



# 1 — Foundations

## Summary

This chapter starts by providing evidence of the growing importance of services in our society which was reinforced by recent technological and economic developments. Thereafter, a service definition is presented and discussed in detail to explain the basic principles of services. Concepts from operations management are used to describe services as transformation processes involving resources from both customer and provider. The last section contrasts services with goods and investigates the differences in marketing and management of these distinct economic commodities.

## Learning Objectives

1. Identify the recent developments that enabled the expansion of the service sector and its most predominant service industries.
2. Explain the concept of service and analyze the various types of interactions that can occur during service delivery.
3. Apply the I-T-O model from operations management to analyze and understand a service system.
4. Compare the main characteristics that make services and goods fundamentally different and explain how they can be bundled into one unique offering.

**Opening Case** Services in the clothing industry

**MAN-MADE CUSTOMIZATION TO MASS PRODUCTION ...  
TO MASS CUSTOMIZATION**

In the pre-industrial era, getting a new dress was a personal experience. In a collaborative face-to-face process, the tailor and his assistant took measurement, while the customer formulated her wishes and desires. Together they selected fabrics, colors, and patterns. Then the tailor would start the cutting and sewing, possibly requiring additional fittings, until the final product could be delivered.

Nowadays, only few people can afford custom-tailored dresses or suits. Clothes are typically pre-fabricated in large quantities and are sold ready-to-wear in fashion boutiques or department stores. Even if occasionally assisted by the store personnel, the customer is largely in a self-service mode in looking for sizes, assessing qualities, trying clothes on, and finally making the choice.

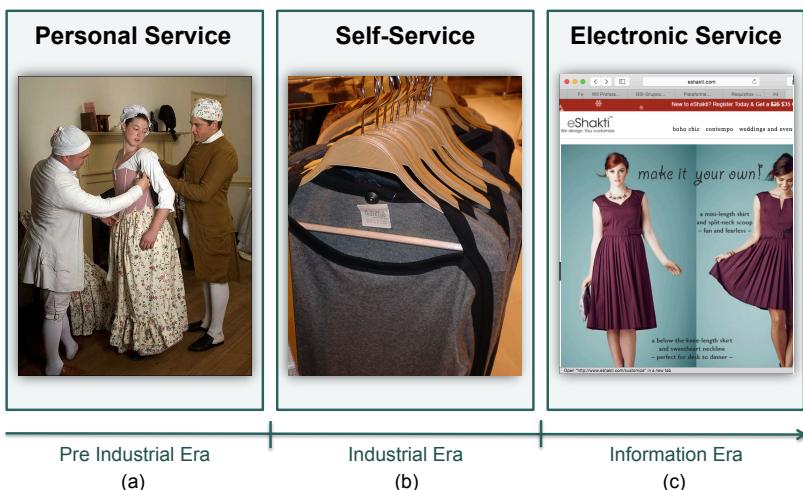
**Why to study services?  
An example from the clothing industry...**


Figure 1.1: From customization, to mass production, and to mass customization

Mass production resulted in affordable prices at the cost of standardized products of limited choice. With the advent of intelligent manufacturing and information technologies, mass production evolved in what is called mass customization - the production of individualized and personalized products in large volumes.

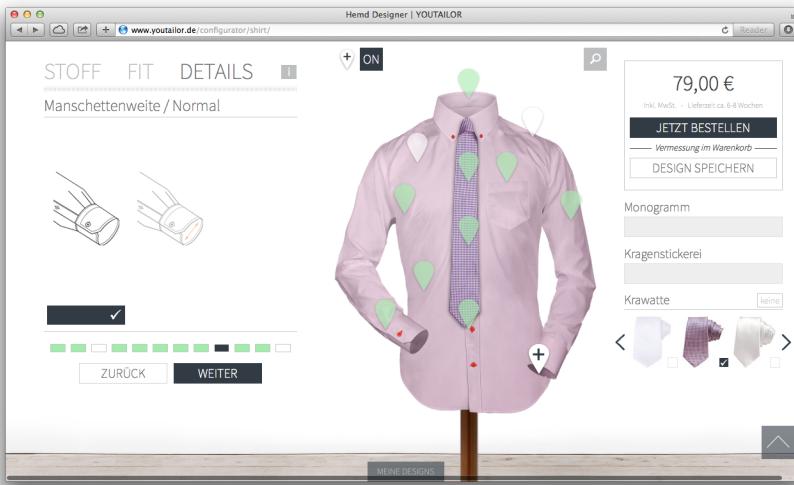


Figure 1.2: The Design Studio configurator of YouTailor

IT-enabled mass customization is the most recent evolution in the information age which provides innovative services to shoppers to enable them to customize their products with a range of options, for instance, when ordering clothing, a car, or a computer (Figure 1.1.c). The use of web-based configurators, which emerged in the late-2000's, made possible to deliver customized products manufactured by well-established production processes. Shoppers can use web-based configurators to indirectly and dynamically program robotic systems that can switch between clothing models and variants with little loss of efficiency and at a low cost.

For example, [youtailor.de](http://youtailor.de) (Figure 1.2) provides an effective online customizing tool – the Designer Studio, which allows shoppers to easily design their shirts according to exact preferences. It is possible to choose from more than 10 configuration parameters (e.g., fabric, fit, buttons, color, style). The visual representation is 3D to enable customers to “see” the final product.

The three situations depicted in Figure 1.1 perfectly symbolize the historical development of services over the last centuries: all started with highly-individualized, face-to-face services, evolved into highly-standardized, customer-anonymous self-services, and has now reached a stage that can combine the advantages of the previous two: highly-individualized and personalized electronic services.

### Opening Case

## 1.1 Service-oriented Societies

The intense competition of economies and the globalization of worldwide markets in conjunction with the generalization and expansion of information systems and information technologies have opened up significant opportunities for the conception of new specialized services. Providers are focusing on services for increased differentiation and creation of consumer value as a source of competitive advantage. In the age of information technology, traditional trading processes which involve a close and intense human interaction are often inadequate and can become a burden for companies competing in a globalized world.

### 1.1.1 Recent Developments

The rapid dissemination of services in society is visible at various levels.

**Service economies** Agriculture and manufacturing used to be the major productive elements of the world's economies. Nowadays, services are the new fundamental element driving economies to grow. Services represent 80% of the US economy and account for more than 50% of the economies in countries such as Brazil, Germany, Japan, Russia, and the UK [1].

**Service-Dominant (S-D) Logic** Recent theoretical contributions, such as S-D Logic [2], indicate that all markets are centered on the exchange of services, and all economies and societies are service based. It views service as the focus of economic and social exchange.

**Electronic services** Several governments have already made the decision to invest in strategies to provide public services online in a systematic manner. For example, the UK government launched the Government Digital Service (GDS) initiative. The “Digital by Default” strategy was implemented in April 2014. The New Zealand government has followed the same path and is also making their services online in a digital form ([beta.govt.nz](http://beta.govt.nz)).

**Mobile services** There is an increasing use of services from mobile devices. From Facebook to Dropbox to GMail and beyond, most people use one or more mobile services in their personal lives. Mobile services are also entering the agenda of companies to improve the efficiency of employees, as a new marketing and delivery channel, and as a form to create new disruptive business models.

**Cloud services** Companies are using cloud services, which use the utility model, to outsource their applications, development platforms, and infrastructures. The main driving factors include cost reduction and the scalability offered. Important cloud computing companies include Amazon, IBM, Microsoft, Google, and Rackspace. Global Software as a Service revenues are forecasted to reach \$106B in 2016, increasing 21% over projected 2015 spending levels [3].

**Service marketplaces** Several service marketplaces – such as [ServiceMagic.com](http://ServiceMagic.com), Sears' [ServiceLive.com](http://ServiceLive.com), [ServiceAlley.com](http://ServiceAlley.com), and [RedBeacon.com](http://RedBeacon.com) – are growing very quickly to enable consumers to find local services through the internet. The value of this type of marketplaces is attracting the attention of large companies. For example, [RedBeacon.com](http://RedBeacon.com), a platform that lets users search, browse, and hire local home service providers such as painters and house cleaners, was acquired in 2012 by The Home Depot, the largest home improvement retailer in the US.

