Chapter 2. Hardware and Software.

Ethical & Societal Issues

Digital Software Systems May Improve Nuclear Power Plant Safety

Discussion Questions

1. The purpose of a reactor protection system (RPS) is to protect the integrity of the plant's nuclear fuel by monitoring inputs from the reactor core. To accomplish this monitoring, application software must check sensors located throughout the reactor. If any safe operating values are exceeded, the software takes action, such as injecting cooling water or shutting the reactor down by inserting control rods.

2. Advantages of proprietary software:
   - You can get exactly what you need in terms of features, reports, and so on.
   - Being involved in the development offers control over the results.
   - You can modify features that you might need to counteract an initiative by competitors or to meet new supplier or customer demands.

   Disadvantages of proprietary software
   - It can take a long time and significant resources to develop required features.
   - In-house system development staff may be hard pressed to provide the required level of ongoing support and maintenance because of pressure to move on to other new projects.
   - The features and performance of software that has yet to be developed presents more potential risk.

   Advantages of off-the-shelf software
   - The initial cost is lower because the software firm can spread the development costs over many customers.
   - The software is likely to meet the basic business needs—you can analyze existing features and the performance of the package before purchasing.
   - The package is likely to be of high quality because many customer firms have tested the software and helped identify its bugs.

   Disadvantages of off-the-shelf software
   - An organization might have to pay for features that are not required and never used.
   - The software might lack important features, thus requiring future modification or customization. This lack can be very expensive because users must adopt future releases of the software as well.
   - The software might not match current work processes and data standards.

Critical Thinking Questions

1. Using software to control power plants offers the potential of increased safety compared to earlier methods.

2. Student responses will vary. Some may suggest that programmers who write software for these system be required to pass standardized official examinations.

Information Systems @ Work

Printing Livers at Organovo

Discussion Questions

1. To create human tissues and organs, scientists must build highly customized artificial scaffolds to seed the cells temporarily until they are strong enough to stand alone. 3D printing can help because unlike other manufacturing devices, 3D printers have a unique ability to customize a product by tweaking the blueprint that is fed into the printer.

2. Potential uses include complex engine parts, aircraft wings, and on-demand parts in space.

Critical Thinking Questions

1. Organova has a competitive advantage in the production of tissues and body parts.

2. Student responses will vary. They should note that even though the research was funded by the U.S. government, Organovo holds all the patents. Therefore, one could argue that Organovo should be the sole financial beneficiary.

Review Questions

1. Green computing has three goals: reduce the use of hazardous material, allow companies to lower their power-related costs (including potential cap and trade fees), and enable the safe disposal or recycling of computers and computer-related equipment.

2. RAM is temporary and volatile; RAM chips lose their contents if the current is turned off or disrupted. Read-only memory (ROM) is usually nonvolatile. In ROM, the combination of circuit states is fixed, and therefore its contents are not lost if the power is removed. ROM provides permanent storage for data and instructions that do not change.

3. RFID technology employs a microchip with an antenna that broadcasts its unique identifier and location to receivers. One popular application of RFID is to place microchips on retail items and install in-store readers that track the inventory on the shelves to determine when shelves should be restocked. The Canadian government is also supporting a move to require the sheep industry to use RFID chips to enable a "farm to fork" traceability system. RFID technology can also be used for asset tracking.

4. A blade server houses many computer motherboards that include one or more processors, computer memory, computer storage, and computer network connections. These all share a common power supply and air-cooling source within a single chassis. By placing many blades into a single chassis, and then mounting multiple chassis in a single rack, the blade server is more powerful but less expensive than traditional systems based on mainframes or server farms of individual computers. In addition, the blade server approach requires much less physical space than traditional server farms.

5. The arithmetic logic unit (ALU) performs mathematical calculations and makes logical comparisons. The control unit sequentially accesses program instructions, decodes them, and coordinates data flows in and out of the ALU, registers, primary storage, secondary storage, and various output devices.

6. Solid state storage devices (SSDs) store data in memory chips rather than magnetic or optical media. These memory chips require less power and provide faster data access than magnetic data-storage devices. In addition, SSDs have few moving parts, so they are less fragile than hard disk drives. All these factors make the SSD a preferred choice for portable computers.

7. A laptop computer is a personal computer designed for use by mobile users, being small and light enough to sit comfortably on a user's lap. Laptop computers use a variety of flat-panel technologies to produce lightweight and thin display screens with good resolution.

