The Firm, Knowledge and Capital: Toward the Definition of Knowledge Capital

In this chapter, we investigate the meaning of words. The term *innovation* is plural and its sense has evolved over time. Here, we examine the current typologies, the modalities of organization of activities that intertwine to give rise to innovation and the indicators used for its measurement (section 1.1). In order to grasp the knowledge capital of an enterprise, it is also useful to review the relationship between information and knowledge. The productive use of a set of information and knowledge produced, acquired and mobilized by a company makes it possible to understand the transformation of knowledge into capital and thus the formation of knowledge capital (section 1.2). The analysis of knowledge capital is based upon the contemporary theoretical developments of the firm and knowledge, which are associated with the contributions of some pioneer authors. We refer to them in section 1.3 of this chapter.

1.1. Innovation: definition, organization and measurement

1.1.1. “From vice to virtue”: the evolution of the definition for innovation

While the concept of innovation is everywhere today, and symbolizes the very latest in modernity, it is nonetheless very old and has not always been associated with progress and growth. According to Godin [GOD 14], the concept of innovation goes back to antiquity and was then used by Greek
philosophers in their political theories. This political sense would remain
dominant until the 19th Century, up until when innovation meant a “change
in the established order” with regard to politics and religion. Innovation was
thus banned (e.g. by Edward VI of England in 1548) and religious or
political innovators (such as the French revolutionaries of the 18th Century
and the reformers of the 19th Century) were indicted, imprisoned, or even
worse.

It is only in the 20th Century that the meaning of innovation began to
transform and came to be associated with positive notions of progress,
creativity and economic growth. From this century onwards, “there is no
longer any doubt that the vice that was once characterized innovation, has
become a virtue” (Godin [GOD 14, p. 33, our translation]). As such,
innovation quickly became associated with technology.

Schumpeter (1883–1950) is often considered as the first economist to use
and construct an economic theory based on innovation. However, before
him, classical economists were largely preoccupied by the changes brought
about through “technical progress”, or “mechanization”, key terms found in
the writings of Adam Smith, David Ricardo, Jean-Baptiste Say and Karl
Marx to name only a few. In addition, as noted by Godin [GOD 14], the
sociologist Gabriel Tarde (1843–1904) is often mentioned as the first person
to have devoted theoretical writings to innovation, toward the end of the 19th
Century. According to Djellal and Gallouj [DJE 17], although the latter
never cited him, he would have been an important inspiration for
Schumpeter, at least in his work devoted to the theory of innovation. Despite
this, Schumpeter is still widely considered as the father of modern
innovation theories.

In Schumpeter’s Theory of Economic Development [SCH 11], he
considers that “To produce means to combine materials and forces within
our reach (...). To produce other things, or the same things by a different
method, means to combine these materials and forces differently” [SCH 05,
p. 65]. Evolution results from the execution of “new combinations amongst
the means of production”, which include the following cases (Box 1.1).

1) The introduction of a new good – that is, one with which consumers are not
yet familiar – or of a new quality of a good.

2) The introduction of a new method of production, that is, one not yet tested
by experience in the branch of manufacture concerned, which need by no means
to be founded on a new scientific discovery, and which can also exist in a new way of handling a commodity commercially.

3) The opening of a new market, that is, a market into which the particular branch of manufacture of the country in question has not previously entered, whether or not this market has existed before.

4) The conquest of a new source of raw materials or half-manufactured goods; again, irrespective of whether this source already exists or whether it has to be created first.

5) The realisation of a new organization of any industry, such as the creation of a monopoly position (for example through trustification) or the breaking up of a monopoly position.

Box 1.1. Forms of new combinations, according to Schumpeter [SCH 05, p. 66]

The importance of this definition and Schumpeterian analysis in the theory of innovation in general can be explained via several arguments, which are presented below.