Although many of these developments are recent, they are already having a positive impact on society. Consequently, more progress are needed in developing new theories, systematic methods, and tools for service innovation, design, implementation, analysis, and optimization, just to name a few.

### 1.1.2 Services Sector Growth

In 2005, the concept of service acquired a renewed importance since after several years of public debate, the European Parliament approved the *service directive* [4]. This directive intended to enhance competition by removing restrictions on cross-border market access for services in Europe. The implications of this measure for businesses and the IT community are enormous since the service sector represents more than 70% of the Gross National Product (GNP) of EU countries and the directive can amplify the consumption of services in the European Union by 0.6% (€ 37 billion) [5].

Figure 1.3 shows a more statistical perspective given by The World Factbook published by the Central Intelligence Agency (CIA). In 2013, US, China, Japan, and Germany were the countries with the highest service revenues<sup>1</sup>.

Between 1997 and 2007, the growth among OECD<sup>2</sup> member countries of service imports was highest in Ireland and was also well above average in Greece, Luxembourg, and Poland. Imports of services grew relatively slowly in Japan. In the same period, the growth rate of service exports for Ireland was again well above average and a relatively high growth was also recorded for Luxembourg and Denmark. A rather low relative growth occurred in Turkey, Mexico, and France. Averaged over the last three years, the trade in services was relatively balanced for most countries, but large surpluses were recorded for US and UK, and substantial deficits occurred in Germany and Japan. The fastest growing services in OECD exports are now insurance, and computer and information services, and for imports, insurance and government services. The slowest growing export category has been construction services.

R In the UK, since 16 years new businesses ranging from restaurants to law firms

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<sup>1</sup>Services cover government activities, communications, transportation, finance, and all other private economic activities that do not produce material goods.

<sup>2</sup>Organization for Economic Cooperation and Development

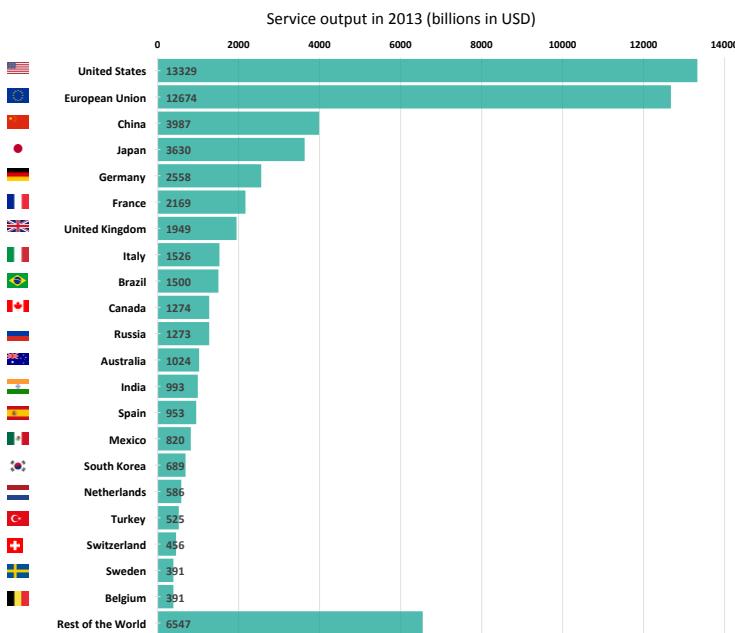


Figure 1.3: The worldwide importance of services (The World Factbook)

expanded at the sharpest rate. In 2013, the UK service sector growth reached a six-year high.

The Independent, 04.09.2013

In most countries, one of the largest and most important providers of services is the government which operates in sectors such as water management, public safety, and basic healthcare.

Cost reduction and flexibility are often two main arguments for studying services from a scientific perspective. For example, in Denmark the use of various channels to deliver a service has the following costs per transaction [6]: electronic services and self-services € 4.2; telephone calls € 7.8; emails received € 11; letters (paper) € 11.7; personal services (face-to-face) € 14.

The economic value and importance of services raise one question, “how can science and research provide a solution to create services with a higher quality?” Since the internet and the web are now an integral ingredient of the fabric of worldwide societies, economies, and commerce, it can intuitively provide a fundamental infrastructure to enable the realization of the Internet of Services (see Chapter 2).

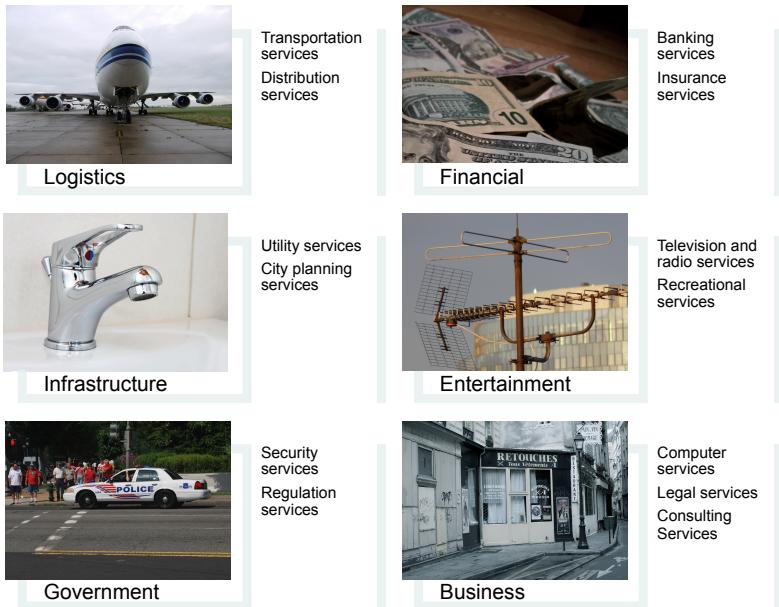


Figure 1.4: Examples of service industries

### 1.1.3 Service Industries

One approach to promote the understanding of real world, digital, and everyday services across service industries is to provide examples. The service sector is amazingly varied. A brief reading of the listings in the Yellow Pages shows an overwhelming number of services directed at individual consumers as well as to corporate purchasers. Most consumers use services almost every day. Traveling by bus, visiting the dentist, mailing a letter, getting a haircut, refueling a car or sending clothes to the cleaners are all examples of service consumption. This section provides a small set of examples of services categorized by industry. The focus is on presenting examples of everyday services for which a simple grouping mechanism was developed based on intrinsic characteristics. The services are categorized into six industries (Figure 1.4<sup>3</sup>): logistics, infrastructure, government, financial, entertainment, and business.

**Logistics** For the logistic domain, two classes of services are provided as examples: transportation and distribution services. *Transportation services* represent an essential element of economic spaces since developments are based on an increase in freight and passenger transports. This class of services

<sup>3</sup>Photos used under the public domain dedication license from <http://all-free-download.com/>

covers transportation such as sea, air, and land services and involves the carriage of passengers and the movement of goods. *Distribution services* enable providers to choose a wide variety of methods to distribute products. Direct distribution methods include, for example, direct mail, retail, catalogs, and the internet.

**Infrastructure** The infrastructure domain includes a vast number of services. Two classes of services were selected as examples: utilities and city planning services. *Utility services* include telecommunications, postal services, electrical power, natural gas, and also water and wastewater treatment services. Each type of service can be decomposed further. For example, telecommunication services include the transmission of sound, images, and other digital information by devices such as telephone, cable, broadcasting, and satellite. *City planning services* include engineering and technical services related to architectural design and planning of urban projects and supervision of large infrastructures such as dams, bridges, airports, and hospitals.

