# Module 4: Software Development and Information Technology

Strategies to Engineer Quality Software-Key Issues in Software Development- The impact of IT on the Standard of Living and Productivity -Industry 4.0 standards and applications in areas like Food, Water, Energy and Health care

# Strategies for Engineering Quality Software

- High-quality software systems are easy to learn & use:
    - Perform quickly and efficiently
    - Operate safely and reliably
    - Meet their users' needs
    - are required to support the fields of:
        - Air traffic control
        - Nuclear power
        - Automobile safety
        - Health care
        - Military and defense
        - Space exploration
- Increased demand for high-quality software

- A **software defect** is any error that, if not removed, could cause a software system to fail to meet users' needs.
  - Impact of the defects may be trivial or very serious - a computerized sensor in a refrigerator's ice cube maker might fail to recognize that the tray is full and continue to make ice.
  - Subtle and undetectable – a tax preparation package that makes a minor miscalculation
  - glaringly obvious - a payroll program that generates checks with no deductions for Social Security or other taxes.
- **Software quality** is the degree to which a software product meets the needs of the users.
- **Quality management** focuses on **defining, measuring, and refining the quality** of the development process and products developed during the various stages.
- **Objective**
  - To help developers deliver high-quality systems that meet the needs of the users.
- **Deliverables** are products such as:
  - Statements of requirements
  - Flowcharts
  - User documentation

- **Primary cause for poor software quality:**
  - Many developers do not know how to design quality into software from the start
  - Or do not take the time to do so
- **To develop high-quality software, developers must:**
  - **Define and follow** rigorous engineering principles
  - **Learn** from past mistakes
  - **Understand** systems' operating environment
  - **Design systems** relatively immune to human error
- Programmers make mistakes in **defining user requirements** and **turning design specifications into code.**
  - About one defect for every 7-10 lines of code
- **Another factor that can contribute to poor-quality software:**
  - Extreme pressure that software companies feel to reduce the time to market for the products.
  - Driven by the need to:
    - beat the competition in delivering new functionality to users
    - begin generating revenue to recover costs of development
    - show a profit for shareholders
    - meet quarterly earnings forecasts
  - Resources and time to ensure quality are often cut

- **Ethical dilemma for software development organizations:** how much additional cost and effort should be expended to ensure products and services meet customers' expectations?
- Customers are the stakeholders who are key to the success of a software application.
- As a result of the lack of consistent quality in software
  - Organizations avoid buying the first release of a major software product.
  - prohibit its use in critical systems
  - Usually has many defects that cause problems.
- Established software products can also falter:
  - When operating conditions change

# The Importance of Software Quality

- A **business information system** is a set of interrelated components including:
  - Hardware
  - Software
  - Databases
  - Networks
  - People
  - Procedures

  that collects and processes data and disseminates the output
- A **common type of business system** is one that captures and records business transactions.
- Business information system examples
  - Manufacturer's order-processing system
  - Bank's electronic-funds transfer system
  - Airline's online ticket reservation system
- **Key requirement** - accurate, thorough, and timely processing of business transactions

# Decision support system (DSS)

- **Decision support system (DSS)** - used to improve decision making.
- DSS can be used to **develop accurate forecasts of customer demand**, **recommend stocks and bonds for an investment portfolio**, or **schedule shift workers** in such a way as to **minimize cost while meeting customer service goals.**
- **Software** is also used to **control many industrial processes** in an effort to **reduce costs**, **eliminate human error**, **improve quality**, and **shorten the time** it takes to manufacture products.
- For example, steel manufacturers use process-control software to capture data from sensors about the equipment that rolls steel into bars and about the furnace that heats the steel before it is rolled. Without process-control computers, workers could react to defects only after the fact and would have to guess at the adjustments needed to correct the process. Process-control computers enable the process to be monitored for variations from operating standards (e.g., a low furnace temperature or incorrect levels of iron ore) and to eliminate product defects before they affect product quality.
- Any defect in this software can lead to decreased product quality, increased waste and costs, or even unsafe operating conditions for employees.
- **Software** is also used to **control the operation of many industrial and consumer products**.
- Examples: automobiles, medical diagnostic and treatment equipment, televisions, radios, stereos, refrigerators, and washers.
- A software defect could have relatively minor consequences, such as clothes not drying long enough, or it could cause serious damage, such as a patient being overexposed to powerful X-rays.

- **Mismanaged software** can now be fatal to a business
  - causing it to **miss product delivery dates**
  - **incur increased product development costs**
  - **deliver products that have poor quality**
- **Ethical questions**
  - How much effort and money to invest to ensure high-quality software
  - Whether products could cause damage and what the legal exposure would be if they did

# Software Product Liability

- **Product liability**
  - Liability of manufacturers, sellers, lessors, and others for injuries caused by defective products
  - There is no federal product liability law
    - Mainly common law – made by state judges
    - Article 2 of the Uniform Commercial Code deals with the sale of goods
- **Strict liability**
  - Defendant held responsible for the injuring another person regardless of negligence or intent.
  - Defendants in a strict liability action may use several legal defenses:
    - the **doctrine of supervening event**
    - the **government contractor defense**
    - **expired statute of limitations**