   Numerous portable computers are smaller than the typical laptop and have various names, including notebook and the even smaller ultrabook. The newest notebook computers come with a natural user interface, including both voice control integration and touch screens

   Tablet computers are portable, lightweight computers that can come with or without a keyboard and allow you to roam the office, home, or factory floor carrying the device like a clipboard. You can enter text with a writing stylus directly on the screen, thanks to built-in handwriting recognition software.

8. The Green Electronics Council manages the Electronic Product Environment Assessment Tool (EPEAT) to assist in the evaluation and purchase of green computing systems. The EPEAT assesses products against 51 life cycle environmental criteria developed by representatives of the environmental community, manufacturers, private and public purchasers, resellers, recyclers, and other interested parties.

9. Examples of smartphone operating systems include Windows 8, Apple's iOS, and Android.

10. Software as a service (SaaS) allows businesses to subscribe to Web-delivered business application software by paying a monthly service charge or a per-use fee. SaaS can reduce expenses by sharing its running applications among many businesses.

11. An application programming interface (API) is a set of programming instructions and standards for one software program to access and use the services of another software program.

12. Operating systems use the following five basic task management techniques to increase the amount of processing that can be accomplished in a given amount of time:

    - **Multiuser**: Allows two or more users to run programs at the same time on the same computer. Some operating systems permit hundreds or even thousands of concurrent users. The ability of the computer to handle an increasing number of concurrent users smoothly is called scalability.
    - **Multiprocessing**: Supports running a program on more than one CPU.
    - **Multitasking**: Allows more than one program to run concurrently.
    - **Multithreading**: Allows different threads of a single program to run concurrently. A thread is a set of instructions within an application that is independent of other threads. For example, in a spreadsheet program, the thread to open the workbook is separate from the thread to sum a column of figures.
    - **Real time**: Responds to input instantly. To do this, the operating system task scheduler can stop any task at any point in its execution if it determines another higher priority task needs to run immediately. Such systems are used to control the operation of jet engines, deployment of air bags, the operation of anti-lock braking systems, and other real-time operations.

13. The Linux distributor takes the code from different programs and combines it into a single operating system that can be installed on a computer. The distributor may also add finishing touches, such as what the desktop looks like, what color schemes and character sets are displayed, and what browser and other optional software is included with the operating system.

14. One of the greatest advantages of using a 64-bit version computer is the ability to access physical memory (RAM) above the 4-gigabyte (GB) range, which is not addressable by 32-bit computers. The 4-GB limit can be a severe problem for servers and computers accessing large databases.

15. An embedded system is a computer system (including some sort of processor) that is implanted in and dedicated to the control of another device. Embedded systems control many devices in common use today, including TV cable boxes, cell phones, digital watches, digital cameras, MP3 players, calculators, microwave ovens, washing machines, and traffic lights.

16. The term cloud computing refers to the use of computing resources, including software and data storage, on the Internet (the cloud) rather than on local computers. Rather than installing, storing, and running software on your own computer, with cloud computing, you use the Web browser to access software stored and delivered from a Web server. Typically the data generated by the software is also stored on the Web server. Cloud computing provides the benefit of being able to easily collaborate with others by sharing documents on the Internet.

    Cloud computing involves some risks, however. For example, sensitive information could be compromised in a number of ways, including unauthorized access by employees or computer hackers; the host might not be able to keep its computers and network up and running as consistently as necessary; or a disaster could disable the host's data center, temporarily putting an organization out of business.

17. Workgroup application software is designed to support teamwork, whether people are in the same location or dispersed around the world. This support can be accomplished with software known as groupware that helps groups of people work together effectively. Examples of workgroup software include group scheduling software, electronic mail, and other software that enables people to share ideas. Lotus Notes and Domino are examples of workgroup software from IBM.

18. Middleware is software that allows various systems to communicate and exchange data. Middleware is often developed to address situations where a company acquires different types of information systems through mergers,

Discussion Questions

1. Organizations that don't make wise hardware investments are often stuck with outdated equipment that is unreliable and that cannot take advantage of the latest software advances. Such obsolete hardware can place an organization at a competitive disadvantage. Managers, no matter what their career field and educational background, are expected to help define the business needs that the hardware must support. In addition, managers must be able to ask good questions and evaluate options when considering hardware investments for their areas of the business. This need is especially true in small organizations, which might not have information system specialists.

