IT Infrastructure and Emerging Technologies


Learning Objectives

- Define IT infrastructure and describe its components.
- Identify and describe the stages and technology drivers of IT infrastructure evolution.
- Assess contemporary computer hardware platform trends.
- Assess contemporary software platform trends.
- Evaluate the challenges of managing IT infrastructure and management solutions.

Defining IT infrastructure (1/2)

- Set of physical devices and software required to operate enterprise
- Set of firmwide services including:
  - Computing platforms providing computing services
  - Telecommunications services
  - Data management services
  - Application software services
  - Physical facilities management services
  - IT management, standards, education, research and development services
- “Service platform” perspective more accurate view of value of investments

Defining IT infrastructure (2/2)

Figure 5-1

Connection Between the Firm, IT Infrastructure, and Business Capabilities

The services a firm is capable of providing to its customers, suppliers, and employees are a direct function of its IT infrastructure. Ideally, this infrastructure supports the firm’s business and information systems strategy. New information technologies have a powerful impact on business and IT strategies, as well as the services that can be provided to customers.
Evolution of IT infrastructure (1/5)

- General-purpose mainframe and minicomputer era: 1959 to present
  - 1958 IBM first mainframes introduced, eventually used to support thousands of online remote terminals
  - 1965 less expensive DEC minicomputers introduced, allowing decentralized computing
- Personal computer era: 1981 to present
  - 1981 Introduction of IBM PC
  - Proliferation in 80s, 90s resulted in growth of personal software
- Client/server era: 1983 to present
  - Desktop clients networked to servers, with processing work split between clients and servers
  - Network may be two-tiered or multitiered (N-tiered)
  - Various types of servers (network, application, Web)

Evolution of IT infrastructure (2/5)

Eras in IT Infrastructure Evolution

- Evolution of IT infrastructure (cont.)
  - Enterprise Internet computing era: 1992 to present
    - Move toward integrating disparate networks, applications using Internet standards and enterprise applications
  - Cloud Computing: 2000 to present
    - Refers to a model of computing where firms and individuals obtain computing power and software applications over the Internet
    - Fastest growing form of computing

Evolution of IT infrastructure (3/5)

Evolution of IT infrastructure (4/5)
• Moore’s law and microprocessing power
  • Computing power doubles every 18 months
  • Nanotechnology: May shrink size of transistors to width of several atoms
  • Contrary factors: Heat dissipation needs, power consumption concerns

• Law of Mass Digital Storage
  • The amount of data being stored each year doubles
Since the first magnetic storage device was used in 1955, the cost of storing a kilobyte of data has fallen exponentially, doubling the amount of digital storage for each dollar expended every 15 months on average.

Figure 5-8

Declining communication costs and the Internet
- An estimated 1.5 billion people worldwide have Internet access
- As communication costs fall toward a very small number and approach 0, utilization of communication and computing facilities explodes

- Technology drivers of infrastructure evolution (cont.)
  - Metcalfe’s Law and network economics
    - Value or power of a network grows exponentially as a function of the number of network members
    - As network members increase, more people want to use it (demand for network access increases)

- Technology drivers of infrastructure evolution (cont.)
  - Standards and network effects
    - Technology standards:
      - Specifications that establish the compatibility of products and the ability to communicate in a network
      - Unleash powerful economies of scale and result in price declines as manufacturers focus on the products built to a single standard
IT Infrastructure has 7 main components
- Computer hardware platforms
- Operating system platforms
- Enterprise software applications
- Data management and storage
- Networking/telecommunications platforms
- Internet platforms
- Consulting system integration services

**Computer hardware platforms**
- Client machines
  - Desktop PCs, mobile computing devices – PDAs, laptops
- Servers
  - Blade servers: ultrathin computers stored in racks
- Mainframes:
  - IBM mainframe equivalent to thousands of blade servers
- Top chip producers: AMD, Intel, IBM
- Top firms: IBM, HP, Dell, Sun Microsystems

**Operating system platforms**
- Operating systems
  - Client level: 95% run Microsoft Windows (XP, 2000, CE, etc.)
  - Server level: 85% run Unix or Linux

**Enterprise software applications**
- Enterprise software applications
  - Enterprise application providers: SAP and Oracle
  - Middleware providers: BEA
IT Infrastructure Components (5/8)

• Data management and storage
  • Database software: IBM (DB2), Oracle, Microsoft (SQL Server), Sybase (Adaptive Server Enterprise), MySQL
  • Physical data storage: EMC Corp (large-scale systems), Seagate, Maxtor, Western Digital
  • Storage area networks: connect multiple storage devices on dedicated network

IT Infrastructure Components (6/8)

• Networking/telecommunications platforms
  • Telecommunication services
    • Telecommunications, cable, telephone company charges for voice lines and Internet access
    • AT&T, Verizon
  • Network operating systems:
    • Windows Server, Novell, Linux, Unix
  • Network hardware providers: Cisco, Lucent, Nortel, Juniper Networks

IT Infrastructure Components (7/8)

• Internet platforms
  • Hardware, software, management services to support company Web sites, (including Web hosting services) intranets, extranets
  • Internet hardware server market: Dell, HP/Compaq, IBM
  • Web development tools/suites: Microsoft (FrontPage, .NET) IBM (WebSphere) Sun (Java), independent software developers: Macromedia/Adobe, RealMedia