- **Strict liability**
  - Plaintiff must prove only that the software product is defective or unreasonably dangerous and that the defect caused the injury
  - No requirement to prove that the manufacturer was careless or negligent or to prove who caused the defect
  - All parties in the chain of distribution are liable
    - Manufacturer
    - Subcontractors
    - Distributors

- **Negligence**
  - Failure to do what a reasonable person would do, or doing something that a reasonable person would not do
  - Responsibility is limited to defects that could have been detected and corrected through “reasonable” software development practices
  - Area of great risk for software manufacturers
  - Defense of negligence may include:
    - Legal justification for the alleged misconduct
    - Demonstration that the plaintiffs’ own actions contributed to injuries - **contributory negligence**

- **Warranty**
  - assures buyers or lessees that a product meets certain standards of quality
- A **warranty of quality** may be expressly stated or implied by law.
- **Express warranties** can be oral, written, or inferred from the seller's conduct.
- For example, sales contracts contain an implied warranty of merchantability, which requires that the following standards be met:
  - The goods must be fit for the ordinary purpose for which they are used.
  - The goods must be adequately contained, packaged, and labeled.
  - The goods must be of an even kind, quality, and quantity within each unit.
  - The goods must conform to any promise or affirmation of fact made on the container or label.
  - The quality of the goods must pass without objection in the trade.
  - The goods must meet a fair average or middle range of quality.
- **Breach of warranty**
  - When the product fails to meet the terms of its warranty – the buyer or lessee can sue for **breach of warranty**
  - Plaintiff must have a valid contract that the supplier did not fulfill in order to win a **breach of warranty claim**
  - can be extremely difficult to prove because the software supplier writes the warranty to limit liability

- **Intentional misrepresentation**
  - Seller or lessor either misrepresents the quality of a product or conceals a defect in it.
  - Forms of representation
    - Advertising
    - Salespersons' comments
    - Invoices
    - Shipping labels
- Most software manufacturers use **limited warranties and disclaimers** to avoid any claim of misrepresentation.

# Software Development Process

- Developing information system software is not a simple process; it requires completing many complex activities, with many dependencies among the various activities.
- Systems analysts, programmers, architects, database specialists, project managers, documentation specialists, trainers, and testers **- involved in large software projects**
- **Software development methodology** – adopted in software companies
  - A **standard, proven work process** that enables systems analysts, programmers, project managers and others
    - to **make controlled and orderly progress** in developing high-quality software
    - **defines activities** in software development process
    - **defines** individual and group **responsibilities**
    - **recommends specific techniques** for activities
    - offers **guidelines** for managing the quality of software during various stages of development

- Easier and cheaper to avoid software problems at the beginning than to attempt to fix damages after the fact
  - Cost to identify and remove a defect in an early stage can be up to 100 times less than removing a defect in a piece of software that has been distributed to customers.
  - Identify and remove errors early in the development process
    - Cost-saving measure
    - Most efficient way to improve software quality
- Effective methodology protects from legal liability
  - Reduces the number of software errors
  - If an organization follows widely accepted development methods, negligence on its part is harder to prove
- **Software quality assurance (QA)** refers to methods within the development cycle
  - **Designed** to guarantee **reliable operation of product**
  - are **applied at each stage** in the development cycle
  - include **testing** before the product ships