**Government** The government domain covers classes of services such as security and regulation. *Security services* provide many different types of support to citizens and are arguably the most important type of services during crisis situations. For example, the Department of Homeland Security, in the US, provides an integrated approach to security allowing a more efficient exchange of information, using IT, among government agencies. *Regulation services* refer to the mechanisms by which governments consign requirements (i.e., legislation, regulations, and administrative policies) on enterprises, citizens, and the government itself.

**Finance** The financial domain includes services such as banking and insurance services. *Banking services* cover services such as credit, leasing, foreign exchange transactions, asset management, and financial market operations. In recent years, banking markets became integrated at the national level and have increasingly become global. IT has contributed to an increased productivity, lower costs and prices, improvements in quality, variety, and flexibility. *Insurance services* cover the provision of various types of insurance such as freight and car insurance, life and health insurance, and real-estate insurance.

**Entertainment** Entertainment covers several service classes, including television and radio, and recreational classes. *Television and radio services* include audiovisual services related to the production of motion pictures, radio and television programs, and musical recordings. It also includes receipts and payments for distribution rights. *Recreational services* comprise services such as those associated with museums, libraries, concerts, and other cultural activities.

**Business** The business domain most likely covers the largest spectrum of service classes. Popular examples of classes include: computer, legal, and consulting

services. *Computer services* include hardware and software consultancy, and analysis, design, documentation, and programming of systems. *Legal services* cover legal advisory and representation services in any law, judicial, and statutory procedures. Other popular services include drafting of legal documentation, certification consultancy, auctioning, escrow, and settlement services. Finally, *consulting services* help firms adapt to changes in their markets, environment, and their own structure. They involve business process design, marketing advice, change management, training, and re-skilling.

## 1.2 Basic Principles of Services

A prerequisite for services is the *division of work*, a practice that is known since early history. The division of work — dividing a job into smaller tasks — goes along with the *division of labor* — the specialization of individuals who develop special skills, tools, and experience to perform these tasks. There is a hypothesis that the Neanderthals were not able to survive because of their lack of labor division – other than the Homo sapiens who was familiar with this practice. Durckheim [7] considers the division of labor as “the supreme law of human societies and the condition of their progress”. In modern society, division of work does not only occurs between individuals, but also between larger economic units like firms or even nations. What an individual or firm cannot do by itself, it is requesting as a service from others.

In the French feudal society of the 18th century, the aristocrats enjoyed fine dining prepared in their own grand kitchens by their personal chefs. During the 1789 revolution many aristocrats fled to the countryside and could not afford this luxury anymore. The chefs were laid off and had to seek new opportunities of income. With their staff and equipment they opened restaurants in Paris and attracted the upper-class bourgeoisie to their establishments. This is how Paris became the birthplace of the modern-day restaurant.

In our times, firms are often in situations comparable to the 18th century French households: they consider if they should afford to have their own kitchens and chefs, their own security staff, their own IT equipment — or outsourcing these functions. Catering, security, and IT are provided back to the firms as a service. Catering service providers, security service providers, and IT service providers emerge. This explains the rapid growth of the service industry in today’s economy.

### 1.2.1 Definition of a Service

Services have many facets. The word service can have different meanings in colloquial language as it will be pointed out later. The academic community has looked at services for many years. Yet, different academic disciplines came up with different views on services. As a consequence, it cannot be expected that there exists a single comprehensive and commonly accepted definition of a service.

One definition worth looking at is the definition of Hill [8]:

**Definition — Service.** A service is a change in the condition of a person, or a good belonging to some economic unit, which is brought about as the result of the activity of some other economic unit, with the prior agreement of the former person or economic unit.

Figure 1.5.a illustrates this situation. The essence of this definition is that a service is an *activity* (other terms are *acts*, *deeds*, *performances*, *efforts*) between two economic units (typically denoted as *customer* and *provider*) which changes the condition (“creates value for”) of the first economic unit, the customer.

Hill does not get very specific on the economical units. His definition implies that the receiver of the service is a single person or the belongings of a single person. This certainly reflects simple situations like a hairdressing service or a car repair service. But it does not express more complicated situations like consulting services in a business-to-business environment. In the latter case, the receiving economic unit is a company (an organization) incorporating different people and “belongings” (assets belonging to a company). Putting the words “person” and “good” into the plural form, Hill’s definition becomes general enough to cover all kinds of service situations. It is implicit in this definition that the receiving economic unit (the unit requesting and eventually paying for the service) and the realities being acted upon (persons, goods) can, but must not be different entities. In the simple example of hairdressing, requestor and receiver of the service are typically identical, but in the case of a business consulting service, the requestor and the targeted reality can be quite different.

Also, Hill does not get very specific on the “prior agreement”. This agreement can be implicit (tacit consent) or explicit (written contract), it can be the result of a simple request (“please cut my hair”) or the result of a complex negotiation. The service delivery, in response to the request, can be a single activity or a complex combination of activities, its duration can be short (telephone directory inquiry) or long-lasting (insurance policy).

It should be noted that the activity *per se* does not distinguish a service. One and the same activity can be at one time a service and at another time not a service. If somebody has the tires of his car changed by a mechanic, this is a service. If somebody changes the tires of his car by himself, there is no service involved.

Hill and other authors who later built on Hill’s definition of a service (e.g., Gadrey [9]) are more explicit on the customer’s side (who is receiving the service, which realities are acted upon) than on the provider’s side (who is performing the service).

As persons and their belongings can *receive* a service, persons and their belongings can be needed to *provide* the service. For example, the hairdresser uses facilities (shop, chairs, mirrors), tools (scissors, combs, brushes), and materials

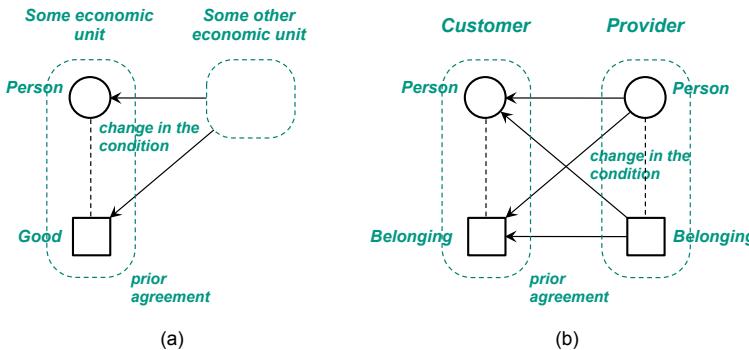


Figure 1.5: An illustration of Hill's service definition (a) and an extension (b)

(shampoo, conditioner, colorant) to deliver his or her service. This is illustrated in Figure 1.5.b. The two symbols for “person” and “belongings” are meant to represent the general situation in which a service provider has *people* (i.e., persons with skills, competencies, and knowledge) and *belongings* (like facilities, tools, and materials) to deliver a service.

## 1.2.2 Service System

The term *service system* has been widely used in the service literature. While the term appeared already in the 1960s in the context of queuing systems [10], most authors since believed that everybody knows what a service system is and left it largely undefined. Most of the characteristics of a service system, however, can easily be derived from the general and well-defined concept of a system.

A *system* is a set of interacting units or elements that form an integrated whole [11]. A system has a boundary delineating the elements which are inside the system and which are outside - part of the system’s surroundings or environment. A system has a *structure* defining its elements and their *relationships*. It might be possible to describe the *behavior* of a system that is intended to fulfill a *function* or *purpose* [12]. The system behavior is often described as a *process* or *mechanism*. There might be a *set of rules* that govern behavior and structure. An open system usually interacts with some elements in its environment. A closed system is isolated from its environment.

The traditional perception of a service system is that of a *service delivery system*. The service system consists of elements (resources like people with skills, competencies, and knowledge, but also things like facilities, tools, materials, computer programs) that have a structure (organization and configuration), a behavior (described as a process or mechanism), and a purpose (to deliver a service). The smallest service system could be an individual person with or without his or her

belongings (e.g., a carpenter with his tools), but also a single computer program (e.g., a web service). Larger service systems are service businesses (e.g., a rental car company) or complex networks of businesses and organizations (e.g., the national healthcare system).