In the first place, this definition is important inasmuch as for the first time it distinguishes the various forms that innovation can take, without reducing it to technology. These various forms of innovation are central to the contemporary definition proposed by the OECD, and which we will discuss in greater depth later. Meanwhile, in the analysis of long waves by Kondratieff, technology occupies a central position. In Business Cycles [SCH 39], Schumpeter links the three Kondratieff movements, from the period 1750 to 1940, to the three waves of fundamental innovations, which mainly concern technology, namely the textile, steel and steam industries of the late 18th Century; the railroad empires of the middle 19th Century; and the electricity, automotive, chemistry-based industries at the turn of the 20th Century. “Consequently, the role of innovation… is essential to the explanation of economic cycles” (Uzunidis [UZU 96, p. 122, our translation]). These innovations lead to an increase in supply-side capacities (increased demand for production goods, lower production costs and an increase in the quantities of new products on offer) that is accompanied by an increase in demand (new consumption needs and recourse to credit). We also find this primacy of technology in the analysis of the technoeconomic paradigm proposed by Freeman and Perez [FRE 88, FRE 08, PER 10]. It is defined as the set of the most successful, cost-effective practices in terms of input choices, methods
and technologies, as well as in terms of organizational structures, economic models and strategies. The paradigm forms a kind of common sense that facilitates the diffusion of technologies that shape a technological revolution, defined as a constellation of technical systems with a common dynamic that can integrate a set of generic technologies, which can be widely applied (Boutillier and Laperche [BOU 16]).

In Schumpeter’s analysis, innovation is therefore associated with evolution and change. This is the second essential point. “Capitalism, then, is by nature a form or method of economic change and it not only never is, but never can be stationary” [SCH 75, p. 82]; in fact, “The fundamental impulse that sets and keeps the capitalist engine in motion comes from the new consumers’ goods, the new methods of production or transportation, the new markets, the new forms of industrial organization, all the elements created by the capitalist initiative” [SCH 75, p. 83]. These new combinations cause the hurricane of Creative Destruction, continuously destroying older elements and continuously creating new ones. Thus, changes induced by innovation also have negative consequences. If we return to the analysis of long waves, excess investment in the growth phase is in fact penalized by losses, redundancies and bankruptcies that will carry out a “vacuum clean-up” at the same time creating anew the spirit of enterprise.

This central role of technology and as such the potential for change, as made possible through technology, is still a subject of debate today. For Gordon [GOR 16], for example, information and communication technologies (ICT) affect a smaller number of activities as compared with the key technologies of the second industrial revolution (electricity and aviation), which is hampering the resumption of activity. On the contrary, other authors (Achibugi [ARC 16], Archibugi et al. [ARC 17]) consider that current technologies offer many opportunities, in terms of job creation and new growth. However, they believe that the economic and social system do not sufficiently promote their exploitation or dissemination. According to these authors, massive public investment into not only science and technology but also infrastructure should be made to help companies develop marketable products and services. The current high financialization of the economy, which makes equity investments more profitable and productive investments more risky, also plays a key role in the absence of a long-awaited recovery and the emergence of a new period of growth (Uzunidis [UZU 03]). Another connected argument is for the focus of
science and technical progress to be toward short-term profitability targets, which do not sufficiently take into account large-scale challenges (e.g. climate change, aging populations), which could offer many new business opportunities.

Of course, and this is the third argument justifying the importance of Schumpeter’s analysis, not all innovations have the same effects on the economic structure. New combinations can result from continuous, small-scale transformations – now called minor or incremental innovation – and their effect on the economic structure will therefore be limited. “Insofar as the ‘new combination’ may in time grow out of the old by continuous adjustment in small steps, there is certainly change, possibly growth, but neither a new phenomenon that would be out of the bounds of an equilibrium interpretation nor development in our sense” [SCH 05, pp. 65–66]. On the other hand, Schumpeter goes on to refer to what is today called radical or major innovation: “Insofar as this is not the case, and the new combinations appear discontinuously, then the phenomenon characterizing development emerges. For reasons of expository convenience, henceforth we shall only mean the latter case when we speak of new combinations of productive means” [SCH 05, p. 66].

A radical innovation can be defined as an innovation with a significant impact on the market and on the economic activity of firms. This impact may include changing the market structure, creating new markets or making existing products obsolete. In fact, in the analysis of cycles the new combinations appear in clusters, thereby combining both major and minor innovations. Radical innovations launched by entrepreneurs trigger the beginning of the cycle. The creation of profit opportunities attracts imitating entrepreneurs who offer incremental innovations and thus prolong the growth trend at a slower pace until the eventual turning point of that cycle. Researchers in economics and management now refer to a third category of innovation with respect to these effects: breakthrough, or disruptive innovation (Christensen [CHR 97, CHR 03]). Its trait is to introduce new performance criteria by targeting different users. It opposes continuous innovation and favors new entrants, who adopt a different business model. Consequently, the notions of disruptive innovation and radical innovation are close; however, radical innovation is more closely associated with new technologies that originate from advancements made in science and technology, whereas disruptive innovation can be ascribed to non-technological changes. Products can simply be more basic and not
necessarily rely on technological change, or they should introduce new features and functions aimed at appealing to new consumers.

