respect these differences. All members of the team should be given an opportunity to make a contribution.
- **3. Inclusion**
  - It is important to develop a working environment where all views, even those of the least experienced staff, are considered.
- **4. Honesty**
  - As a manager, you should always be honest about what is going well and what is going badly in the team. You should also be honest about your level of technical knowledge and be willing to defer to staff with more knowledge when necessary.

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Motivating people

- motivation means organizing work and its environment to encourage people to work as effectively as possible. If people are not motivated, they will be less interested in the work they are doing. They will work slowly, be more likely to make mistakes, and will not contribute to the broader goals of the team or the organization.
- To provide this encouragement, you should understand a little about what motivates people. Maslow (Maslow 1954) suggests that people are motivated by satisfying their needs.

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These needs are arranged in a series of levels, as shown in Figure .
The lower levels of this hierarchy represent fundamental needs for food, sleep, and so on, and the need to feel secure in an environment.

Social need is concerned with the need to feel part of a social grouping.

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Esteem need represents the need to feel respected by others, and self-realization need is concerned with personal development.

People need to satisfy lower-level needs such as hunger before the more abstract, higher-level needs.

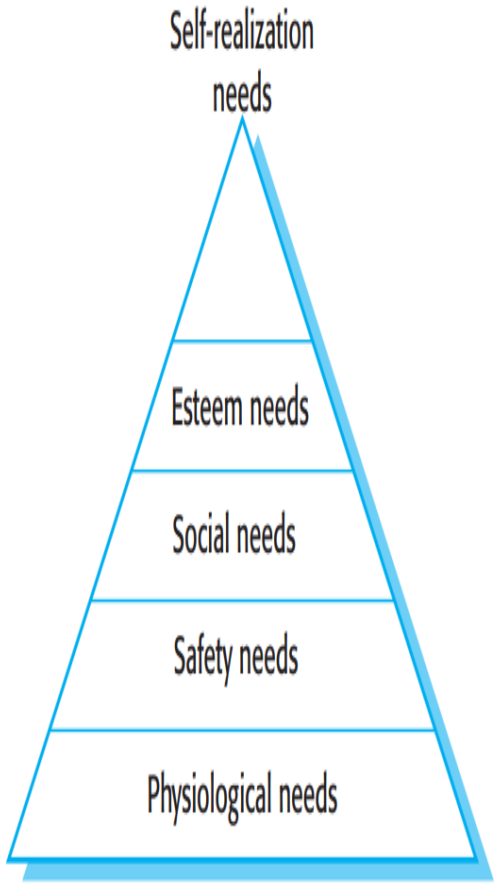

Figure 22.7 Human needs hierarchy

Making sure that peoples' social, esteem, and self-realization needs are satisfied is most important from a management point of view.

1. To satisfy social needs, you need to give people time to meet their co-workers and provide places for them to meet. Software companies such as Google provide social space in their offices for people to get together. This is relatively easy when all of the members of a development team work in the same place
2. 2. To satisfy esteem needs, you need to show people that they are valued by the organization. Public recognition of achievements is a simple and effective way of doing this.
3. 3. Finally, to satisfy self-realization needs, you need to give people responsibility for their work, assign them demanding (but not impossible) tasks, and provide opportunities for training and development where people can enhance their skills. Training is an important motivating influence as people like to gain new knowledge and learn new skills

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Three classifications for professional workers:

- 1. Task-oriented people, who are motivated by the work they do. In software engineering, these are people who are motivated by the intellectual challenge of software development
- 2. Self-oriented people, who are principally motivated by personal success and recognition. They are interested in software development as a means of achieving their own goals. They often have longer-term goals, such as career progression, that motivate them, and they wish to be successful in their work to help realize these goals.
- 3. Interaction-oriented people, who are motivated by the presence and actions of co-workers. As more and more attention is paid to user interface design, interaction-oriented individuals are becoming more involved in software engineering.

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Team work

- Most professional software is developed by project teams that range in size from two to several hundred people.
- it is impossible for everyone in a large group to work together on a single problem, large teams are usually split into a number of smaller groups.
- Each group is responsible for developing part of the overall system. The best size for a software engineering group is 4 to 6 members, and they should never have more than 12 members.
- When groups are small, communication problems are reduced.
- Everyone knows everyone else, and the whole group can get around a table for a meeting to discuss the project and the software that they are developing.