**Definition — Service System.** A service system consists of elements (e.g., people, facilities, tools, and computer programs) that have a structure (i.e., an organization), a behavior (possibly described as a process), and a purpose.

The modern perception of a service system is based on the principle of value co-creation and, accordingly, includes the customer within its boundaries: “Service systems comprise service providers and service clients working together to coproduce value in complex value chains or networks” [13]. The smallest service system in this case is represented by the dyadic relationship between just two entities, the customer and the provider [14]. Larger service systems are services businesses or complex service networks including their customers (e.g., the healthcare system with its patients). It should be noted that even if a complex service system might have only one end customer (the patient), it might consist of a multitude of dyadic customer-provider relationships that have been established to deliver the service. And according to the co-creation paradigm, even the end customer assumes the role of a provider, e.g., by sharing information with other actors in the service system.

Complex service systems have been studied under different perspectives, and different terms have been used such as service networks [15, 16], service ecosystems [17], value networks [18, 19], service value networks [20], and service supply chains [21]. Chapter 10 will further discuss service networks.

### 1.2.3 Interaction between Customers and Providers

The general scheme in Figure 1.5.b can be used to explain different service scenarios according to the varying involvement of persons and their belongings. Figure 1.6.a shows the situation where a person (the provider) delivers a service to another person (the customer). No belongings (things) are involved on either side.

**Definition — Customer and Consumer.** The terms consumer and customer are often used interchangeably, but a consumer and customer are not always the same entity. A customer (also known as a client, buyer, or purchaser) is someone who buys services or goods from someone else, while a consumer is someone that receives a certain service or consumes a product. Clearly, a customer may or may not also be a consumer. It happens often that both terms are used interchangeably. When no ambiguity arises, this textbook can use one or the other term as they are better suited to the context.

Figure 1.6.b displays the situation where a person equipped with belongings (provider) acts on another person (customer). The simple hairdressing example is

representative for a large variety of services encompassing beauty services, medical services, education services, etc., all targeted towards human beings. Figure 1.6.c depicts a service that is targeted towards the belonging of a person, exemplified by car repair. Again, the person on the provider's side (mechanic) is equipped with belongings (tools). The customer is not involved in the actual repair process. This situation is representative for cleaning, maintenance and repair services, and for any kind of transportation or storage of things (mail, cargo, parts).

**Example — Customer Involvement.** Today, several food chains, like Subway, have a menu with a strong emphasis on customer involvement. Customers decide the ingredients they want in their sandwich. This entails more than 50% of involvement of customers.

Two other service scenarios will be more extensively discussed in the next chapter of this book. The first case is *self-service*, a service provided without or with little human involvement on the provider's side. The provider typically sets up facilities or equipment that the customer can use to perform a certain task. Examples are self-service gas stations, ticket vending machines, rental cars, and electronic services. This is shown in Figure 1.6.c. The last case becomes more and more prevalent with recent advances in technology: belongings (things) provide services to belongings (things). For example, computer programs can request services from and deliver services to other computer programs. This situation is illustrated in Figure 1.6.d.

For some of the service scenarios described in Figure 1.6, a terminology has been used that comes from communications technology. In this field, people describe different *types of communication* such as person-to-person or *human-to-human (H2H)*, *human-to-machine (H2M)*, and *machine-to-machine (M2M)*. Since communication is considered bi-directional, M2H is typically not distinguished from H2M, and therefore rarely used. This terminology has been used to indicate the type of service interaction in different service scenarios. Also service interaction, like communication, is considered bi-directional (request and response). Accordingly, the service scenarios described in Figure 1.6.a and b are characterized by their person-to-person or human-to-human (H2H) interaction (belongings in Figure 1.6.b are not considered to interact with the customer). Self-service in Figure 1.6.d is a typical example for human-to-machine (H2M) interaction (a person requests a service from a machine, and the machine delivers a service to a person), and the situation in Figure 1.6.e is representing machine-to-machine (M2M) interaction. The situation in Figure 1.6.c has not received one of these tags. The belongings on the customer's side are not considered to interact with the service provider. In the case where the “machines” are software applications, the terms *human-to-application (H2A)* and *application-to-application (A2A)* have been used.

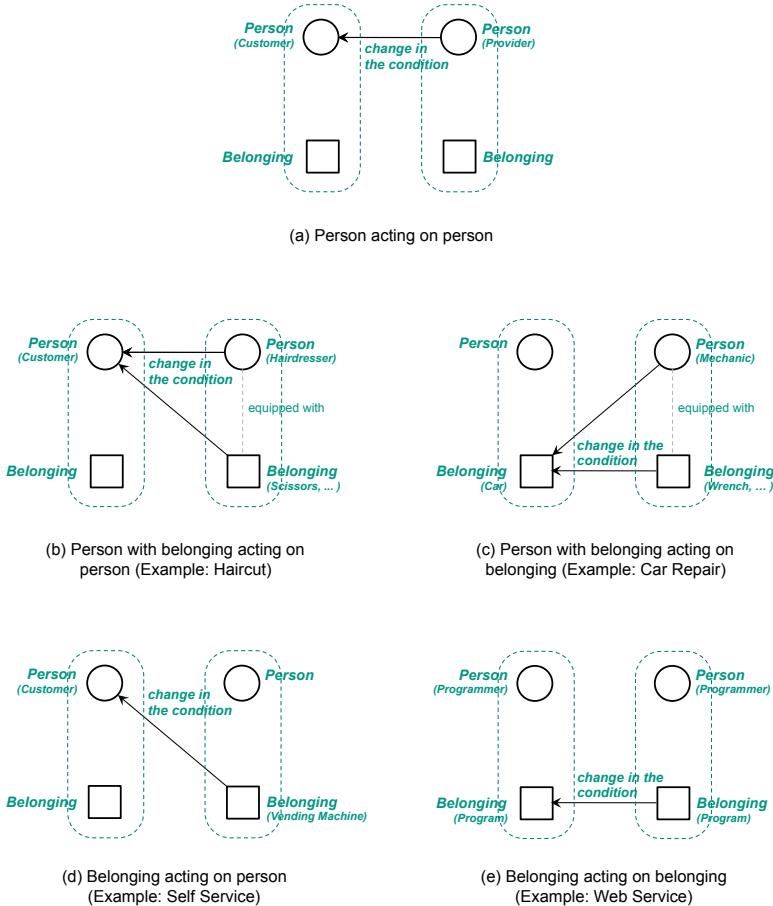


Figure 1.6: Different service scenarios according to the involvement of persons and their belongings

### 1.2.4 Operations Management View on Services

In the related disciplines of *operations management (OM)* and *operations research (OR)*, services have been the objects of research long before service science emerged as an autonomous discipline. In German-speaking countries, a sub-discipline of OR, queueing theory, used to be called “*Bedienungstheorie*” that translates into “service theory” [22]. Most books on queueing theory and discrete event simulation exemplify service scenarios, e.g., Hall’s “*Queueing Methods for Services and Manufacturing*” [23]. The application of OR methods to services will be discussed in Chapter 7 on Service Optimization. In this section, it will be shown that OM

provides an appropriate model and terminology to describe services in a structured way. It will be shown that the definition of services presented by Hill [8] can easily be translated into OM terms.

### Transformation Process

One of the basic concepts of OM is the *transformation process* [24, 25]. A transformation process is any activity or group of activities that takes one or more inputs, transforms and adds value to them, and provides outputs for customers or clients. This so-called *input-transformation-output model* is shown in Figure 1.7.a. When the inputs are raw materials, it is relatively easy to identify the transformation involved, as when milk is transformed into cheese and butter or when thousands of parts are assembled to build an automobile. When the inputs are information or people, the nature of the transformation might be less obvious. For example, a hospital transforms ill patients (the input) into healthier patients (the output), a teacher transforms less educated students (the input) into well-educated students (the output).

