GLOBAL EDITION

# Management Information Systems

## *Managing the Digital Firm*

SEVENTEENTH EDITION

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# MANAGEMENT INFORMATION SYSTEMS

## MANAGING THE DIGITAL FIRM

SEVENTEENTH EDITION

GLOBAL EDITION

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CHAPTER

# 5 IT Infrastructure and Emerging Technologies

## LEARNING OBJECTIVES

After reading this chapter, you will be able to answer the following questions:

**5-1** What is IT infrastructure, and what are the stages and drivers of IT infrastructure evolution?

**5-2** What are the components of IT infrastructure?

**5-3** What are the current trends in computer hardware platforms?

**5-4** What are the current computer software platforms and trends?

**5-5** What are the challenges of managing IT infrastructure and management solutions?

**5-6** How will MIS help my career?

## CHAPTER CASES

Southeast Asia's Grab Leverages Information Technology to Enhance Its Services

Open Source Innovation: The New Company Advantage

Glory Finds Solutions in the Cloud

Project JEDI: A Cloud of Controversy

## VIDEO CASES

Rockwell Automation Fuels the Oil and Gas Industry with the Internet of Things (IoT)

ESPN.com: The Future of Sports Coverage in the Cloud

Netflix: Building a Business in the Cloud

**MyLab MIS**

**Discussion Questions:** 5-6, 5-7, 5-8; **Hands-On MIS Projects:** 5-9, 5-10, 5-11, 5-12; **eText with Conceptual Animations**

# Southeast Asia's Grab Leverages Information Technology to Enhance Its Services

Grab is a Singapore-based company that offers customers a taxi-booking service, as well as food delivery and mobile payments, via a smartphone app. Initially founded and established in neighboring Malaysia in 2012, Grab has undergone rapid expansion, extending its operations to a number of other Southeast Asian countries, including Thailand, Vietnam, the Philippines, and Singapore. The company employs around 6,000 employees, with 2.8 million drivers currently registered. The Grab mobile application has been downloaded onto approximately 185 million mobile devices to date, and the app is used to book in excess of 6 million rides every day. Grab's annual revenue in 2019 was $2.3 billion.

Grab's success is founded upon the successful leveraging of information technology to provide passengers with a safer and more reliable taxi service. Its success in Malaysia capitalized on the unpredictability and unreliability of the country's taxis, many of which opt not to use the taxi meter during peak periods. Grab has thus provided stability to an otherwise unpredictable sector, guaranteeing customers a metered taxi with transparency via the driver's rating, all through an easy-to-use smartphone app. The firm currently operates five research and development centers across Asia and one in the United States as it continues to explore how it can best utilize information technology.

Grab uses Amazon's Redshift and ElastiCache data warehousing and data storage cloud-based services to manage its millions of daily bookings in real-time as well as to allow users to track drivers and view traffic conditions. Through data analytics, the firm is better able to match demand with supply, thus increasing the app user's chances of obtaining a driver quickly. Through a technique called geohashing, cities like Singapore are divided into grids, each of which is analyzed by the system to determine the ratio of drivers to customers. Using a color-coding system, drivers in low-demand areas receive a notification on their mobile phone instructing them to drive to an appropriate low-supply area denoted by a red dot in the app's map. This allows Grab to effectively manage and adjust the distribution of drivers to ensure that resources are allocated appropriately to high-demand areas. Integrated with the firm's Android and iPhone app, the system provides real-time updates regarding the driver's current position as well as an estimated time of arrival. Such provisions help to reduce customer frustration and minimize the amount of time they have to spend just waiting around.

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In 2016, the firm allied itself with Lippo, Southeast Asia's consumer services provider, to implement an e-payment platform in Indonesia, the company's largest market. The payment platform allows Grab's users not only to pay for the rides directly via their mobile phone but also to pay for a number of Lippo's retail services. Anthony Tan, Grab's co-founder and group CEO, views the initiative as a step towards broader e-money adoption in Indonesia and the Southeast Asian region as a whole, given the large number of individuals who do not have access to a bank account but are equipped with a smartphone.

The GrabPlatform, launched in 2018, aims to integrate all of Grab's services, from rides and payment apps to food delivery services and on-demand grocery delivery. This means that Grab's over 9 million drivers, delivery partners, merchants, and agents across 339 cities in eight countries can use the same technology, localized to their own language and needs. In 2019, Grab took in $1.4 billion in funding to further expand its services.

