Chapter 6
A Systems Approach to Cloud Computing Services

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ABSTRACT
Cloud services are becoming part of every company’s “right”mare. They know it is the future but are afraid to jump on the cloud computing bandwagon. This may be due to lack of standardization, evolving technology, and/or fear of loss of privacy and security. However, every emerging technology has its root in early adopters who defy the common wisdom, take chances, and help it to evolve into something marketable. They get the first advantage before it becomes a norm. History is full of such examples: e-commerce, m-commerce, online banking, check in through kiosk, et cetera. Companies who were early adopters still have an advantage over late adopters. Amazon.com and eBay are prime examples of this. As technology evolves, it transfers from “push” to “pull” cycle. Cloud services are in their infancy and still evolving around “push” cycle. The number of companies offering cloud services is multiplying exponentially. This chapter presents a systems approach to cloud computing services. Specifically, it examines issues in the context of the system development life cycle (SDLC). For completeness purposes, the chapter discusses issues in relation to SDLC; however, in practice, each user has to customize this approach to suit their own application(s).

INTRODUCTION
As the cloud service concept is still evolving, theories and applications are emerging. Cloud services require knowledge from multiple disciplines, such as information systems, computer science, management science, statistics, social sciences, international management, and leadership. It is almost impossible for one individual to have expertise in so many domains, which makes this a very challenging but rewarding area of research. Given the richness and research potential of this area, it is becoming important to brainstorm and to bring diverse points of view to develop underlying theory and frameworks.

Cloud services are gaining momentum and are expected to grow exponentially. Cloud computing is not a buzz word anymore; it is becoming a norm as users see practical applications and
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resulting benefits. Cloud computing is becoming lucrative, and according to Forrester Research, it is expected to become a $159 billion market by the year 2020. Given this astronomical number, it is not surprising that cloud computing is in transition from a “push” to a “pull” technology. A push concept/technology is pushed by vendors on customers, and once it gains traction, customers start demanding better products, and then it becomes a pull concept/technology. The question, of course, arises, “What are cloud services?” Before we can define cloud services, we need to define cloud computing. The best way to understand cloud computing is to look at electrical consumption at home. We pay for only the amount of electricity we use, and we do not have to be concerned about how or where the electricity is generated. In the process, however, we lose control of how much electricity we are allowed to use. In peak periods, utilities may restrict usage, or power outage may occur, or our individual line may be affected. In this case, we have to rely on utilities to restore them, which can take a long time. The concept behind cloud computing is quite similar. We pay for whatever computing resources we use, and we do not have to worry about how or where the computer power is generated. However, we may lose control of our data, privacy and security.

Researchers have provided different definitions of cloud computing. We will use the definition provided by the National Institute of Standards and Technology (NIST). They define cloud computing as a “model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.” Cloud computing is changing the way companies will perform computing in the future.

Cloud services imply cloud computing with added-value services. We can compare cloud services to services provided by telephone companies. They offer telephone equipment, provide installation, and the dial tone to make the telephone operational. In addition, they add value by offering line maintenance, call forwarding/waiting, mail boxes, caller ID, etc. Cloud computing vendors, in addition to providing basic cloud computing capability, can also add value by offering maintenance, policy management, customized portability, security, programming, etc. Cloud computing is already a norm, whereas cloud services are still emerging. We will concentrate on cloud computing in the remainder of this chapter and cloud services wherever appropriate.

The architecture of cloud computing is comprised of many different layers. We classify them as primary and secondary layers. Primary layers support the backbone of cloud computing, whereas secondary layers add value to cloud computing. Primary layers consist of: Infrastructure as a Service (IaaS): comprised of servers, hypervisor, storage, networks and other basic computer resources; Platform as a Service (PaaS): development environment, including database, programming tools, integration and development tools, all ready to use in minutes; and Software as a Service (SaaS): readymade applications hosted on providers’ clouds, and secondary (or value) layers consisting of Policy as a Service (PlaaS), Database as a Service (DaaS), Storage as a Service (SaaS): also used for software as a service, Business Process as a Service (BPaaS), Mobility as a Service (MaaS), Communication as a Service (CaaS), Integration as a Service (InaaS) and Security (SaaS) as a Service (though many will argue security to be a primary layer). In addition, there are different types of clouds: private, public, hybrid, and community clouds, with different capabilities and requirements. As with any new area, cloud computing raises many conceptual, technical and managerial issues that need to be addressed by both academicians and practitioners. The next section discusses the systems approach for designing cloud computing services. The