The fourth argument that illustrates Schumpeter’s contribution to the theory of innovation is that innovation is embodied by individuals, or more precisely within “economic functions” as carried out by specific individuals. In this sense, an entrepreneur according to Schumpeter is an individual whose function is to carry out new combinations [SCH 05, p. 74]. By doing so, Schumpeter prolonged the analysis of the French economist J.-B. Say (1767–1832), who considered the entrepreneur as a producer, alongside the scientist and the worker (Boutillier and Tiran [BOU 16]). The entrepreneur’s primary competence lies in the “art of application”, which rests not only on science and knowledge but also on their application in terms of the needs of people (Tiran [TIR 17]). The entrepreneur implements new combinations. By highlighting this function of “placing on the market” or “introducing into production”, Schumpeter highlights the essential difference between novelty or invention (in the technical sense) and innovation. If the invention is defined as a technical solution to a technical problem, innovation consists of its productive and commercial exploitation with the objective of making a profit. The characteristic that distinguishes a novelty from an innovation is that the latter involves “implementation”, whether that is in the form of a market launch of a product or service or a productive use for innovation in commercial or organization processes. The aims of innovation are always linked to economic objectives: increasing the company’s turnover, opening up new markets, reducing production costs, internalizing organizational costs, internalizing and externalizing transaction costs, increasing labor productivity.

However, the creative power of the entrepreneurial spirit and the advent of entrepreneurs as a “group” at the heart of this analysis on the theory of economic development depersonalizes itself in the course of its work, showing an awareness by Schumpeter as to the nature and scope of the transformations which had taken place in the structure of capitalism since the beginning of the 20th Century. The discovery of the existence of what he calls “trustified capitalism” in Business Cycles, will be the object of increasing attention, to the point of becoming the essential cause behind the historically determined character of “capitalism” as it features in Capitalism, Socialism and Democracy. The planning of technological progress by large companies, the development of private research laboratories whose aim is to reinforce the innovation potential of the company are the signs of the “bureaucratization” of technical progress: “Technological progress”, writes
Schumpeter, “is increasingly becoming the business of teams of trained specialists who turn out what is required and make it work in predictable ways. The romance of earlier commercial adventure is rapidly wearing away, because so many more things can be strictly calculated that had of old to be visualized in a flash of genius” [SCH 75, p. 132]. This bureaucratization, necessary in the face of competition, is a sign of the strengthening of monopolistic structures. Economists, especially neo-Schumpeterians, raise this evolution by referring to Schumpeter Mark I for small companies that innovate, and to Schumpeter Mark II for the larger corporations that take on this role (Nelson and Winter [NEL 82], Malerba and Orsenigo [MAL 95]). This distinction, as Munier [MUN 13] explains, should be nuanced, since the decisive role of the entrepreneur – and the small business – is a constant theme in all of Schumpeter’s work; it is indeed the disappearance of the entrepreneur that will sound the death knell of capitalism.

The Schumpeterian legacy is thus omnipresent in the themes that animate researchers who specialize in the subject of innovation. Indeed, the contemporary definition of innovation is part of this legacy.

1.1.2. Typology of innovation: the contemporary definition

The contemporary definition of innovation is that as outlined in the third edition of the Oslo manual, published by the OECD in 2005. It is part of a series of OECD-edited textbooks on measuring and interpreting data as it pertains to science, technology and innovation. For example, it complements the Frascati Manual from 2015 [OEC 15a], which focuses on R&D, and the Canberra report from 1995 [OEC 95], which deals with the measurement of human resources that are devoted to science and technology.

The definition of innovation incorporates for the first time forms of technological and non-technological innovation. Indeed, previous versions of the Oslo manual restricted innovation to its technological form (products and processes). Innovation is defined as “the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations” [OEC 05, p. 46].

1.1.2.1. The four categories of the Oslo manual

Four categories of innovation are thus distinguished: product, process, marketing and organizational innovations.
Product innovations relate to “the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics” [OEC 05, p. 48]. New products can be based on original knowledge and technologies (such as the first microprocessors or digital cameras) or a combination of existing technologies (e.g. the first portable MP3 players). They may also relate to a new type of use, for example an existing chemical composition that is used to produce a new type of detergent when its previous use was quite different. Significantly improved products relate to changes in materials, components or other characteristics that make these products more efficient. Examples not only include “stop and go” systems that cut car engines at traffic lights, GPS navigation systems or automatic parking, but also the increase in the computing or storage power of our electronic devices. The term product innovations also apply to services, whether they are completely new (e.g. a new apartment rental service) or simply improved (e.g. Internet banking).