# Software development methodology

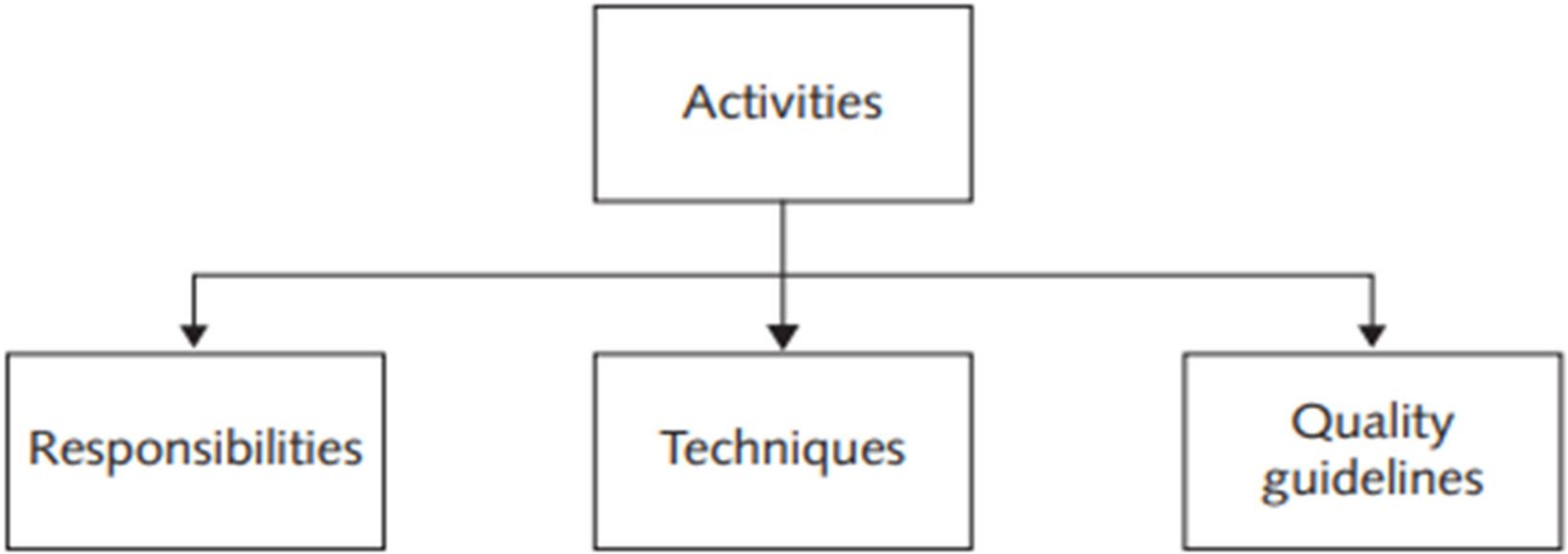



**FIGURE 7-1** Components of a software development methodology

# Waterfall system development model

The waterfall system development model is a sequential, multistage system development process in which development of the next stage of the system cannot begin until the results of the current stage are approved or modified as necessary

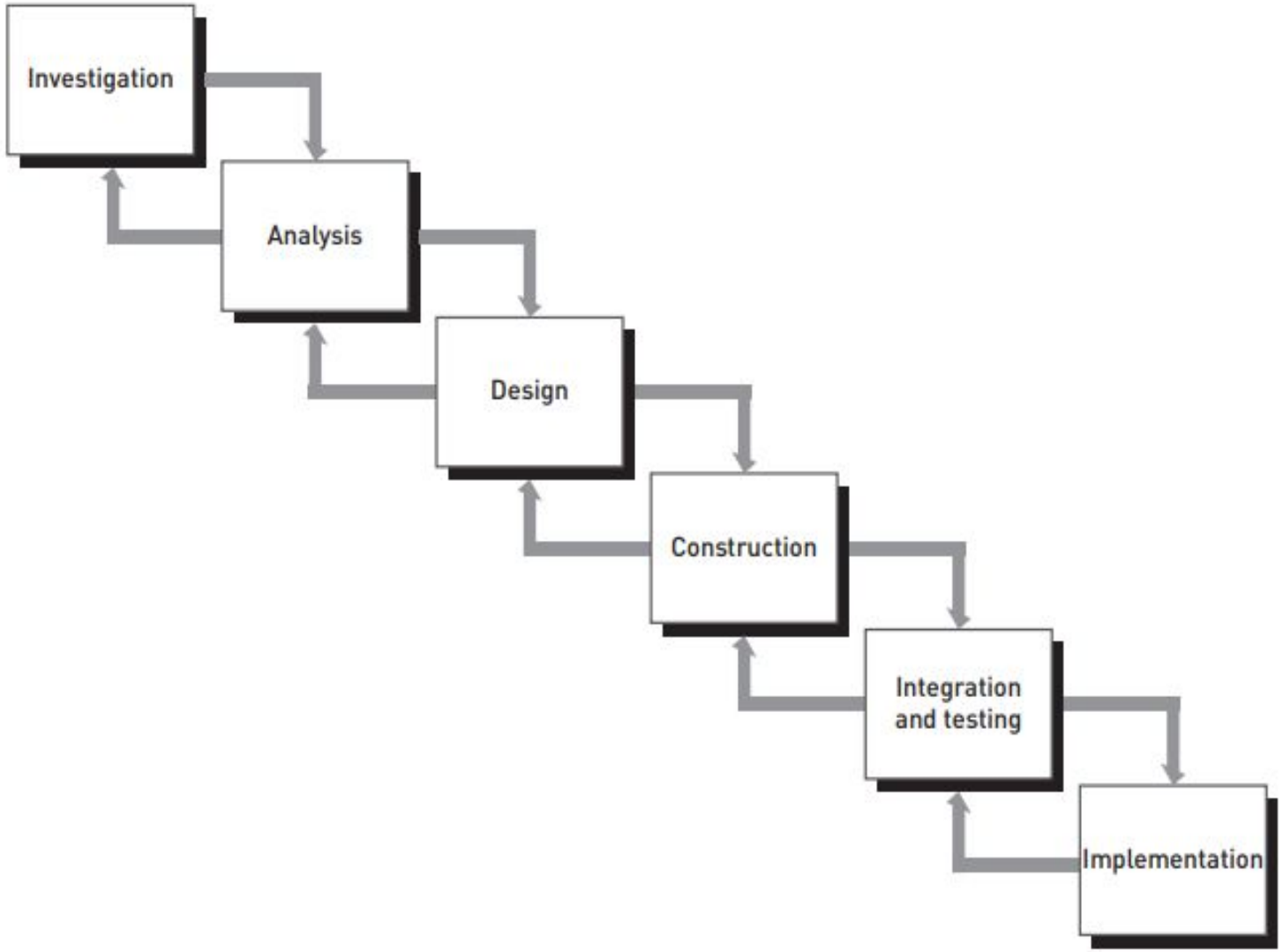



**FIGURE 7-2** Waterfall system development model

# Agile development methodology

- Under the agile development methodology, a system is developed in iterations (often called sprints) lasting from one to four weeks.
- Agile development accepts the fact that system requirements are evolving and cannot be fully understood or defined at the start of the project.
- Agile development concentrates on maximizing the team's ability to deliver quickly and respond to emerging requirements.
- In an agile development project, the team evaluates the system every one to four weeks, giving it ample opportunity to identify and implement new requirements