IT Infrastructure Components (8/8)

• Consulting and system integration services
  • Even large firms do not have resources for full range of support for new, complex infrastructure
  • Software integration: ensuring new infrastructure works with legacy systems
  • Legacy systems: older TPS created for mainframes that would be too costly to replace or redesign
  • Accenture, IBM Global Services, EDS, Infosys, Wipro
### Contemporary Hardware Platform Trends (1/3)

- **While cost of computing is lower, infrastructure costs have expanded**
  - More computing, more sophisticated computing, increased consumer expectations, need for security
- **The emerging mobile digital platform**
  - Cell phones, smartphones (BlackBerry, iPhone) have assumed data transmission, Web surfing, e-mail and IM duties
  - Netbooks: small, low-cost lightweight notebooks optimized for wireless communication and core computing tasks

### Contemporary Hardware Platform Trends (3/3)

- **Autonomic computing**
  - Industry-wide effort to develop systems that can configure, optimize themselves, heal themselves when broken, and protect themselves from outside intruders
  - Similar to self-updating antivirus software; Apple and Microsoft both use automatic updates
- **Virtualization and multicore processors**
  - Virtualization: presents computing resources so that they can be accessed in ways that are not restricted by configuration
  - Allows multiple operating systems to run on one machine; increases server utilization rates from 10-15 to 70 percent of capacity
  - Multicore processors: reduced power requirements, enhanced performance

### Contemporary Hardware Platform Trends (2/3)

- **Grid computing**
  - Connects geographically remote computers into a single network to combine processing power and create virtual supercomputer
  - Provides cost savings, speed, agility
- **Cloud computing (utility computing)**
  - Data permanently stored in remote servers, accessed and updated over the Internet by users
  - Organizations using cloud computing need only pay for the computing power they actually use (on-demand or utility computing)

### Contemporary Hardware Platform Trends (1/6)

- **Linux and open-source software**
  - Open-source software: Produced by community of programmers, free and modifiable by user
  - Linux: Open-source software OS
- **Java**
  - Object-oriented programming language (Sun Microsystems)
  - Operating system, processor-independent (Java Virtual Machine)
  - Leading programming environment for Web
    - Applets, E-commerce applications
• Web Services
  • Software components that exchange information using Web standards and languages
  • XML: Extensible Markup Language
    • More powerful and flexible than HTML
    • Tagging allows computers to process data automatically
  • SOAP: Simple Object Access Protocol
    • Rules for structuring messages enabling applications to pass data and instructions
  • WSDL: Web Services Description Language
    • Framework for describing Web service and capabilities
  • UDDI: Universal Description, Discovery, and Integration
    • Directory for locating Web services

• SOA: Service-oriented architecture
  • Set of self-contained services that communicate with each other to create a working software application
  • Software developers reuse these services in other combinations to assemble other applications as needed
    • Example: an “invoice service” to serve whole firm for calculating and sending printed invoices
  • Dollar Rent A Car
    • Uses Web services to link online booking system with Southwest Airlines’ Web site

• Mashups and widgets
  • Mashups: Combinations of two or more online applications, such as combining mapping software (Google Maps) with local content
  • Widgets: small programs that can be added to Web pages or placed on the desktop to add additional functionality

• Software outsourcing
  • Three sources: external commercial vendor, online service providers, offshore firms
  • Software packages: prewritten set of software available commercially
  • Software as a service (SaaS): software delivered over the Internet
  • Offshore outsourcing: usually governed by service level agreement
The Changing Sources of Software

U.S. firms currently spend about $250 billion each year on software. In 2008, about 40 percent of that software will originate outside the firm, either from enterprise software vendors selling firmwide applications or individual application service providers selling software modules.

Figure 5-12

Management and governance
- Who controls IT infrastructure
- Centralized/decentralized
- How are costs allocated between divisions, departments?

Management Issues of IT Infrastructure (1/5)

- Dealing with platform and infrastructure change
  - As firms shrink or grow, IT needs to be flexible and scalable
    - How does firm remain flexible and still make long term investments?
  - Scalability: Ability to expand to serve larger number of users
  - Firms using mobile computing and cloud computing require new policies and procedures for managing these new platforms
  - Contractual agreements with firms running clouds and distributing software required

Management Issues of IT Infrastructure (2/5)

Management Issues of IT Infrastructure (3/5)

- Making wise infrastructure investments
  - Amount to spend on IT is complex question
    - Rent vs. buy, outsourcing
  - Competitive forces model for IT infrastructure investment
    - Market demand for firm’s services
    - Firm’s business strategy
    - Firm’s IT strategy, infrastructure, and cost
    - Information technology assessment
    - Competitor firm services
    - Competitor firm IT infrastructure investments
There are six factors you can use to answer the question, "How much should our firm spend on IT infrastructure?"

- **Total Cost of Ownership of Technology Assets**
  - **TCO model**: Used to analyze direct and indirect costs of systems
    - Hardware, software account for only about 20% of TCO
    - Other costs include: installation, training, support, maintenance, infrastructure, downtime, space and energy
  - TCO can be reduced through greater centralization and standardization of hardware and software resources