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The benefits of creating a group are:

- 1. The group can establish its own quality standards- Because these standards are established by consensus, they are more likely to be observed than external standards imposed on the group.
- 2. Individuals learn from and support each other -Group members learn by working together. Inhibitions caused by ignorance are minimized as mutual learning is encouraged.
- 3. Knowledge is shared- Continuity can be maintained if a group member leaves. Others in the group can take over critical tasks and ensure that the project is not unduly disrupted.
- 4. Refactoring and continual improvement is encouraged- Group members work collectively to deliver high-quality results and fix problems, irrespective of the individuals who originally created the design or program.

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Three factors that have the biggest effect on team working are:

- 1. The people in the group You need a mix of people in a project group as software development involves diverse activities such as negotiating with clients, programming, testing, and documentation.
- 2. The way the group is organized A group should be organized so that individuals can contribute to the best of their abilities and tasks can be completed as expected.
- 3. Technical and managerial communications Good communication between group members, and between the software engineering team and other project stakeholders, is essential.

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1 Selecting group members

- A manager or team leader's job is to create a cohesive group and organize that group so that they work together effectively. This task involves selecting a group with the right balance of technical skills and personalities.
- Sometimes people are hired from outside the organization; more often, software engineering groups are put together from current employees who have experience on other projects.
- Managers rarely have a completely free hand in team selection. They often have to use the people who are available in the company, even if they are not the ideal people for the job.

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- Technical knowledge and ability should not be the only factor used to select group members.
- The “competing engineers” problem can be reduced if the people in the group have complementary motivations.
- People who are motivated by the work are likely to be the strongest technically.
- People who are self-oriented will probably be best at pushing the work forward to finish the job.
- People who are interaction-oriented help facilitate communications within the group.

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2.Group organization

The way a group is organized affects the group's decisions, the ways information is exchanged, and the interactions between the development group and external project stakeholders.

Important organizational questions for project managers include the following:

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1. Should the project manager be the technical leader of the group?
2. Who will be involved in making critical technical decisions, and how will these decisions be made? Will decisions be made by the system architect or the project manager or by reaching consensus among a wider range of team members?

- 3. How will interactions with external stakeholders and senior company management be handled?
- 4. How can groups integrate people who are not co-located? It is now common for groups to include members from different organizations and for people to work from home as well as in a shared office. This change has to be considered in group decision-making processes.
- 5. How can knowledge be shared across the group? Group organization affects information sharing as certain methods of organization are better for sharing than others. However, you should avoid too much information sharing as people become overloaded and excessive information distracts them from their work.

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3 Group communications

- It is absolutely essential that group members communicate effectively and efficiently with each other and with other project stakeholders.
- Group members must exchange information on the status of their work, the design decisions that have been made, and changes to previous design decisions.
- They have to resolve problems that arise with other stakeholders and inform these stakeholders of changes to the system, the group, and delivery plans.
- Good communication also helps strengthen group cohesiveness.
- Group members come to understand the motivations, strengths, and weaknesses of other people in the group.

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The effectiveness and efficiency of communications are influenced by:

- 1. Group size
  - As a group gets bigger, it gets harder for members to communicate effectively. The number of one-way communication links is n * (n − 1), where n is the group size.For a group of eight members, there are 56 possible communication pathways. This means that it is quite possible that some people will rarely communicate with each other.
- 2. Group structure
  - People in informally structured groups communicate more effectively than people in groups with a formal, hierarchical structure. In hierarchical groups, communications tend to flow up and down the hierarchy. People at the same level may not talk to each other. This is a particular problem in a large project with several development groups
- 3. Group composition
  - People with the same personality types may clash, and, as a result, communications can be inhibited. Communication is also usually better in mixed-sex groups than in single-sex groups. Women are often more interaction-oriented than men and may act as interaction controllers and facilitators for the group.

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- 4. The physical work environment
  - The organization of the workplace is a major factor in facilitating or inhibiting communications. While some companies use standard open-plan offices for their staff, others invest in providing a workspace that includes a mixture of private and group working areas. This allows for both collaborative activities and individual development that require a high level of concentration.
- 5. The available communication channels
  - There are many different forms of communication—face to face, email messages, formal documents, telephone, and technologies such as social networking and wikis. As project teams become increasingly distributed, with team members working remotely, you need to make use of interaction technologies, such as conferencing systems, to facilitate group communications.

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