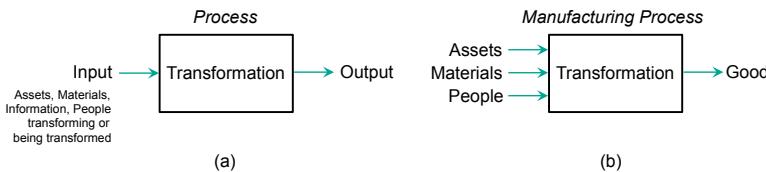


Figure 1.7: The input-transformation-output Model from operations management and the I-T-O model of a manufacturing process

### Resources

In operations management, the inputs to the transformation process are called *resources*. Resources can be persons or things (compare with Figure 1.6 and Hill [8]). Things are typically distinguished into assets and materials. Resources can be *transforming* and *being transformed* [25]. In a typical manufacturing process, the transforming resources are workers together with assets (facilities, machines and tools) that transform materials (the transformed resources) into finished goods (Figure 1.7.b).

### Service as a Transformation Process

A service is also a transformation process that can be described with the input-transformation-output model. The difference compared to manufacturing is that both provider and customer give input to and participate in the transformation process (compare with Sampson's service I/O model [26]).

As already illustrated in Figure 1.5.b, the input resources can be persons or belongings (goods, things) on both sides (provider and customer). The "change

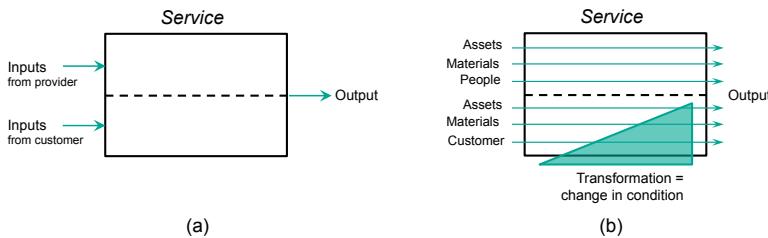


Figure 1.8: The input-transformation-output model from operations management and its translation to services

of condition” (Hill) or “transformation” (OM) can be of very different nature: e.g., changes in the physical characteristics of resources (repair services, cleaning services, beauty services), changes in the location of resources (transportation services), or changes in the physiological or mental state of people (healthcare services, well-being services, education services, entertainment services). Table 1.1 presents a few examples of service processes with their respective input resources and transformations.

To accentuate the special nature of the service process in Figure 1.8.a and b, a horizontal dotted line is drawn to divide the transformation box into a supplier's and a customer's side. Resources "don't change sides" during the service process – this means, there is no change in ownership involved. Both sides participate in the transformation process. Even if the main target of the condition change is on the customer's side (symbolized by the triangle representing increase of value), this does not mean that the resources on the supplier's side don't experience a change during the service process. The service person might get tired from the service delivery, but also more experienced and more knowledgeable. Assets might become worn, materials be consumed. For this close interplay between provider and customer in the service process, the term "co-creation of value" was coined. Co-creation of value is one of the most important principles of modern service science (see Chapter 8).

A frequent misconception is that services are the outputs of service processes as goods are the outputs of manufacturing processes. Even OM textbooks are often not precise in this respect. From the preceding discussion it should have become clear that a service is not the *output* of a transformation process, a service *is* a transformation process.

## 1.2.5 Resource Intensity of Services

Resources are a fundamental element of services. An important characterization of services is based on the *proportion*, or *intensity*, with which different types of resources or capabilities are used in the service process. The following main types

|  | Provider's Resources  | Customer's Resources   | Transformation                 |
|--|---|--|--------------------------------|
| Hairdressing Service                       | Facilities (shop, chair, mirror)<br>Tools (scissors, combs, brushes)<br>Materials (shampoo, conditioner, colorant)<br>Hairdresser   | Customer him- or herself   | Change in hairstyle            |
| Car Service/Repair                         | Facilities (garage, lifting ramp)<br>Tools (wrench, hammer, screw driver)<br>Materials (spare parts, oil)<br>Repair Person  | Customer's car   | Change in condition of car     |
| Medical Service                            | Facilities (hospital, operating rooms)<br>Instruments (stethoscope, syringe)<br>Materials (medicaments, plasters, dressings, disinfectants)<br>Doctors, nurses, paramedics, admin | Customer (patient) him- or herself   | Change in health condition     |
| Electronic Service<br>(e.g., stock report) | Computing infrastructure with internet connectivity (web server)<br>Software application (web application)<br>(No human resources)  | Customer him- or herself<br>Internet access device (personal computer, smartphone) | Change in level of information |

Table 1.1: Examples of service processes with input resources and transformations

of services have been distinguished according to their resource intensity (they are naturally not mutually exclusive):

- Labor- and capital-intensive services.
- Knowledge-intensive service.
- Information-intensive service.
- Technology-intensive service.

### Labor- and capital-intensive Services

A *labor-intensive service* is a service in which the labor costs outweigh the costs for equipment and materials. A *capital-intensive service* (also *equipment-intensive service*) is a service in which the capital costs (for facilities, equipment, tools) prevail. A hospital, even if it employs many doctors, nurses, administrative staff, and technicians, is a capital-intensive service due to its expensive facilities and equipment (operating rooms, x-ray, tomography, dialysis). Schmenner [27] provides

an overview of the capital-labor-ratio for different service industries.

### **Knowledge-intensive Services**

*Knowledge-intensive services*, mostly used in the form of *knowledge-intensive business services*, are services that heavily rely on *professional knowledge*. Similarly, *skills-intensive services* [28] rely on *professional skills*. Both knowledge-intensive services and skills-intensive services are forms of labor-intensive services. Cedefop [28] further distinguishes between elementary manual resources (workers), skilled manual resources (agricultural, craft and trade workers, machine operators), skilled non-manual resources (clerks and service/sales workers), and high-skilled non-manual resources (legislators, managers, professionals and technicians). The latter are certainly coincident with knowledge-intensive resources. Physicians are generally distinguished by their professional knowledge, but surgeons or dentists additionally need special manual skills to perform their work.

### **Information-intensive Services**

*Information-intensive services* are services in which the activities involve substantial information processing [29]. This might include collecting, manipulating, interpreting, and transmitting data to create value [30]. Information can be collected and processed by people. Examples are opinion surveys (over telephone or face-to-face) or criminal investigations.

More and more information is nowadays available in electronic form, so that the collection and processing can be automated using *information and communication technology (ICT)*. Examples of ICT-based information-intensive services are news ticker services, financial information services, traffic information services, remote diagnostic services, or internet search engines. With the continuing dissemination of instrumentation technology in everyday life (sensors, GPS, vehicle telematics, surveillance cameras) the amount of data available gets bigger and bigger (“big data”), and the task of extracting valuable information becomes more and more sophisticated (“big data analytics”).

### **Technology-intensive Services**

*Technology-intensive services* are services in which the proportion of labor is very low or zero. The service is delivered by resources that are purely technological – machines or computer programs. These technology-based services can be used by customers in a self-service mode (cf. Figure 1.6.d) or in turn by technological resources (typically computer programs) on the customer’s side (cf. Figure 1.6.e). Technology used in services today is predominantly ICT. The dissemination of ICT, and especially the internet, has revolutionized the world of services and has led to concepts like *Electronic Services*, *Web Services*, *Cloud Services*, the *Internet of Things*, and the *Internet of Services*. These concepts will be discussed in the next chapter.

## 1.3 Services and Goods

Why should one compare services with goods? Services and goods are quite different realities. Operations Management has come up with a clear picture: Goods are “things” that are typically the output of a manufacturing process, and services are transformation processes by themselves.

The attempt to compare services with goods, and, moreover, to define services in contrast to goods, arose in the discipline of Service Marketing. For marketing people, services and goods have one thing in common: both are economic commodities that are promoted and sold by companies. Very often not only goods, but also services, are called the *products* of a company. Since the marketing discipline traditionally focused on goods, the orientation towards services was mainly governed by the question: What are the differences between marketing goods and marketing services? This legitimate question resulted in a considerable but questionable effort to answer a different question: What differentiates services from goods?