2. Software upgrades are an important source of increased revenue for software manufacturers and can provide useful new functionality and improved quality for software users.

3. It could be argued that with no hard disk, thin clients never pick up viruses or suffer a hard disk crash. Unlike personal computers, thin clients download software from a network when needed, making support, distribution, and updating of software applications much easier and less expensive.

4. 3D printing technology takes a three dimensional model of an object stored on your computer and sends it to a 3D printer to create the object using strands of a plastic filament or synthetic powder. The filament comes in spools of various colors and is fed through a heated extruder that moves in several directions to place layer upon layer on top of each other until the object is created.

   3D printing is commonly used by aerospace firms, auto manufacturers, and other design-intensive companies.

5. Responses will vary. Tablet computers often include a variety of software and communications capabilities. Most can communicate with desktop computers over wireless networks. A smartphone combines the functionality of a mobile phone, camera, Web browser, e-mail tool, MP3 player, and other devices into a single handheld device.

6. Important operating system features could be an attractive, easy to use user interface, file protection, system restore capabilities, security features, such as a security center and firewall, and troubleshooters.

7. SaaS can reduce expenses by sharing its running applications among many businesses. Note that providing one high-quality SaaS application to thousands of businesses is much more cost-effective than custom designing software for each business.

SaaS does involve some risks. For example, sensitive information could be compromised in a number of ways, including unauthorized access by employees or computer hackers; the host might not be able to keep its computers and network up and running as consistently as necessary; or a disaster could disable the host's data center, temporarily putting an organization out of business. It can also be difficult to integrate the SaaS approach with existing software.

8. The student might recommend a sight interface, which uses a camera on the computer to determine where a person is looking on the screen and performs the appropriate command or operation.

9. For most companies, the spheres of influence are personal, workgroup, and enterprise. Information systems that operate within the personal sphere of influence serve the needs of an individual user. These information systems enable their users to improve their personal effectiveness, increasing the amount of work they can do and its quality. Such software is often referred to as personal productivity software.

   A workgroup is two or more people who work together to achieve a common goal. An information system that operates in the workgroup sphere of influence supports a workgroup in the attainment of a common goal.

   Information systems that operate within the enterprise sphere of influence support the firm in its interaction with its environment.

10. Sources of application software are proprietary software and off-the-shelf software. An advantage of proprietary software is that you can get exactly what you need in terms of features and reports. A disadvantage however is that it can take a long time, plus significant resources, to develop required features. An advantage of off-the-shelf software is that the initial cost is lower since the software firm is able to spread the development costs over a large number of customers. One disadvantage is that the organization may have to pay for features that are not required and are never used.

11. The operating system for a mainframe computer can accommodate hundreds or thousands of users at the same time. The operating system for a laptop computer allows one user at time to operate the computer. The operating systems for both executes the following activities:
    - Performing common computer hardware functions
    - Providing a user interface
    - Providing a degree of hardware independence
    - Managing system memory
    - Managing processing tasks
    - Providing networking capability
    - Controlling access to system resources
    - Managing files

12. Students might use spreadsheet software such as Excel, database software such as Access, and financial software such as Quicken.

13. Grid computing is the use of a collection of computers, often owned by many people or organizations, to work in a coordinated manner to solve a common problem. Grid computing is one low-cost approach to parallel processing. The grid can include dozens, hundreds, or even thousands of computers that run collectively to solve extremely large parallel processing problems. Cloud computing refers to the use of computing resources, including software and data storage, on the Internet (the cloud) rather than on local computers.

    Parallel computing is the simultaneous execution of the same task on multiple processors to obtain results faster. The most frequent uses for parallel computing include modeling, simulation, and analyzing large amounts of data.

Problem-Solving Exercises

1. Responses may include the following information:

	2013	**2012**	**2011**	**2010**
Smartphones	250,231,000	171,652,000	149,041,000	101,150,000
Tablets	60,016,000	118,883,000	182,457,000	369,258,000

2. Students should outline several measures that could be taken to ensure the accuracy of a large spreadsheet that is used to make key business decisions.

3. Students should imagine that they are going to buy a smartphone to improve their communication capabilities and organizational abilities and submit a report that discusses the tasks they would need it to perform and its features.

