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# Handbook Integral Logistics Management

Operations and Supply Chain Management  
Within and Across Companies

*6th Edition*

 Springer



# Introduction

*Intended learning outcomes: Describe an enterprise as a company in its economic environment, and namely as a sociotechnical system. Explain three dimensions of business activity. Disclose the structure of the suite of courses. Identify notes to the student.*

An *enterprise* is, according to the APICS Dictionary (15<sup>th</sup> edition, APICS, Chicago, 2016), any undertaking, venture, initiative, or business organization with a defined mission.

In this book, the enterprise is understood as a *firm*, a *company* in its economic environment, and namely as a sociotechnical system. The elements of the system as well as their relationships, both within the system and to surrounding systems, are complex in nature. Various interested parties with different ideas and goals have an impact on the company, which makes company management a complex task. Figure 1 shows three dimensions of business activity. Integral company management means building management systems along these dimensions, which simultaneously interlock.

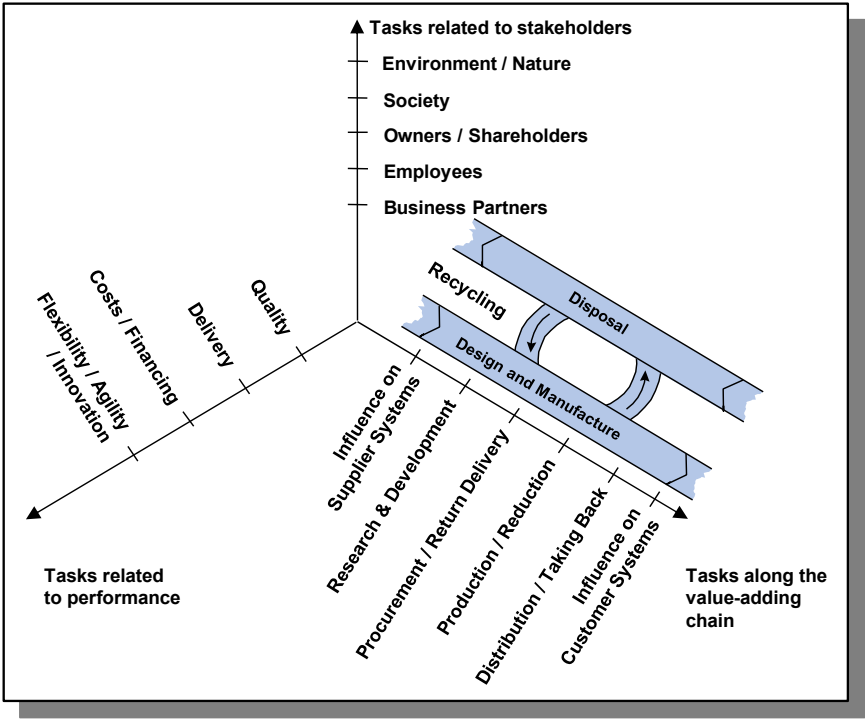


Fig. 1 Three dimensions of business activity.

Today, management systems for tasks *along the value-adding chain* affect customers and especially suppliers, just as customers and suppliers influence the management systems. This close partnership is also necessary from the perspective of the comprehensive product life

cycle. Product returns from the customer, disassembly, recycling, and returns to suppliers have to be considered as part of value-adding and paid for accordingly.

Management systems for the *stakeholders* of the enterprise deal with business partners, employees and owners (shareholders). Such individual stakeholders stand opposite the collective stakeholders in the form of society — that is, the macroeconomic system in which the company as a microcosm is embedded. In the figure, the environment (nature) is shown as a personified stakeholder. In practice, of course, the demands of the environment become manifest only through the environmental consciousness of the other stakeholders mentioned.

Priority areas of management systems related to company *performance* focus on the expected quality and delivery as well as required costs and their financing. Flexibility, agility, and innovation are usually potentials that have an indirect impact on business results, via future performance in the other three areas. Tasks related to company performance influence one another mutually and function as tasks that cut across the tasks along the value-adding chain and the tasks related to stakeholders.

Integral logistics management focuses in particular on *expected delivery* — on goals such as customer service ratio, delivery reliability, and short lead times. To achieve the objectives, the corresponding way of thinking has to be successfully anchored in all of the management systems along the entire value-adding chain, also across companies. Integral logistics management monitors value-adding over the entire product life cycle, but also considers the impact on the various stakeholders, especially the business partners.