The most popular outcome of this discourse are the so-called *IHIP criteria*: *intangibility*, *heterogeneity*, *inseparability*, and *perishability*. IHIP criteria have been embraced by many scholars in lectures and textbooks, because they are easy to understand and easy to memorize. Unfortunately, they have led to misconceptions like “services are intangible goods” or “the more intangible, the more something is a service”. It is long known that IHIP criteria “do not distinguish services from goods” [13] and “should not be used as generic service characteristics” [31] — no wonder, because “services and goods belong to quite different logical categories” [8]. But IHIP criteria are not useless. They indeed can help to understand the differences in marketing and management of services versus marketing and management of goods.

### 1.3.1 Differences in Marketing and Management

In the following, two cases will be discussed in which the difference between services and goods is particularly crucial.

#### Inseparability and Demand Management

The first case addresses the consequences of separability/inseparability on *demand management* and *pricing* of services and goods. Figure 1.9 shows two situations: (a) the fluctuating demand curve for automobile tires, with peaks in fall for winter tires and in spring for summer tires, and (b) the fluctuating demand for a call center with peaks of incoming calls daily around noon. (a) describes a situation that a manufacturer has to handle, (b) a problem for a service provider.

The tire manufacturer has one advantage: due to the separability of production and consumption, he can produce the tires ahead of time and can thus prepare for the peaks occurring in fall and spring. This requires good forecasting methods to predict the upturn and peak point of the demand curve for the coming season. If this is done intelligently, the manufacturer can fulfill all demands and yet smooth

out the tire production so that the manufacturing resources are almost constantly utilized throughout the year.

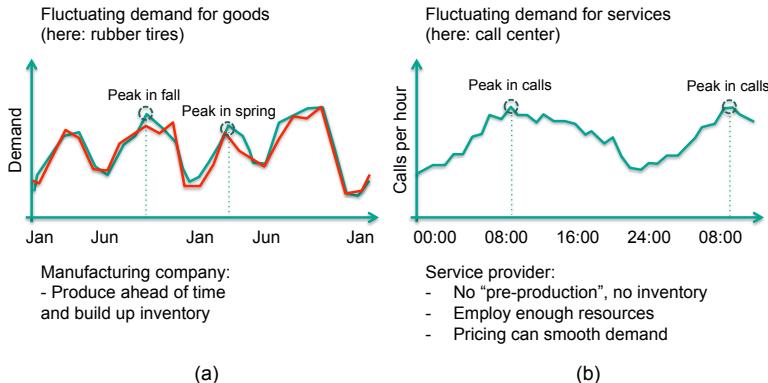


Figure 1.9: Fluctuating demand of goods and services

The service provider does not have this advantage: calls need to be answered by the call center agents at exactly the time when they are coming in. There is no “pre-production” of responses (due to inseparability). If the demand shall be completely fulfilled, the call center has to employ as many agents as calls come in at the peak time period. The agents are only fully utilized at this peak time period – in other periods, a number of agents are idle. This is a phenomenon common to many different service situations: the demand for electricity is heavily fluctuating during the day, the demand for flights and hotel rooms is fluctuating during the year, etc.

**Example — Fluctuating Demand of a Call Center.** To avoid customer waiting-times, call centers employ enough agents to cover peak demands. As a consequence, call center agents are often idle during off-peak periods. This is costly for the employer and tedious for the agents. A German call center decided to provide an additional workload when they are not busy answering calls. Agents were assigned the transcoding medical diagnoses written with free text into machine-readable ICD-10 codes (the International Classification of Diseases coding system). Results showed that agents were more satisfied with the new steady workload than they were before.

To cope with this challenging situation, service providers have taken advantage of different management practices. One practice is *demand aggregation*: the provider tries to acquire loads with different demand patterns to take advantage of the statistical effects that reduce variability in the aggregate demand. An example is a call center that serves different time zones: the peaks of one time zone might fall

into the quiet periods of the other time zone, and thus the overall demand smooths out.

Another practice is *demand conditioning*: the provider offers incentives to customers to use the service in off-peak periods. These incentives are typically lower prices in off-peak periods and higher prices in peak periods. This is common practice in the travel industry (hotels, airlines, railways). Prices can vary over the year (depending on the attractiveness of the traveling location in a particular season), over the week (working days, weekends) and sometimes even over the day (early morning, late night).

Electricity service providers also experience high demand variability. They have seasonal, weekly and daily fluctuations which are caused by climate/temperatures, length of daylight and dark, working hours in offices and factories, and behavioral characteristics of private households (lighting, heating, cooling, cooking, washing). With the availability of smart meters, energy providers can offer flexible electricity prices on an hourly basis to their customers. If customers change their consumption patterns in reaction to lower prices, the energy providers will be able to avoid costly demand peaks, smooth out demand, and increase the efficiency of their operation.

### **Intangibility and Advertising**

The second case addresses the consequences of “intangibility” on advertising of services. Advertising relies on the *presentation* of products (goods and services) in marketing channels. Only in shops and showrooms, products can be physically presented and are “tangible” for the customer (can be touched). In all other channels, such as newspapers, advertising walls, TV, or internet, products can only be virtually presented or *pictured* for advertising. Tangibility is no longer an issue, one should rather talk about the *picturability* of a product.

It is clear that “tangible goods” are easiest to be displayed in showrooms and pictured in ads. The situation for services – but similarly for intangible goods like music and videos — is more difficult. The advertisement of services has been a major concern of marketing people for many years [32, 33]. Services are activities or transformation processes. An activity or transformation process is not picturable like a tangible good (call this intangibility if you will). But substitutes can be found that make services picturable. A popular substitute is to picture physical delivery resources of a service (a friendly looking newsboy with his vehicle) or happy customers while receiving or after having received a service (Figure 1.10). The condition of a customer can be pictured before and after the service (hair transplant, cosmetic surgery).

Other possibilities are citing past performance characteristics, or presenting customer testimonials [33]. Substitutes are also used in advertising intangible goods. An ad for a newly released CD cannot picture the musical content, but can picture substitutes like the CD cover, a portrait of the musician, or the musician in action interpreting the music in a concert room.



Figure 1.10: Advertising services

**Example — IBM stand on CeBIT with Mercedes-Benz Actros.** An eye-catcher on the computer fair CeBIT 2012 was a big Mercedes Actros truck on the IBM stand. It attracted people who were curious to understand what a truck has to do with IBM's offerings. They learned that the Actros symbolized an intelligent logistics solution that IBM had developed for the Mercedes-Benz truck manufacturing plant within a service project. IT services are hard to present on a fair. As a substitute, the truck was a perfect tangible object that helped to promote IBM's service capabilities.

### 1.3.2 The Dual Nature of Services

The word “service”, as it was used in this book so far, refers to an *activity* or *transformation process* as defined earlier. But in colloquial language, the word “service” sometimes has a slightly different meaning. It might refer to the *resources* that are provided to deliver the service. Consider the following two sentences:

- A turbulence hit the airplane during the meal service.
- My neighbor owns a dry cleaning service.

In the first sentence, clearly an activity or transformation process is meant, in the second sentence, a set of resources. This colloquial ambiguity is another reason why the IHIP criteria are so difficult to digest. In the first case, intangibility and perishability are clearly given (the meal service is an activity – and as such intangible, other than a thing - and it has a beginning and an end). In the second case absolutely not (the dry cleaning service consists of tangible resources that continue to exist).

### The Process and Resource Nature

One could speak of two natures or dimensions of a service. This subtle difference has hardly been noticed and conceptualized in the academic literature. Donabedian [34] distinguished between the structural dimension and process dimension of a service. Shostack [35] mentioned that “services exist in two states of being”: in a potential state (where they may be “stored”) and in a kinetic state corresponding to the actual rendering. Both authors express the same thing in different words. In the terminology that has been used in this book so far, one could distinguish between the “resource nature” or “resource dimension” and the “process nature” or “process dimension” of a service.