Team Activities

1. Students should visit a data center or server farm with one or two of their classmates.

2. Students should visit a retail store that employs Radio Frequency Identification chips to track inventory and interview an employee involved in inventory control.

3. Students should interview people on the topic of modifying off-the-shelf software packages.

Web Exercises

1. The three fastest supercomputers are NUDT Tianhe-2A (China), Cray Titan (USA), and BM Sequoia Blue Gene/Q (USA).

2. In 2012, Apple notified the EPEAT that it was withdrawing its products from its registry citing incompatibility with Apple's design direction and EPEAT's requirements. The company reversed its decision after public outcry.

3. Students should use the Web to find multiple reviews and reports on four different personal productivity software suites from various vendors.

Career Exercises

1. Students should examine the possibility of a career in computer hardware sales and discuss the area of sales they believe holds the brightest prospects for young college graduates.

2. Students should identify three specific smartphone applications that would greatly help them in their current or next job.

3. Student responses will vary. The project team could include managers in marketing, sales, human resources, finance, and accounting.

Case Studies

Case One: Kaiser Permanente Implements Electronic Health Record (EHR) System

Discussion Questions

1. In 2003, Kaiser had announced its intention to work with Epic Systems Corporation over a three-year period to build an integrated set of systems to support EHRs, computerized physician order entry, scheduling and billing, and clinical decision support at an estimated cost of $1:8 billion. The project ballooned into a seven-year, $4.2 billion effort as the scope of the project was expanded time and again. Training and productivity losses made up more than 50 percent of the cost of the project, as Kaiser had to cut physicians' hours at clinics during training and was forced to hire physicians temporarily to handle the workload.

2. Student responses will vary. Some may argue that every effort should be made to protect the security, privacy, and confidentiality of patient information. As such, sharing patient information with researchers could be construed as a violation of

the Health Insurance Portability and Accountability Act which ensures patient confidentiality for all healthcare related data.

Critical Thinking Questions

1. The EHR system provides Kaiser with a competitive advantage by enabling physicians to benchmark their performance against colleagues on a number of fronts - efficiency, quality, safety, and service. Hospitals can also benchmark each other on measures such as adverse events and complications. "Best in class" practices can be identified, and physicians and hospitals can borrow these best practices from one another to further improve the overall quality of care.

2. HealthConnect empowers healthcare plan subscribers to take more responsibility for managing their own health care. Kaiser subscribers can access HealthConnect via a Web portal at kp.org. Here they are able to view most of their personal health records online, including their lab results, medication history, and treatment summaries. Patients can enter their own readings from blood pressure and glucose meters. They can also securely email their healthcare providers, which cuts down on the amount of time patients spend on hold waiting to speak to a doctor and on the number of office visits.

Case Two: Sending Computers into the Cloud

Discussion Questions

1. When a user requests a virtual machine, the system already knows who has to approve the request (if anyone), where its cost should be billed, and who should be allowed to administer the machine. The cloud-based system means users do not have to worry about how virtual machines are created, making it more practical to use them.

2. Student responses will vary. Universities could benefit from this approach to cut IT costs.

Critical Thinking Questions

1. Student responses will vary. Cloud computing could be very helpful to schools, universities, and many small business. The cost savings are substantial plus the ability to access content from anywhere in the world is very attractive.

2. Student responses will vary. The location independence of cloud computing is helpful in the event that the company needs to recover from a disaster.

Questions for Web Case

Altitude Online: Choosing Hardware

Discussion Questions

1. During the systems analysis phase, Altitude Online will be able to determine what new hardware devices it requires to support the service that its employees use.

2. Jon and the systems administrators will determine the exact amount of processing power and storage capacity they need after further investigation and collaboration with the ERP vendor.

Critical Thinking Questions

1. Altitude Online could donate the old hardware to high schools and/or universities.

2. There was a more immediate need for employees that work outside the Altitude Online offices to have convenient access to e-mail and corporate systems from any location.

Altitude Online: Choosing Software

Discussion Questions

1. Many of its Web developers and graphic artists prefer the Mac platform, while its business staff tends to prefer the Windows platform.

2. Because software packages are sold with a license that specifies how many copies can be used.

Critical Thinking Questions

1. Altitude Online uses Microsoft Office for its word processing, spreadsheet, email, and presentation capabilities. Many of its customers and partners use Office as well, so using the same software makes Altitude Online compatible with those it does business with.

2. Student responses will vary.