Integral logistics management means *implementing* ideas, concepts, and methods that have the potential to increase the effectiveness and efficiency of company performance. Here, magic formulas, catchwords, and simplifying theories do not stand much of a chance. The complex reality of day-to-day operation of companies in industry and the service sector demands highly diligent detailed work. In contrast to many a strategic concept in company management, the proof of truth — namely, effectiveness — shows up quickly and measurably. Errors rapidly produce dissatisfied customers and employees, and thus poor business results. This immediacy and measurability do not make it easy to shift the blame to others.

On the other hand, logistics tasks offer a variety of possible solutions. This is an area that calls for human creativity, drive, and perseverance. Methods of planning & control in company logistics, and particularly computer-supported tools, are after all merely supporting aids. Moreover, experience has shown repeatedly that the successful use of methods and tools depends heavily on the people who implement them.

## Structure of the Book

The book comprises 4 parts:

- Part A (Chapters 1 through 3): Fundamentals, Strategies, and Design Options in Integral Logistics Management

- Part B (Chapters 4 through 9): Strategic and Tactical Concepts of Planning & Control in Integral Logistics Management
- Part C (Chapters 10 through 17): Methods of Planning & Control in the Operational Routine
- Part D (Chapters 18 through 20): Overview of Adjacent Management Systems in the Enterprise

Part A examines integral logistics management as embedded in the entrepreneurial activities as well as the strategic design of supply chains.

- Chapter 1 deals with integral logistics management as embedded in the entrepreneurial activities of developing, manufacturing, using, and disposing of goods. The focus is on the business objects, target areas, basic principles, analyses, concepts, systemic and systematic methods, as well as technologies for the management of logistics systems both within and across companies.
- Chapter 2 on supply chain design first considers basic principles for make-or-buy. It discusses models, opportunities and threats for different kinds of partnership between legally independent firms along the supply chain, followed by the management of supply chain risks.
- Chapter 3, also on supply chain design, discusses location planning with its integrated determination of production, distribution, service, and transport networks as well as the sustainability in supply chain management.

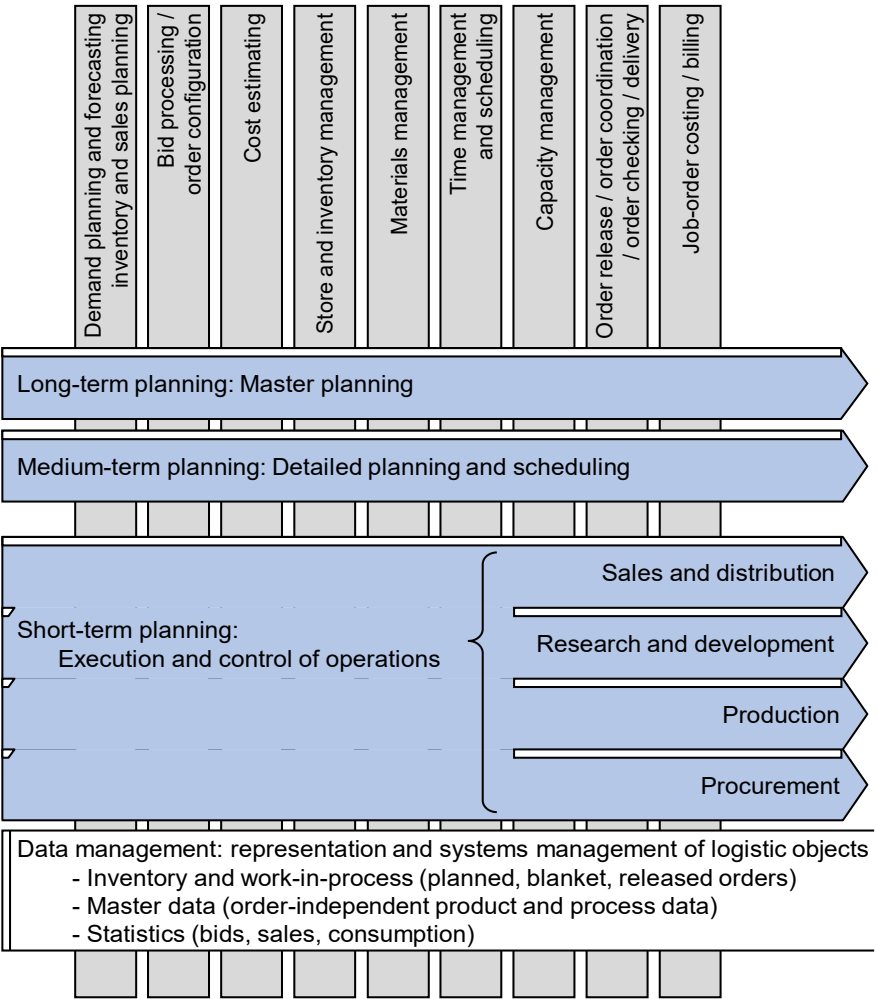
Part B introduces the fundamental concepts and tasks of planning & control in logistics, operations, and supply chain management, as well as the corresponding software.