In most cases, when people speak about services they have the process dimension in mind. Sometimes, the resource nature is shining through. Would everybody accept - as a theoretician would - that a massage is an intangible service? No – because people think of the hands of a masseur operating on the body of a client. A sensible, tangible experience! Colloquial language does not clearly distinguish between the two natures of a service.

### Services in Computer Science

In the academic discourse, it should be precisely ascertained which service dimension (nature) prevails in a particular context. In computer science, “services” and “web services” are terms that describe fundamental programming paradigms. Services are “software components of distinct functional meaning” [36], or “software programs with distinct design characteristics” [37]. Web services are “self-describing, self-contained software modules” [38], or “software applications with a published programming interface” [33], and web services “can be sold, too” [39]. It should have become clear from these definitions, that computer scientists use the term services consistently in its resource dimension and their service has more the characteristics of a good (can be sold, can be stored) than of an activity or transformation process. However, also the process dimension is sometimes “shining through”.

The novelty of this textbook is that it combines the concepts of services as they are used in economics and as they are used in computer science. Both disciplines have an unambiguous understanding of term service. Treated in isolation, there is no problem. But when the concepts of the two disciplines are brought together, the small but subtle difference poses some challenges.

#### 1.3.3 Non-Ownership

Recall the example from the beginning: the chef with his staff and equipment moved out of the aristocrat’s house, opened a restaurant and could then offer his capabilities to his former employer or to other customers *as a service*. Nothing has changed in the activities of the kitchen and in the utilization of resources except that the resources no longer belong to the aristocrat.

The non-ownership characteristic of services has early been recognized by researchers [40, 41]. “Yet subsequent theorizing has largely ignored this striking characteristic” ([42], p. 34). Lovelock and Gummesson [42] propose a “fresh perspective” on services considering non-ownership or rental/access – and not intangibility – as the main differentiator of services and goods. In the meantime, the treatment of non-ownership has found its way into service management and marketing textbooks [43, 44].

### **Outsourcing**

A modern way of describing this approach of giving up resources and demanding them back as a service without ownership is called *outsourcing*. Companies have begun many years ago to outsource their cafeteria, their security personnel, their facilities management, and even parts of their administration to service providers. The reason is always the same: companies want to turn fixed costs into variable costs and pay for the service only *on demand*. Non-ownership gives more flexibility and avoids risks if the company’s business goes up or down. On the other side, the service provider can mitigate risks and handle varying demand better through economies of scale.

Another example is *IT outsourcing*, where all the IT resources of a company (computers, applications, and IT people) are taken over by a third party and provided back to the first company as a service. IT outsourcing can take many different forms ranging from infrastructure outsourcing over application management services (AMS) to business process outsourcing (BPO).

In the last few years, IT outsourcing has seen a renaissance with tremendous momentum in form of *cloud services*. Cloud services are IT services made available over the internet. The easy accessibility has made them attractive not only for companies, but also for private customers. It is again about non-ownership: a user who previously had a license for a software product and had installed it on his or her personal computer is now buying the software “as a service” from a cloud provider (SaaS = Software as a Service). The user has no problem with installation, maintenance and upgrades — all is done within the cloud.

### **The Culture of Non-Ownership**

Even if non-ownership is an old phenomenon, the trend towards it is still on the rise. Not only have the firms discovered the benefits of non-ownership, but their intentions to use non-ownership services has increased [45]. The whole society, and especially the youth, is shifting towards a culture of non-ownership [46]. The desire for ownership decreases and owning is replaced by sharing [47, 48]. This can be observed for books, music, videos, fashion, art, software, cars, and many other products. The internet is the predominant platform to facilitate this development. The internet provides services for people to borrow or exchange physical goods. The tremendous growth in bandwidth has created the opportunity to transmit goods that are available in digital format (music, video) directly over the internet. This

has resulted in new kinds of services that are known as *on-demand services* (video-on-demand) or *streaming services* (music streaming).

**Example — Consumers want to rent their music, not to own it.** When Apple introduced their iPod and iTunes products in 2001, Steve Jobs still argued that consumers want to own their music, not rent it. Over a decade later it turned out that Steve Jobs was wrong. Musical subscription services like Spotify or Deezer are becoming more and more dominant. According to Nielsen SoundScan, CD sales in the first half of 2014 have dropped down 14.9% from the first half of 2013, and digital downloads 11.6%. At the same time, audio and video streaming services had a strong growth of 42%.

What streaming services are for music and video, are cloud services for software (software-as-a-service). They have similar economic models (on-demand, pay-per-use) and are based on the non-ownership paradigm. Both cloud services and streaming services are forms of *electronic services* which will be discussed in the next chapter.

#### 1.3.4 Bundling of Goods and Services

Many companies combine products with services into new offerings with a superior value for their customers. Examples of well-known offerings include Apple's iPod product which was combined with the iTunes service.

##### Hybrid Offering

Such a combination is called a hybrid offering [49, 50]. If a company offers an extended warranty contract in addition to an electronic product, this is a hybrid offering. If a beauty salon sells expensive cosmetics in addition to their regular beauty services, this is a hybrid offering. Other examples are airlines which sell duty-free merchandise on board, cable TV providers which sell digital TV receivers or recorders, or leasing companies which sell their used cars after the leasing period.

A hybrid offering should not be confused with a pure service that includes tangible elements. A rental car service is such an example. It includes the car as a tangible element, but the car does not go into the ownership of the customer. As the examples illustrate, the trend towards hybrid offerings can take different directions: providers of goods extend their offerings by adding services and providers of services extend their offerings by adding goods (Table 1.2).

**Example — Goods-Services Bundle.** Mobile network operators offer their mobile phone and internet access services often in bundles with smartphones or other access devices. For example, British Vodafone customers (as of December 2014) can sign a 24 month contract with unlimited calling time at monthly payments of £53.50 and get an Apple iPhone 6 for free. At a monthly rate

| Pure Goods    | Core Goods & Services   | Core Services & Goods                  | Pure Services  |
|---------------|---|--|--|
| Books         | Automobiles with maintenance  | Beauty salons selling cosmetics        | Teaching (high school, university)   |
| Chemicals     | Automobiles with financing  | Airlines selling duty-free merchandise | Financial services (banking, insurance, taxes)   |
| Food products | Heavy equipment with full service contracts and training<br>Software with maintenance and support | Leasing companies selling used cars    | Communication services (telephone, Internet, cable TV)<br><br>Transportation services (taxi, rental car, bus, train, airplane) |

Table 1.2: Bundling of goods and services

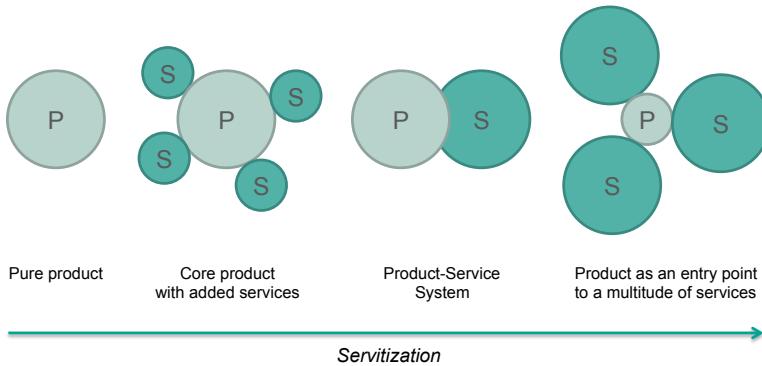


Figure 1.11: Servitization: adding services to core products (based on Steunenbrink [51])

of £43.50, the iPhone is offered at £99. Both offerings are bundled with an additional entertainment service such as Netflix or Spotify.

### Servitization

Many manufacturing companies have added services to their core offerings and services have become a dominant portion of their revenues and profits. This process is called servitization [52]. Figure 1.11 illustrates the servitization process. A hybrid offering in which products and services are integrated and have reached a similar level of importance is called a product-service system [53] or a solution [54].