# Agile system development methodology

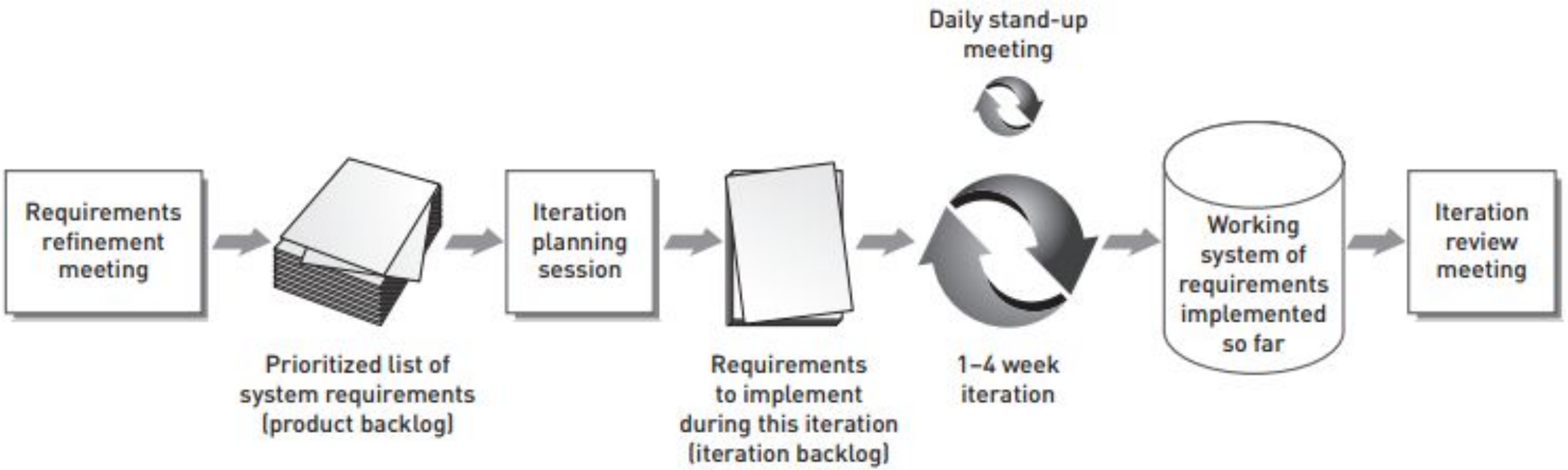



**FIGURE 7-3** Agile system development methodology

# Software Development Process (cont'd.)

- Easier and cheaper to avoid software problems at the beginning than to attempt to fix damages after the fact
  - Cost to identify and remove a defect in an early stage can be up to 100 times less than removing a defect in distributed software
  - Identify and remove errors early in the development process
    - Cost-saving measure
    - Most efficient way to improve software quality

# Dynamic testing

- Software is developed in units called **subroutines or programs**. These units are combined to form large systems. One approach to QA is to test the code for a completed unit of software by actually entering test data and comparing the results with the expected results in a process called **dynamic testing.**

- 2 forms of dynamic testing**:**
  - **Black-box testing**
    - involves **viewing the software unit as a device that has expected input and output behaviors** but whose **internal workings are unknown** (a black box).
    - If the unit demonstrates the expected behaviors for all the input data in the test suite, it passes the test.
    - Black-box testing **takes place without the tester having any knowledge of the structure or nature of the actual code**. For this reason, it is often done by someone other than the person who wrote the code.
  - **White-box testing**
    - treats the software unit as a device that has expected input and output behaviors but whose internal workings, unlike the unit in blackbox testing, are known.
    - White-box testing involves testing all possible logic paths through the software unit with thorough knowledge of its logic.
    - The test data must be carefully constructed so that each program statement executes at least once.

# Different types of testing

- **Static testing**
  - Special software programs called static analyzers are run against new code.
  - Rather than reviewing input and output, the static analyzer looks for suspicious patterns in programs that might indicate a defect
- **Integration testing**
  - Occurs after successful unit testing
  - Software units are combined into an integrated subsystem that undergoes rigorous testing
  - Ensures that all linkages among various subsystems work successfully
- **System testing**
  - Occurs after successful integration testing
  - Various subsystems are combined
  - Tests the entire system as a complete entity
- **User acceptance testing**
  - Independent testing performed by trained end users
  - Ensures that the system operates as they expect

# Key Issues in Software Development

- Consequences of software defects in certain systems can be deadly
    - Companies must take special precautions
- Ethical decisions involve a trade-off between quality and cost, ease of use, and time to market