- Chapter 4 starts with methods for business process analysis that are important for the systematic procedure for the design of systems for planning & control in supply chains. It develops a characteristic in planning & control with features that are tailored to the key performance indicators for measuring the degree of achievement of the company objectives in Chapter 1. This characteristic can be different for each product family. Finally, the chapter introduces four concepts for planning & control in supply chains dependent on this characteristic.
- Chapters 5 through 8 introduce the essential business objects and business processes for these four concepts:
  - Chapter 5: the MRP II / ERP concept
  - Chapter 6: the Lean / Just-in-Time concept and repetitive manufacturing
  - Chapter 7: the concept for product families and one-of-a-kind production
  - Chapter 8: the concept for the process industry.

Chapters 5 through 8 present an overview of the business methods and their relation to the characteristic in planning & control. The respective chapter develop detailed business methods in two simple but important cases: master planning in the MRP II / ERP concept and repetitive manufacturing in the Lean / Just-in-Time concept.

- Finally, Chapter 9 discusses ERP and SCM software for these four concepts as well as success factors for the implementation of this kind of software.

Part C offers a detailed discussion of planning & control methods in the operational routine. The reference model in [Figure 2](#) (introduced in Section 5.1.4) summarizes the presents an overview of the planning processes according to — vertically — temporal range (long, medium, and short term) and — horizontally — all the planning & control tasks. The processes and tasks are shown in the logical temporal sequence.



**Fig. 2** Reference model of business processes and tasks in planning & control.

- Chapters 10 through 17 examine the individual tasks in succession (exceptions: The discussion of bid processing and customer order configuration starts in Section 5.2.1 and continues in Section 12.1; Chapter 16 discusses cost estimation together with job-order costing):

- Chapter 10: Demand planning and demand forecasting
- Chapter 11: Inventory management and stochastic materials management
- Chapter 12: Deterministic materials management
- Chapter 13: Time management and scheduling
- Chapter 14: Capacity management
- Chapter 15: Order release and control
- Chapter 16: Cost estimation, job-order costing, and activity-based costing
- Chapter 17: Representation and system management of logistic objects

The introduction to each section will refer back to the above reference model and show the task together with the temporal ranges of planning for which the task is particularly pertinent.

- The methods in Chapters 10 through 17 provide a deeper understanding of the concepts in Chapters 5 through 8. They comprise all that is required for designing the logistic systems that is not characterized by frequent order repetition. The detailed discussion of these methods provides the reader with an in-depth methodological foundation for understanding the Kanban and master planning techniques introduced in part B. Many of these techniques have their origins in the MRP II / ERP concepts. However, they also apply to the process industry as well as to product families with many variants, whereby they, of course, are applied to the business objects of those processes.

Part D provides an overview of some adjacent management systems that are closely interconnected with Integral logistics management. Among these are strategic management, technology and product innovation management, the financial and cost accounting system, information, knowledge and know-how management, and system and project management. Part D shows, also and most especially, why and where the linkages exist. In any case, the information provided here is meant to serve as a summary.

- Chapter 18: Integral Logistics Management and Total Quality Management (or Six Sigma) are interconnected. Both management systems focus on fulfillment of concrete customer needs and thus belong to the area of operative implementation in the enterprise. The Japanese approaches give priority to a combination of concepts from both systems. The Toyota Production System for example, combines the lean / just-in-time concept with the jidoka concept, which is a concept for quality management.
- Chapter 19: Systems engineering and project management are also very strongly connected with Integral Logistics Management. First, the associated tasks in their entirety can be understood as management systems. The design, development, and continual improvement of these systems must be approached using the methods of systems engineering and project management. Second, some tasks are unique (one-of-a-kind); for example, in facility location planning, in the project business, or in customer-specific services (production and procurement without order repetition). Third, some techniques are used in both management systems. These are, among

others, scheduling techniques, such as the Critical Path Method (CPM) and the Gantt chart, and methods of financial evaluation of investments, such as the payback or Net Present Value methods.