As many recent examples show, the role of the product may become more of an entry point to a multitude of services (smart phones, tablet computers). Even a traditional product like the automobile will be surrounded by an increasing number of services in the future. Examples of services accessible through entry points like

smart phones, tablet computers, or cars are news services, e-mail services, navigation services, weather reports, real-time traffic information, and entertainments services.

## 1.4 Conclusions

Globalization, the steady growth of electronic commerce, the removal of regulatory barriers to economic activities, and the technological advances in computing and telecommunications has enabled the creation of wider service markets.

The term service is used to refer to a range of activities that is difficult to encapsulate within a simple definition. The literature often associates the term service with an act or a performance, or with a change in the condition of a person or of a good belonging to some economic unit under a prior agreement.

A definition becomes even more complex to find since services are also often difficult to separate from the goods with which they may be associated in varying degrees. Nonetheless, it is recognized that services when contracting a service, its ownership is not transferred to the end customer: buying an airline ticket does not entail to own part of the airline. This fact can be contrasted to the action of buying a car, which transfers ownership of the car to the customer.

The differences between goods and services are based on many different factors (e.g., absence of inventories, production and consumption is at the same time, intangibility), which are becoming more and more acute as the services sector expands. These differences are also being explored by using bundling, a marketing tactic that involves offering two or more goods or services as a package deal for a discounted price. Examples of bundling are as widespread as selling iPhone 6, with insurance, a service contract with 6GB of internet data, 1500 SMS/MMS, and 700 minutes of local calls.

But one of the major enablers of service markets expansion is IT, which bridges the physical distance between providers and consumers to enable a remote customer involvement during service provisioning. The next chapter will look into this class of services termed *electronic services*.

## Review Section

### Review questions

1. Beside the recent developments identified in this chapter, which enabled the dissemination of services in modern society, enumerate other developments which were relevant.
2. Describe the types of digital services the UK government is providing to its citizens.
3. Execute a web search to identify which service industries have a higher market share. Contrast the values found for US, EU, and Asia.

4. Explain how the division of work and labor, and the ownership of resources, are prerequisites for the edification of a service-based society.
5. Compile a list of five distinct definitions for the term service and highlight possible limitations when compared to the definition from Hill [8] adopted in Section 1.2.1.
6. Provide four examples of services for each of the interaction types shown in Figure 1.6.
7. Can the model of interaction types shown in Figure 1.6 be extended with additional scenarios? Give examples of services for the new scenarios you have identified.
8. Due to the inseparability of production and consumption, services cannot be “stored”. What techniques, methods, or tools can be used to manage the supply and demand of services more effectively?
9. How can *crowdsourcing* be used to match service supply and demand more efficiently? Describe two or three services, which could benefit from this sourcing model.
10. Identify and discuss how five well-known companies from various service industries could provide new services using servitization as a differentiating model?

## Project

Service systems can consist of hundreds or even thousands of components which are the combination of technology, processes, people skills, and material resources. To ease the comprehension of what constitutes a service, their decomposition and the identification of their main parts is important. Decomposition refers to the process by which a complex system is broken down into parts that are easier to understand, systematize, use, and maintain.

The goal of this project is to select three familiar services (e.g., library loan, internal IT consulting, e-banking, or cloud services) and to use the capstone model [55] presented in Table 1.3 to identify their main components. The final report should constitute a precise service manual that can be used by managers for service operation, management, and improvement.

The capstone model (also known as CAIOPHYKE) was proposed by Kaner and Karni to conceptualize service systems using a five-level hierarchy of components: *major classes*, *main classes*, *attribute description*, *requirement/specification*, and *possible values*. The model enables one to define a service system at several levels. Each level provides another layer of details. The major classes, which are nine, are the most relevant to understand the main components of a service system and are:

1. Customers. The people that benefit or are affected by the service. Customers can be seen as initiators and receivers of a service.

2. Aims. The goals, purposes, and meaning of the system.
3. Inputs. The inputs to the system. They include physical, human, and informational entities to be handled through the service system.
4. Outputs. The outputs from and effects of the system. They can also include physical, human, and informational entities after being handled in the system.
5. Processes. Processes that are performed by the system. They are the transformations for obtaining outputs from inputs.
6. Human enablers. Human enablers are the human resources that own and/or operate the system.
7. Physical enablers. Physical enablers are physical and technological resources which aid or support the operation of the system.
8. Information enablers. Information enablers are information and knowledge resources that support the system.
9. Environment. The system's environment which include all the factors that can influence the system. For example, physical, technological, social, and legal factors.

**R** The term CAIOPHYKE was derived from the letters of the nine major classes of the taxonomy constructed: Customers, Aims, Inputs, Outputs, Processes, Human enablers, Physical enablers, Information enablers (Knowledge), and Environment.

These nine major classes are extended to a second level of 75 main classes. At a third level, they are decomposed into 351 minor classes. The fourth and fifth levels include the actual attributes of a service and their possible values. A complete description of the various levels can be found in [55, page 264].

**Example — CAIOPHYKE.** The major class Customer has the main class Customer Feature, which in turn has the minor class Age, the attribute Age of Customers, and the possible values are: Children, Teenagers, Adults.

The major, main, and minor classes identify aspects of service systems, which can be analyzed to understand how a service is build and structured to, e.g., increase its transparency as well as discover and highlight the aspects that can be improved.

## Key terms

**Service-Dominant Logic** A theory which views service as the focus of economic and social exchange.

**Service** A service is a change in the condition of a person, or a good belonging to some economic unit, which is brought about as the result of the activity of some other economic unit, with the prior agreement of the former person or economic unit.

| Capstone Model             |                                 |                               |                                    |                       |
|----------------------------|---------------------------------|-------------------------------|------------------------------------|-----------------------|
| <i>Customers</i>           | Customer organization           | Customer features             | Customer association               | Customer attitudes    |
| <i>Aims</i>                | Strategic goals (general)       | Strategic goals (service)     | Service goals                      | Customer goals        |
| <i>Inputs</i>              | Physical factors                | Human factors                 | Demand factors                     | Utilization factors   |
| <i>Outputs</i>             | Physical factors                | Human factors                 | Informatics                        | Financial factors     |
| <i>Processes</i>           | Service configuration           | Service variability           | Service initiation                 | Service provision     |
| <i>Human enablers</i>      | Owner organization (enterprise) | Service providers             | Support providers                  | Employee management   |
| <i>Physical enablers</i>   | Service center (physical)       | Facilities (primary services) | Amenities (supplementary services) | Equipment             |
| <i>Informatic enablers</i> | Product/service information     | Promotion                     | Official documentation             | Product configuration |
| <i>Environment</i>         | Market factors                  | Geographic factors            | Economic factors                   | Technological factors |

Table 1.3: The capstone model [55] proposed by Kaner and Karni to conceptualize service systems

**I-T-O Model** A basic concept from operations management that represents a service as a transformation (T) process that takes inputs (I), transforms and adds value to them, and provides outputs (O) for customers.

**Self-service** A service which is provided without or with little human involvement on the provider's side. The provider often sets up facilities or equipment that the customer can use to perform a certain task.

**Knowledge-intensive Services** Services that heavily rely on professional knowledge.

**IHIP** An acronym for four concepts often used to characterize services: intangibility (I), heterogeneity (H), inseparability (I), and perishability (P).

**Demand Aggregation** An approach from the field of demand management which aggregates loads with different demand patterns to take advantage of the statistical effects that reduce variability in the aggregate demand.

**Demand Conditioning** An approach from the field of demand management which creates artificial incentives for customers to use services in off-peak periods.

**Outsourcing** A strategy that many companies follow to turn fixed costs into variable costs by paying for services only on demand to avoid risks if the company's business goes up or down.

**Servitization** A strategy that a company may follow which consists in adding services to existing core products. The result is an hybrid offering in which products and services are integrated as one bundle.

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