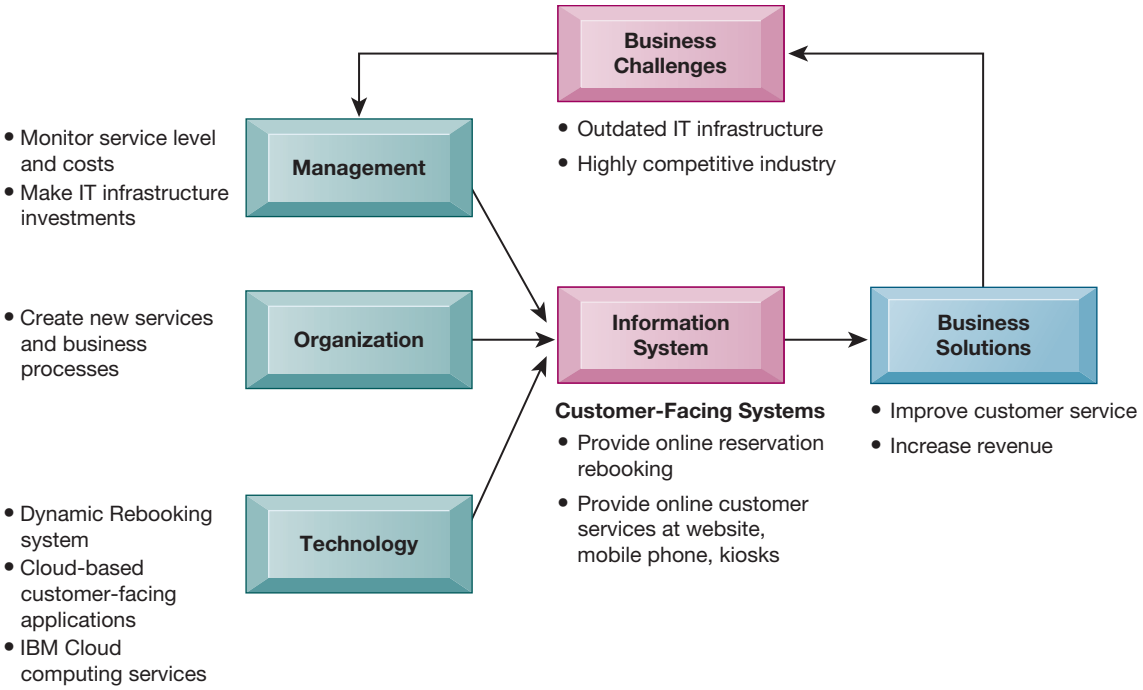
**Sources:** Molly Moore, "Number of Active Drivers of Grab, Go-Jek, and Ola APAC 2019," Statista.com, December 15, 2020; Yoolum Lee, "Grab to Cut 5% of Employees in Another Setback for Softbank," bloomberg.com, June 16, 2020; "Grab Everything Online: Grab Releases Digital-first GrabPayCard in the Phillippines Powered by Mastercard," newsroom.mastercard.com, June 3, 2020; Aw Cheng Wei, "Grab Broadens Its Financial Services Here, Offering Loans to Businesses," *Straits Times*, March 13, 2019; Claudia Chong, "Grab Takes in US$1.46b More to Feed Super App Ambition in SEA," *Business Times*, Singapore, March 2, 2019; "Grab Unveils Open Platform Strategy to Build Southeast Asia's First Everyday Superapp," grab.com, July 10, 2018; Radhika Dhawan Puri, "Grab Pushes Digital Innovation to Stay Ahead of the Game," futurereadysingapore.com, accessed October 21, 2017; "Grab and Lippo Group Strike Payments Partnership," grab.com, July 22, 2016; "Grab Case Study," aws.amazon.com, 2016; Vincent Chang, "GrabTaxi's Edge Lies in Real-Time Data Analytics," *Straits Times*, December 23, 2015.

*Case contributed by Imran Medi, Asia Pacific University of Technology and Innovation*

Grab's use of information systems illustrates how technology can improve an organization's performance and support its core business processes. Effectively managing resources and ensuring that there is sufficient and timely supply to meet demand lies at the heart of improving an organization's performance. Through its real-time monitoring of ride requests, Grab is able to effectively position its finite resources, provide its customers with a timely service, and ensure that it maximizes capacity, enabling its drivers to earn more fares. This is important, as failure to provide each driver with an adequate number of customers will inevitably result in those drivers deserting the company.