- *Chapter 20:* In connection with ERP and SCM software systems (see Chapter 9), the connection of information management with Integral logistics management is clear. Information management can provide techniques and methods for realistic modeling of business processes and correct representation of logistic business objects. This makes possible suitable data management, which ensures that the necessary data on objects is available at all times in a detailed and up-to-date form.

## Notes to the Reader and Additional Teaching Material

Some notes to the reader:

- Definitions of key concepts and terms usually appear in text boxes, or in special tables or lists, or in footnotes. The terms being defined always appear in *italics*.
- The *definitions of terms* sometimes take the form of an indented bulleted list. This form is useful particularly where one and the same characteristic has varying degrees of expression.
- A gray background highlights important principles, examples, points to remember, prescribed procedures, steps of a technique, or solutions of selected scenarios and exercises. The reader will often find a reference to a figure.
- Some sections of the book are not essential reading for an understanding of the subsequent material. An asterisk (\*) identifies these optional sections.
- Also optional in this sense are the additional definitions provided in footnotes. They appear for the sake of completeness or as information for practitioners or for readers coming from related disciplines.

We use the following abbreviations in the text:

- cf. for “compare”
- R&D for “research and development”
- ID for “identification” (for example, item ID)
- IT for “information technology”

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# 1 Logistics, Operations, and Supply Chain Management

*Intended learning outcomes: Describe basic definitions, issues, and challenges. Identify business partners and business objects. Explain strategies in the entrepreneurial context. Disclose how performance is measured.*

Logistics, operations, and supply chain management deal with the management of systems that determine the performance of an enterprise or among companies as well as with the corresponding planning & control of daily business operations. These tasks are still managed by human beings who, through intuition and based on experience, find creative solutions. People have unique strategic and operational management abilities, in that they can fill in the blanks accurately and react flexibly to specific situations. However, if processes become more complex, frequent, and rapid, intuition alone does not suffice. Prior experience can also be misleading. In large companies and in transcorporate supply chains, moreover, there are many people involved in the processes, both simultaneously and in sequence. They differ in their experience, knowledge, and intuition. Therefore, logistics, operations, and supply chain management stand in the field of tension of the various stakeholders and contradictory objectives of the company or supply chain.

It is here that the scientific approach of Integral Logistics Management comes into play. After defining basic concepts, issues, and challenges (Section 1.1) and the related business objects (Section 1.2), we examine this field of tension in Section 1.3, paying attention to the various aspects of flexibility, as they represent potentials for future benefits. To measure performance, enterprises or supply chains must select appropriate performance indicators (Section 1.4) that relate to the business objects and objectives. These measures allow firms to evaluate the degree to which objectives are reached and to analyze related causes.

## 1.1 Basic Concepts, Issues, and Challenges

*Intended learning outcomes: Present terms of the working environment and of business life. Explain service orientation in the classical industry, product orientation in the service industry, and the industrial product-service system. Disclose the product life cycle, the synchronization of supply and demand, and the role of inventories. Produce an overview on supply chain management, the role of planning and control as well as the SCOR model.*

When looking for solutions of practical problems, people are not generally concerned about definitions. However, clearly defined terms become essential when we seek to gain an understanding of the concepts of Integral Logistics Management. First of all, definitions transmit a picture of the phenomena under study. They also avoid misunderstandings that arise because people and companies make varying usage of technical terms. Finally, definitions are indispensable for structured presentation in a textbook that covers a topic in substantial

detail. However, definitions should not detract from the pleasure of learning new concepts. This section therefore focuses on the issues and challenges connected with the terms defined.

1.1.1 Important Terms of the Working Environment and of Business Life

*Intended learning outcomes: Present terms of the working environment, such as work, task, function, order, procedure, process, method, object, business. Produce an overview on terms of business life, such as value-added, business process, business method, business object, goods, item, part, component, material, product, artifact, management, etc.*

With designing of organizations, there is (too) frequent confusion among the terms *task*, *function*, and *process* (as well as task orientation, function orientation, and process orientation). By referring to etymological dictionaries, such as [MeWe18], and dictionaries of related words and meanings, we can find out how people *normally* understand the terms. While some branches of science traditionally give terms their own definitions, such definitions are arbitrary. However, a company best takes its orientation from everyday understanding, and uses definitions of terms that will be generally understood.