# Development of Safety-Critical Systems

- Safety-critical system
  - A system whose failure may cause injury or death
  - Examples
    - Automobile's antilock brakes
    - Nuclear power plant reactors
    - Airplane navigation
    - Roller coasters
    - Elevators
    - Medical devices
- Key assumption
  - Safety will not automatically result from following the organization's standard development methodology
- Requires a more rigorous and time-consuming development process than other kinds of software
- All tasks require:
  - Additional steps
  - More thorough documentation
  - Vigilant checking and rechecking

- Project safety engineer
  - Explicit responsibility for the system's safety
  - Uses a logging and monitoring system:
    - To track hazards from the project's start to finish
- Hazard log
  - Used at each stage of the software development process to assess how project team has accounted for detected hazards
- Safety reviews
  - Held throughout the development process
- Robust configuration management system
  - Tracks all safety-related documentation
- Formal documentation required
  - Including verification reviews and signatures
- Key issues
  - Ethical dilemmas : increased time and expense
  - Deciding when QA staff has performed enough testing

- Risk
  - Probability of an undesirable event occurring times the magnitude of the event's consequences
  - Consequences include:
    - Damage to property
    - Loss of money
    - Injury to people
    - Death
- Redundancy
  - Provision of multiple interchangeable components to perform a single function
  - Used to cope with failures and errors
  - During times of widespread disaster, lack of sufficient redundant can lead to major problems

- N-version programming
  - Form of redundancy
  - Involves the execution of a series of program instructions simultaneously by two different systems
  - Uses different algorithms to execute instructions that accomplish the same result
  - Results from the two systems are compared
  - If a difference is found, another algorithm is executed to determine which system yielded the correct result
  - Instructions for the two systems can be:
    - Written by programmers from two different companies
    - Run on different hardware devices
  - Rationale
    - Both systems are highly unlikely to fail at the same time under the same conditions

- Decide what level of risk is acceptable
  - Difficult and controversial decision
  - Make system modifications if level of risk is judged to be too great
- Mitigate the consequences of failure
  - Devise emergency procedures and evacuation plans
- Decide whether to recall a product:
  - When data indicates a problem
- Reliability
  - Probability of a component or system performing without failure over its product life
- Human interface
  - Important and difficult area of safety-critical system design
  - Should leave the operator little room for erroneous judgment
  - Poor design of a system interface can greatly increase risk

# Quality Management Standards

- **ISO 9001 family of standards**
  - Guide to quality products, services, and management
  - Organization must submit to an examination by an external assessor
  - Requirements
    - Written procedures for everything it does
    - Follow those procedures
    - Prove to the auditor the organization fulfilled the first two requirements
- **Failure mode and effects analysis (FMEA)**
  - Technique used to evaluate reliability and determine the effect of system and equipment failures
  - Failures are classified by:
    - Impact on a project's success
    - Personnel safety
    - Equipment safety
    - Customer satisfaction and safety
  - Goal
    - Identify potential design and process failures early in a project

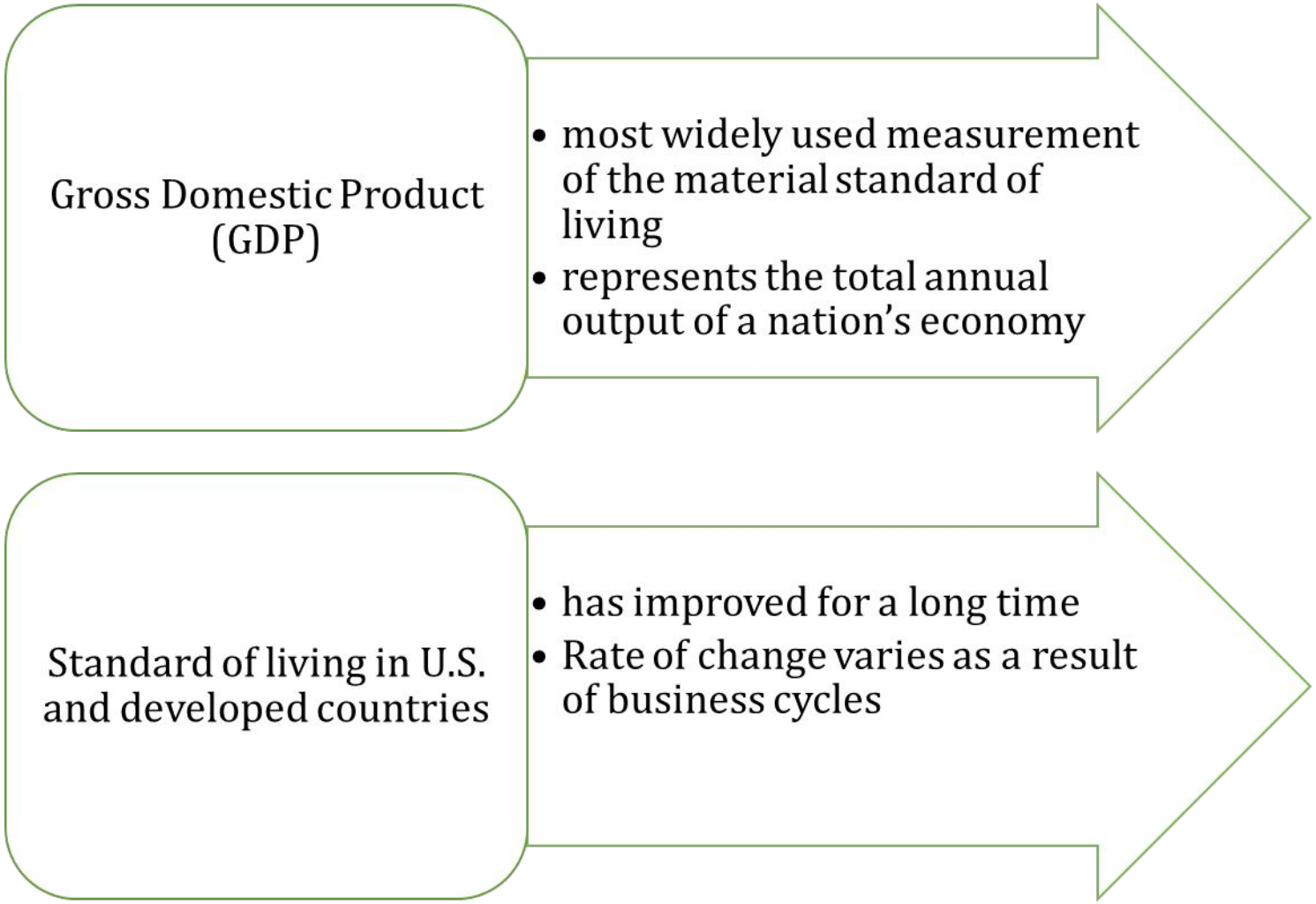
**TABLE 7-4** Manager's checklist for improving software quality