The chapter-opening case diagram illustrates the important points raised by the case. Grab is competing with many other forms of transportation, especially in a city like Singapore, in which the public mass rail transport system is highly efficient and reliable. Grab must at the very least match this level of service by ensuring not only that customers are able to get a driver and car to their desired destination but that their waiting time is minimized as much as possible. This is where the use of Amazon's cloud-based services come in: a dedicated cloud services provider allows the firm to concentrate its energy on the enhancement of its app while benefiting from the capabilities provided by Amazon.

Here are some questions to think about: How has Grab's use of hardware and software facilitated its growth in Southeast Asia? How important is cloud computing to Grab's operations?




## 5-1 What is IT infrastructure, and what are the stages and drivers of IT infrastructure evolution?

In Chapter 1, we defined *information technology (IT) infrastructure* as the shared technology resources that provide the platform for the firm's specific information system applications. An IT infrastructure includes investment in hardware, software, and services—such as consulting, education, and training—that are shared across the entire firm or across entire business units in the firm. A firm's IT infrastructure provides the foundation for serving customers, working with vendors, and managing internal firm business processes (see Figure 5.1).

Supplying firms worldwide with IT infrastructure (hardware, software, networking, and IT services) in 2020 was estimated to be a $3.9 trillion industry (Gartner, 2020). Investments in infrastructure account for between 25 and 50 percent of information technology expenditures in large firms, led by financial services firms where IT investment is well over half of all capital investment.