Figure 1.1.1.1 defines the basic terms of the working environment.

Term	Word origin, definition	Related terms
<i>work</i>	<u>old</u> : travail, toil, drudgery, exertion of strength <u>new</u> : employment, activity that leads to an achievement <u>but also</u> : something produced by mental effort or physical labor	job, task
<i>task</i>	a piece of work that needs to be done regularly	function; order; assignment
<i>function</i>	the particular purpose for which a person or thing is specially fitted or used or for which a thing exists	task; purpose
<i>order</i>	a direction to buy or sell goods	task
<i>procedure</i>	a series of steps followed in a regular order	process
<i>process</i>	a series of actions or operations directed toward a particular result	procedure; course of action
<i>method</i>	a procedure or process for achieving an end <u>also</u> : orderly arrangement	procedure
<i>object</i>	something that may be seen or felt; <u>also</u> : something that may be perceived or examined mentally	thing
<i>business</i>	something to be dealt with; task; concern; <u>new</u> : a commercial or industrial activity or organization	

Fig. 1.1.1.1 Basic terms used in the working environment.

The most important finding here is that the word *work* contains both the character of a process and of content and result. This duality seems to be fundamental. The content of work, that is, its purpose or objective, is often expressed as *task*. The term *function* is clearly related to *task*. *Function* more strongly refers to the result of work, while *task* is more work's content and purpose, whereby each term includes the other. An *order* arises when a task is assigned to someone else.

*Procedure* and *process* are practically synonymous and stand in duality to the terms *task* and *function*. In most cases, a task or function can be structured as a sequence or as a net of subtasks, or subfunctions, and thus thought of as a process. Turned around, a process is usually seen as various works progressing in a certain sequence. Each of these works may be seen as a task or function, or as a part of such. Of course, there exist tasks and functions that finally are “nuclear” — they cannot be broken down further. In the area of company strategy, but also in R&D, we find tasks that are difficult to break down.

Note that *business* refers to the central term *work*, whereby in today's usage, business means tradable work according to its new definition.

Figure 1.1.1.2 presents additional basic terms that are used in business life. The first four (composed) terms have been defined by the author, as [MeWe18] does not give a definition.

*Value added* varies in meaning according to the standpoint of either producer or customer. From the traditional perspective, that of the manufacturer, for example, the expense of keeping inventory or work in process is always value-adding. The customer, however, does not normally view such processes as value-adding. With the trend toward customer orientation, it has become increasingly important to take the customer's point of view.

Linked with a *business process* is its order processing. The order fulfilling unit performs not only the value-adding process itself, but also the necessary planning & control of the process. *Business methods* — e.g., methods of order processing — describe how tasks are performed or functions within the company can be achieved. Familiar *business objects* are, for example, customers, employees, products, equipment, and — particularly — orders.

In general, the term *material* is not perceived synonymous to *component*. *Material* generally refers to rather simple initial resources, such as raw material, or information such as documents, evidence, certificates, or similar things, whereas *component as a business object* can also refer to semifinished products.

For the matters covered in this book, the nuances of meaning between the terms *product* and *artifact* are of minor importance. We thus use both terms synonymously.

## 1.1.2 Service, and Service Orientation in the Classical Industry

*Intended learning outcomes: Present terms of the service domain such as service, customer service, service in the originary sense, servitization. Differentiate between a (primary, or core) product, a product in a broad sense, and a product in the most comprehensive sense.*

A service is, according to [MeWe18], a performance of official or professional duties, the act, fact, or means of serving.