| Question | Yes | No |
|---|---|---|
| Has senior management made a commitment to develop quality software? | | |
| Have you used CMMI to evaluate your organization's software development process? | | |
| Has your company adopted a standard software development methodology? | | |
| Does the methodology place a heavy emphasis on quality management and address how to define, measure, and refine the quality of the software development process and its products? | | |
| Are software project managers and team members trained in the use of this methodology? | | |
| Are software project managers and team members held accountable for following this methodology? | | |
| Is a strong effort made to identify and remove errors as early as possible in the software development process? | | |
| Are both static and dynamic software testing methods used? | | |
| Are white-box testing and black-box testing methods used? | | |
| Has an honest assessment been made to determine if the software being developed is safety critical? | | |
| If the software is safety critical, are additional tools and methods employed, and do they include the following: a project safety engineer, hazard logs, safety reviews, formal configuration management systems, rigorous documentation, risk analysis processes, and the FMEA technique? | | |

Source Line: Course Technology/Cengage Learning.

# The Impact of IT on the Standard of Living and Worker Productivity

- The standard of living varies greatly among groups within a country as well as from nation to nation.
- Overall, industrialized nations tend to have a higher standard of living than developing countries.



# IT Investment & Productivity

- **Productivity** is defined as the **amount of output produced per unit of input**, and it is measured in many different ways.
- For example, productivity in a factory might be measured by the number of labor hours it takes to produce one item, while productivity in a service sector company might be measured by the annual revenue an employee generates divided by the employee's annual salary.
- **Innovation** is a key factor in **productivity improvement**, and IT has played an important role in enabling innovation.
- Progressive management teams use IT, as well as other new technology and capital investment, to implement innovations in products, processes, and services.

Relationship between IT investment and productivity growth is complex

- there is a **lag time** between the application of innovative IT solutions and the capture of significant productivity gains.
- IT can **enhance productivity** in fundamental ways by allowing firms to make radical changes in work processes

## Factors that affect national productivity rates

- **Labor productivity** growth rates differ according to where a country is in the business cycle—expansion or contraction.
  - **Times of expansion** enable firms to gain full advantage of economies of scale and full production.
  - **Times of contraction** present fewer investment opportunities
- **Outsourcing** to contractors can skew productivity
- **Regulations** make it easier to hire and fire workers
- More **competitive markets** for goods and services
- **Difficult to measure** output of some services
- IT investments don't always **yield tangible results**

**TABLE 8-1** Fundamental drivers for productivity performance

| Reduce the amount of input required to produce a given output by: | Increase the value of the output produced by a given amount of input by: |
|---|---|
| Consolidating operations to better leverage economies of scale | Selling higher-value goods |
| Improving performance by becoming more efficient | Selling more goods to increase capacity and use of existing resources |

# Telework

**Telework**

- Telework (also known as **telecommuting**) is a **work arrangement** in which an **employee works away from the office**
- Advances in technology enable communications
- Highly skilled workers demand more flexibility
- Laws are passed to encourage telework
- Organizations must prepare guidelines and policies
- Some positions are not suited to telework
- Some individuals are not suited to be teleworkers

# Advantages/Disadvantages of teleworking for employees

| Advantages | Disadvantages |
|---|---|
| People with disabilities who otherwise find public transportation and office accommodations a barrier to work may now be able to join the workforce. | Some employees are unable to be productive workers away from the office. |
| Teleworkers avoid long, stressful commutes and gain time for additional work or personal activities. | Teleworkers may suffer from isolation and may not really feel "part of the team." |
| Telework minimizes the need for employees to take time off to stay home to care for a sick family member. | Workers who are out of sight also tend to be out of mind. The contributions of teleworkers may not be fully recognized and credited. |
| Teleworkers have an opportunity to experience an improved work/family balance. | Teleworkers must guard from working too many hours per day because work is always there. |
| Telework reduces ad hoc work requests and disruptions from fellow workers. | The cost of the necessary equipment and communication services can be considerable if the organization does not cover these. |