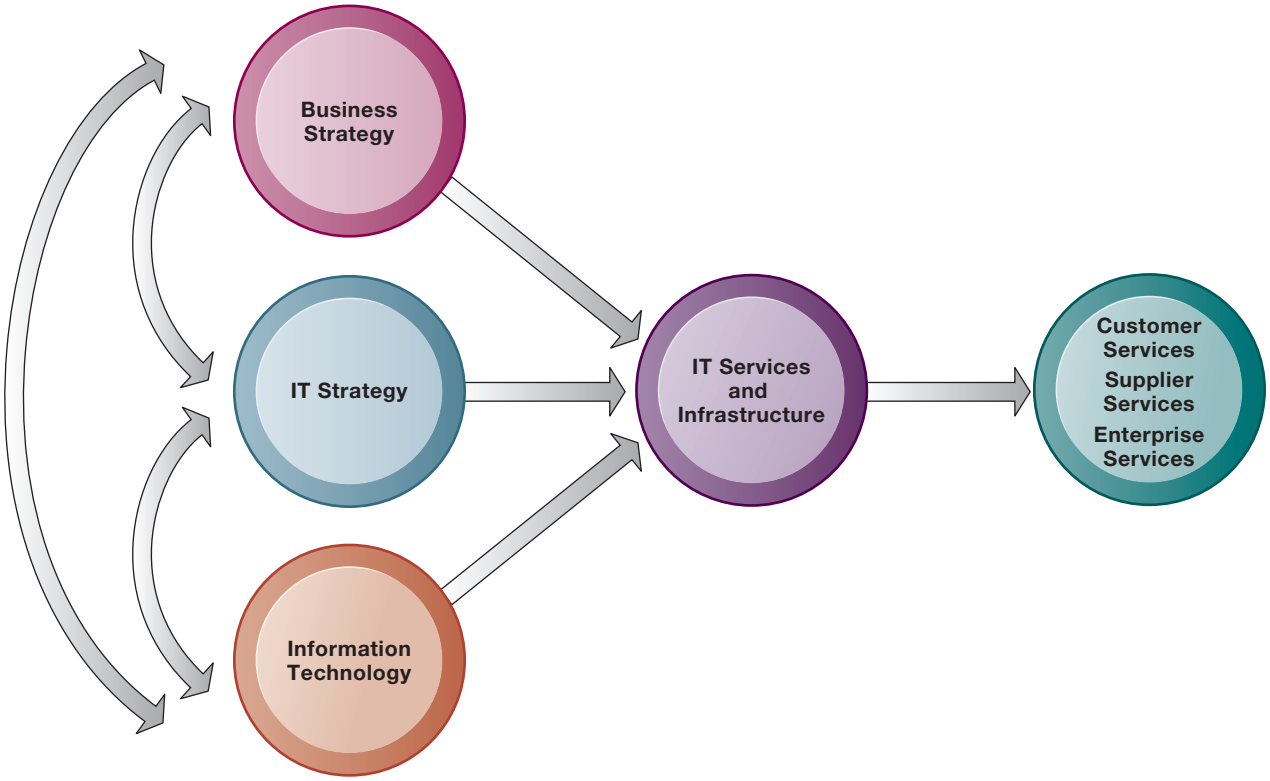
### Defining IT Infrastructure

An IT infrastructure consists of a set of physical devices and software applications that are required to operate the entire enterprise. But IT infrastructure also includes a set of firmwide services budgeted by management and composed of both human and technical capabilities. These services include the following:

- Computing platforms used to provide computing services that connect employees, customers, and suppliers into a coherent digital environment, including large mainframes, midrange computers, desktop and laptop computers, and mobile handheld and remote cloud computing services

**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 should support 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.




- Telecommunications services that provide data, voice, and video connectivity to employees, customers, and suppliers
- Data management services that store and manage corporate data and provide capabilities for analyzing the data
- Application software services, including online software services, that provide enterprise-wide capabilities such as enterprise resource planning, customer relationship management, supply chain management, and knowledge management systems that are shared by all business units
- Physical facilities management services that develop and manage the physical installations required for computing, telecommunications, and data management services
- IT management services that plan and develop the infrastructure, coordinate with the business units for IT services, manage accounting for the IT expenditure, and provide project management services
- IT standards services that provide the firm and its business units with policies that determine which information technology will be used, when, and how
- IT education services that provide training in system use to employees and offer managers training in how to plan for and manage IT investments

- IT research and development services that provide the firm with research on potential future IT projects and investments that could help the firm differentiate itself in the marketplace

This "service platform" perspective makes it easier to understand the business value provided by infrastructure investments. For instance, the real business value of a fully loaded personal computer operating at 3.5 gigahertz that costs about $1,000 and a high-speed Internet connection is hard to understand without knowing who will use it and how it will be used. When we look at the services provided by these tools, however, their value becomes more apparent: The new PC makes it possible for a high-cost employee making $100,000 a year to connect to all the company's major systems and the public Internet. The high-speed Internet service saves this employee about an hour per day in reduced wait time for Internet information. Without this PC and Internet connection, the value of this one employee to the firm might be cut in half.

## Evolution of IT Infrastructure

The IT infrastructure in organizations today is an outgrowth of more than 50 years of evolution in computing platforms. There have been five stages in this evolution, each representing a different configuration of computing power and infrastructure elements (see Figure 5.2). The five eras are general-purpose mainframe and minicomputer computing, personal computers, client/server networks, enterprise computing, and cloud and mobile computing.

Technologies that characterize one era may also be used in another time period for other purposes. For example, some companies still run traditional mainframe systems or use mainframe computers as servers supporting large websites and corporate enterprise applications.

### General-Purpose Mainframe and Minicomputer Era (1959 to Present)

The introduction of the IBM 1401 and 7090 transistorized machines in 1959 marked the beginning of widespread commercial use of **mainframe** computers. In 1965, the mainframe computer truly came into its own with the introduction of the IBM 360 series. The 360 was the first commercial computer that could provide time sharing, multitasking, and virtual memory in more advanced models. IBM has dominated mainframe computing from this point on. Mainframe computers became powerful enough to support thousands of online remote terminals connected to the centralized mainframe using proprietary communication protocols and proprietary data lines.

The mainframe era was a period of highly centralized computing under the control of professional programmers and systems operators (usually in a corporate data center), with most elements of infrastructure provided by a single vendor, the manufacturer of the hardware and the software.

This pattern began to change with the introduction of **minicomputers**, produced by Digital Equipment Corporation (DEC) in 1965. DEC minicomputers (PDP-11 and later the VAX machines) offered powerful machines at far lower prices than IBM mainframes, making possible decentralized computing, customized to the specific needs of individual departments or business units rather than time sharing on a single huge mainframe. In recent years, the minicomputer has evolved into a midrange computer or midrange server and is part of a network.