Term	Definition
<i>value-added</i> (or <i>value creation</i> )	(1): a company's own output, including overhead; purchased products or services may complement this (2): value and usefulness of design and production as seen by the customer
<i>business process</i>	process of a company, performed to achieve a potentially tradable outcome that is value added as seen by the customer — internal or external — and that the customer is willing to pay for
<i>business method</i>	an important method in connection with business
<i>business object</i>	an important thing, or a content of thought, in connection with business
<i>good</i>	something that has economic utility or satisfies an economic want
<i>goods</i>	something manufactured or produced (or bought and sold in business)
<i>investment goods</i>	machinery, tools, factories and commodities used in the production of goods (also called <i>capital goods</i> )
<i>consumer goods</i>	goods that directly satisfy human needs
<i>item</i>	a separate particular in a list, account, or series
<i>part</i>	a division or portion of a whole
<i>component</i>	one of the parts that make up a whole
<i>material</i>	(1): the elements or substance of which something is composed or made (2, usually plural): items needed for the performance of a task or activity
<i>product</i>	something produced by physical or intellectual effort of <i>humans</i>
<i>artifact</i>	something made or modified by <i>humans</i> usually for a purpose
<i>management</i>	(1): the act or art of managing: the conducting or supervising of something (2): judicious use of means to accomplish an end

**Fig. 1.1.1.2** Additional basic terms used in business life.

The definition of service refers to the beneficiary of the service, generally referred to in the commercial world as the customer. With firms, service often means customer support.

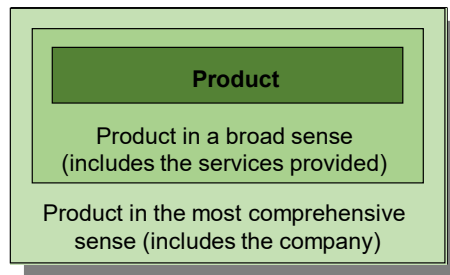
*Customer service or customer support* is the ability of a company to address the needs, inquiries, and requests from customers ([APIC16]).

A *service in the originary sense* is a process involving a *service object*, that is, an object belonging to the customer that must be brought together with the provider of the service (or vice versa), potentially along with additional customer input.

In many cases, the object, thus the recipient of the service is the customer himself. In other cases, it is technical support and maintenance of machines or plants. Further examples include services in relation to information products, such as correction of software.

Interestingly, [Levi81] points out that “distinguishing between companies according to whether they market services or goods has only limited utility”. The author suggests that it is more useful to speak instead of *intangibles* and *tangibles*. He states that “everybody sells intangibles in the marketplace, no matter what is produced in the factory.” Remarkably, based on the above mentioned definitions *goods*, *products*, and *materials* can be either tangible or intangible. On the other hand, the author notes that often “intangible products must be tangibilized. Hotels wrap their drinking glasses in fresh bags or film, put on the toilet seat a sanitized paper band, and neatly shape the end piece of the toilet tissue into a fresh-looking arrowhead”. This is particularly important when an otherwise intangible service is part of a more comprehensive service (e.g. a guest's stay in a hotel) and this specific (partial) service can be provided earlier, i.e. before the customer uses the (entire) service.

As [Levi81] states, “tangible products differ in that they can usually, or to some degree, be directly experienced — seen, touched, smelled, or tasted, as well as tested”. However, for capital goods in particular, tangibility is not enough. As [Figure 1.1.2.1](#) shows, the decisive factor influencing the purchase is rather the holistic experience.



**Fig. 1.1.2.1** The product in its holistic experience.

*A product, in a broad sense*, is a (primary, or core) product along with the services provided, where the consumer sees the two as a unit.

For investment goods, additional services increasingly constitute the key sales argument. Here, “services provided” could mean installation instructions or a user manual, training information, or the promise of future (after-sales) services such as maintenance and repairs.

*Servitization* is an artificial term for the process of systematically designing services that entail considerable additional revenues. Such a design leads to what is called a product-service system. See here Section 1.1.4.

In buyer's markets, individualization of products to customers' requirements and personalized production become more and more important. In particular, an ETO (“engineer-to-order”) production environment leads to a service focus and to value co-creation. See here Section 7.4. With a product variety subject to (changing) customer specification (e.g. for the “haute couture” sector of the fashion industry), repeated input from the customer is a key

characteristic of the production process. Trying on a half-finished dress is actually a service process in the original sense, i.e. it needs ongoing intensive contact with the beneficiary of the service. It even offers an opportunity for the specification of the product (the dress) to be changed. Then, the quality of such services, or the processes “around the product,” can become as much or even more important than the quality of the core product.

*A product, in the most comprehensive sense, comprises the (primary, or core) product, the services provided, and the company itself, with its image and reputation.*

Here, the consumer sees all three as a unit. An example is the concept of *Total Care* in the insurance branch. The aim is to give the customer the idea that the quality of the company, that is of the organization as a whole will provide all-encompassing care. This “all about the customer” process builds trust. Image and reputation of a company are a consequence of stakeholder opinions which, according to [Figure 1](#) in the introduction, include business partners, employees, shareholders, society, environment and nature.