# Advantages & Disadvantages of teleworking for organizations

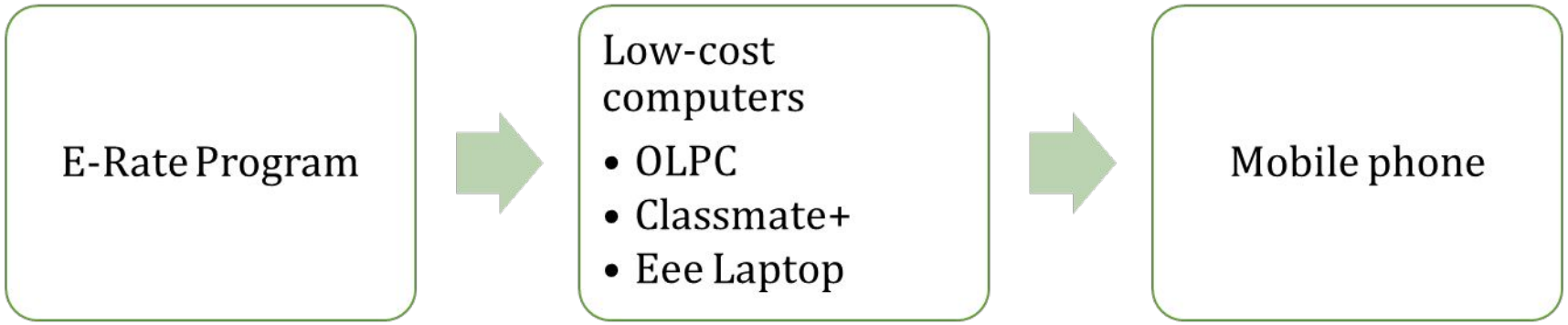
| Advantages | Disadvantages |
|---|---|
| As more employees telework, there is less need for office and parking space; this can lead to lower costs. | Allowing teleworkers to access organizational data and systems from remote sites creates potential security issues. |
| Allowing employees to telework can improve morale and reduce turnover. | Informal, spontaneous meetings become more difficult if not impossible. |
| Telework allows for the continuity of business operations in the event of a local or national disaster and supports national pandemic-preparedness planning. | Managers may have a harder time monitoring the quality and quantity of the work performed by teleworkers, wondering, for instance, if they really "put in a full day." |
| The opportunity to telework can be seen as an additional perk that can help in recruiting. | Increased planning is required by managers to accommodate and include teleworkers. |
| There may be an actual gain in worker productivity. | There are additional costs associated with providing equipment, services, and support for people who work away from the office. |
| Telework can decrease an organization's carbon footprint by reducing daily commuting. | Telework increases the potential for lost or stolen equipment. |

# The Digital Divide

| | |
|---|---|
| Standard of living | • Level of material comfort measured by the goods, services, and luxuries available |
| Digital divide | • Gulf between those who do/don't have access to modern information and communications technology<br>  • Cell phones, Personal computers, The Internet<br>• Gulf among age groups, economic classes, and cities/rural areas |
| Digital divide must be bridged to improve resolution of: | • Health emergencies<br>• Crime emergencies<br>• Other emergencies |
| Access to IT and communications technology: | • Enhances learning<br>• Provides educational and economic opportunities<br>• Influences cultural, social, and political conditions |

# The Digital Divide

- To eliminate the Digital Divide:



# E-Rate Program

- The **E-Rate program** was designed to help **eliminate the digital divide** within the United States. This program and others designed to **increase the availability of low-cost computers, cell phones, and smartphones.**
- The full name of the program is **The Schools and Libraries Program of the Universal Service Fund**.

| **E-Rate Program** |
| --- |
| • created by the **Telecommunications Act of 1996**<br>• Goal to help schools and libraries obtain:<br>  • Access to state-of-the-art services and technologies<br>  • Discounted rates<br>• Supported with up to $2.25 billion per year from fees charged to telephone customers<br>• Administered by the Universal Service Administrative Company (USAC)<br>• Has not gone well but continues today |

# One Laptop per Child (OLPC)

- Non-profit organization
- **Goal** of providing children around the world with low-cost laptop computers to help in education
- The first version was OLPC XO – available to third world countries in 2007 – available with a hand crank for generating power in places where electricity is not readily available.
- Current version – XO-3
  - Comes with Wi-Fi capability, integrated video & a still camera
  - Supports 2-way conferencing

# Classmate+

- In 2006, Intel introduced a low-cost laptop called Classmate PC.
- designed for use in kindergarten to high school class rooms in developing countries.

# Eee laptop

- Asustek Computer, Inc. – Taiwanese multinational manufacturer of computers & computer components.
- Its Eee Pad Transformer computer is a tablet computer that can convert into a laptop with the addition of an optional keyboard.
- The system runs on Google's Android Operating System and does not run Microsoft Windows programs.

# Raspberry Pi

- **Raspberry Pi** is a small (about the size of a credit card), inexpensive computer developed by the **Raspberry Pi Foundation**, a **United Kingdom charity**.
- This stripped-down computer comes with either **256 MB or 512 MB of RAM**, a **700 MHz processor**, **one or two USB ports**, and an **Ethernet port**—but no case and no monitor.
- The computer, which runs the **Linux operating system**, was designed to teach computer programming to young children, and as an alternative, low-cost desktop computer replacement for those willing to try new technology.
- Although the price of the Pi certainly makes it attractive, it is not clear that this device has the necessary ruggedness, portability, and functionality to meet the educational computing needs of schoolchildren.

# Mobile phone

- Mobile phone can bridge the digital divide.
- The rapid and widespread use of cell phones has resulted in an increased investment in the infrastructure required to support wireless communications.
- **Cell phones have several advantages over personal computers**, including the following:
  - Cell phones come in a wide range of capabilities and costs, but are cheaper than personal computers.
  - Cell phones are more portable and convenient than the smallest laptop computer.
  - Cell phones come with an extended battery life (much longer than any personal computer battery), which makes the cell phone more reliable in regions where access to electricity is inadequate or nonexistent.
  - There is almost no learning curve required to master the use of a cell phone.
  - Basic cell phones require no costly or burdensome applications that must be loaded and updated.
  - There are essentially no technical-support challenges to overcome when using a cell phone.

# The Impact of IT on Healthcare Costs

| | |
|---|---|
| Rapidly rising cost of healthcare is major challenge | • Spending increasing at 6.3% per year<br>• Grow from $2.6 trillion to $4.6 trillion by 2019 |
| Increase (above inflation) due to new medical technology | • Diagnostic procedures and treatments<br>• Patients sometimes overuse medical resources |
| Patient awareness must be raised | |
| Technology costs must be managed | |
| Improved use of IT can lead to cost reductions | |

# Electronic Health Records

Electronic health record (EHR)

- Computer readable record of health-related information on an individual: patient demographics, medical history, family history, immunization records, lab data, health problems, progress notes, medications, vital signs, and radiology reports
- Summary of health information generated by each patient encounter in any healthcare delivery setting
- Effective use of EHR improves patient care and reduces costs

Lack of patient data transparency results in:

- Diagnostic and medication errors
- Ordering of duplicate tests
- Compromise of patient safety
- At least 98,000 people die in hospitals each year due to preventable medical mistakes

# Electronic Health Records

Health Information Technology for Economic and Clinical Health Act (HITECH)

- Requires government to develop standards for nationwide exchange and use of health information
- Provides $20 billion in incentives
- Saves $10 billion through improvements in quality of care
- Strengthens protection of identifiable health information

# Use of Mobile and Wireless Technology in the Healthcare Industry

Healthcare industry is a leader in adopting mobile and wireless technology

- means to access/update EHR at bedsides
- scan barcodes to match patient with medications
- communicate with healthcare employees

# Telemedicine

Employs modern telecommunications and information technologies

Provides medical care to people who live far away from healthcare providers

**Store-and-forward telemedicine**

- Acquires data, sound, images, and video from patient and transmits to medical specialist for evaluation at a later time
- Does not require presence of patient

**Live telemedicine**

- Requires the presence of patient and healthcare provider at the same time
- Involves a video conference link between the two sites

Use of telemedicine raises new ethical issues:

- Must physicians providing advice to patients at remote location be licensed at that location?
- Must healthcare system be required to possess a license from a state in which it has a virtual facility?
- Must minimum set of technology standards be met?
- What sort of system certification and verification is necessary?
- Does patient involvement with remote doctors have negative impact on the local doctor's relationship?

# Medical Information Web Sites for Laypeople

People need reliable information on a wide range of medical topics to:

- Learn more about healthcare services
- Take more responsibility for their health

Web sites are not substitutes for professional medical advice, diagnosis, or treatment

Some healthcare providers and employers offer online tools that go beyond basic health information

# Health information websites

| URL | Site |
|---|---|
| www.americanheart.org | American Heart Association |
| www.cancer.org | American Cancer Society |
| www.cdc.gov | Centers for Disease Control and Prevention |
| www.diabetes.org | American Diabetes Association |
| www.heartburn.about.com | Information on the causes of heartburn and how to prevent it |
| www.heartdisease.about.com | Basic information about heart disease and cardiology |
| www.medicinenet.com | Source for medical information on a variety of topics, including symptoms, procedures, tests, and medications, as well as a medical dictionary |
| www.nia.nih.gov/Alzheimers | National Institute on Aging—Alzheimer's Disease Education and Referral Center |
| www.niddk.nih.gov | National Institute of Diabetes and Digestive and Kidney Diseases |
| www.oncolink.upenn.edu | Abramson Cancer Center of the University of Pennsylvania |
| www.osteo.org | National Institutes of Health—Osteoporosis and Related Bone Diseases National Resource Center |
| www.urologychannel.com | Information about urologic conditions, including erectile dysfunction, HIV, AIDS, kidney stones, and STDs; site contains overviews, symptoms, causes, diagnostic procedures, and treatment options |
| www.webmd.com | Access to medical reference material and online professional publications |