### 1.1.3 Service Industry, and Product Orientation in the Service Industry

*Intended learning outcomes: Differentiate between service industry and classical (or conventional) industry. Produce an overview on industrialization of service.*

The *service industry* is, according to [APIC16], in the narrowest sense, an organization that provides *intangibles* (e.g. medical or legal advice). In the broadest sense, all organizations except farming, mining, and manufacturing. It includes retail trade, wholesale trade, transportation and utilities, finance, insurance and real estate; construction; professional, personal, and social services; and local, state, and federal governments and also provides *intangible goods* such as information.

Using this definition, examples of a *classical (or conventional) industry* would include organizations like farming, mining, and manufacturing. Companies working in this sector mainly produce *tangible goods*, or *tangibles*.

Beside the need for service orientation in the classical industry, there also is a need for product orientation in the service industry. According to the hospitality sector example quoted above from [Levi81], “tangibilization of an intangible should ideally be done as a matter of routine on a systematic basis.” Such hotels have “*industrialized* the delivery (of their promise of service).”

*Industrialization* of service means, like in classical industries, standardization and automation of its performance. Section 7.3 describes an example from the insurance industry. The use of a product configurator allows (intangible) elementary insurance services (insurance specialists call them elementary *products*) to be modularly assembled to form a variety of combined products, and these combined products to be put together to form contracts. Catering is another example: there is a lot of similarity between standardized recipes in the catering sector and recipes used in food or chemical-pharmaceutical production.

Industrialization also means some *standardized* service components can be developed and prepared in advance. This applies for hotel and catering services every bit as much as for

spare parts. Also, the costs for these components that form part of a more comprehensive service can be calculated in advance. In this context, it becomes clear why an *industrialized* service, although intangible, is often perceived as a product (and is referred to as one), for example in the above-mentioned hospitality or insurance sector. Industrialization of services offers efficiency gains, without any loss of effectiveness. This is an area where the service sector is learning from classical production used for tangible goods. Then, the performance of the (part) service can be perceived as a “production” of intangibles (sometimes, called service production), and the result can be perceived as an (intangible) product or commodity.

The service industry can also provide entire services that are similar to the supply of tangible products. Simple spare parts delivery is often perceived as a service, but is actually no different to producing standard products, where these are kept in stock to ensure fast delivery. And although delivery of a passport is considered to be a service, these days it is actually no different (even in the degree of industrialization) to the supply of a make-to-order product, for which the beneficiary has to enter their personal data (including a facial photograph). Thus, the customer focus will be on acquiring a product rather than receiving a service.

This means that although the so-called *IHIP characteristics* of services (Intangibility; Heterogeneity, i.e. uniqueness of service processes; Inseparability (or simultaneity) of provision and consumption; and Perishability (e.g. exclusion from inventory)) are popular for practical applications in service-oriented companies, their suitability is limited. According to [Hert13], IHIPs are “not defining characteristics, but simply symptoms.”

#### 1.1.4 The Industrial Product-Service System

*Intended learning outcomes: Present the industrial product-service system. Explain the product-oriented, use-oriented, and result-oriented service, and their degree of intangibility.*

According to [MeRo10], an *industrial product-service system IPSS* (or  $IPS^2$ ) is characterized by the integrated and mutually determined planning, development, provision and use of product and service shares including its immanent software components in business-to-business applications and represents a knowledge-intensive socio-technical system.

An IPSS is thus focused on capital goods such as machinery and equipment which are produced and sold by classical industry, and which are used over a long time period. In that model, customers are businesses, rather than individuals. In addition, although the service recipient is a tangible (core or primary) product, this definition shows that in an IPSS there are no “add-on” services to this product. To create value for the customer and to sell well, the original equipment manufacturer (OEM) network and their suppliers must design the services with the customer (beneficiary) right from the start, as shown in [Figure 1.1.4.1](#). That is the thinking behind the term *value co-creation* (see also [KaNi18]).

Industrial product-service systems have become more important particularly in classical industries, since quality and costs of the core product from many OEM have become almost indistinguishable from the customer's perspective. Offering something different in terms of additional services can be the distinguishing feature that makes what a company is offering stand out, especially in competitive markets.