Process innovations are defined as “the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software” [OEC 05, p. 49]. The introduction of collaborative robots in industry (cobots) is an example of a new production method. New distribution methods, for example, barcode tracking systems or active radio frequency identification goods-tracking systems. Process innovations also apply to services, for example, a new online product reservation system in the case of local food systems (for example La Ruche qui dit Oui!: a Website where consumers can select artisanal products online, whereupon once a critical mass is reached, a pick-up location and time is issued), or the geolocation of available urban rental bikes (or parking spaces).

Marketing innovations concern “the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing” [OEC 05, p. 49]. Changes in product design refer to changes in its shape and appearance, without altering the functional characteristics of the product. Marketing innovation constitutes a change in the wrapping or packaging of foods, beverages, or moisturizers, which does not change the composition of the product itself. Marketing methods for product placement refer to new distribution systems (such as the introduction of a franchising network) or new ways of displaying products, such as furniture, for example, giving the customer the
impression of visiting their future home. In the domain of the promotion and pricing of products and services, these new marketing methods denote branding or the first use of a method to adjust the price according to demand.

Organizational innovations refer to “the implementation of a new organizational method in the firm’s business practices, workplace organization or external relations” (OECD, 2005, p.51). Practices relate to new methods for organizing the routines of a company or enterprise (this may be to facilitate learning and disseminate knowledge through the creation and use of new shared databases, or through the introduction of further education and/or training systems) and work procedures (production management systems, for example waste assessment and management systems such as product Life Cycle Analysis (LCA)). The organization of the workplace can be modified through a new structuring of services and activities, giving greater autonomy to employees (project teams for example) or by contributing to a greater centralization of decision making. The company's external relations can be organized in a new way. The introduction of forms of collaborative innovation (open innovation) or outsourcing through the use of subcontracting for the first time are additional examples.

Novelty is accounted for in the definition of innovation and the Oslo manual distinguishes three forms of novelty: novelty to the firm, to the market and to the world. Novelty to the company is the implementation of an existing innovation by a company; it may already have been implemented by other companies, but is new to that particular firm. The notion of novelty within a market refers to an innovation which a company is the first to implement within said market. For a new global innovation, the innovation needs to be implemented worldwide.

1.1.2.2. The combination of the forms of innovation

For statistical or pedagogical purposes, the forms of innovation are well distinguished from one another, but in reality they are often linked or associated. Hence, in the communication of companies, it is common to hear or to read that they propose “solutions”, which essentially seek to combine different forms of innovation, in particular products, services and organizations. These solutions are often implemented to reduce the environmental impact of the activity (known as “product–service systems” [PSS]); nonetheless, they are also found in areas relating to caring activities, for example in innovations targeted at dependent persons. In the latter case,
there is no correlation in terms of a reduction in the environmental footprint of the activity, but rather these solutions are developed to offer a complete and diverse package of products and services, adapted to the needs of each consumer. These two cases are examined in further detail below.

In addition to the desire to respond to the environmental impact of the offer, solutions combining products and services have resulted in the development of a concept referred to as the “product–service system”. Firms, such as Arcelor Mittal, STMicroelectronics, Saint-Gobain and Schneider Electric for example, provide solutions or systems by mixing products, components and services in order to adapt to the customers’ needs that relate to environmental constraints. For example, Arcelor Mittal develops lightweight steel solutions for the automobile industry; Saint-Gobain develops exterior thermal insulation and many other insulation solutions to meet all types of insulation requirements in new and existing buildings; Schneider Electric develops intelligent energy management systems to help companies measure and manage their energy use; Air Liquide, in its health division, provides new services to patients (for more details, see Laperche and Picard [LAP 13]). The term “product–service system” (or PSS) was defined by Goedkoop et al. [GOE 99] as “A system of products, services, networks of ‘players’ and supporting infrastructure that continuously strives to be competitive, satisfy customer needs and have a lower environmental impact than traditional business models”. According to Baines et al. [BAI 07] literature review, most contributors on this topic have since broadly adopted this definition. The link with the environment lies in the fact that the focus is shifted from the sale of a product to a function capable of fulfilling consumers’ needs while lowering environmental impact (Mont [MON 02]). The main point is that the means by which the environmental impact of an economic activity is decreased can be found in the dematerialization and growth of services within the supply. This approach matches the notion of a functional economy that aims to “optimize the use (or function) of goods and services and thus the management of existing wealth (goods, knowledge and nature). The economic objective of the functional economy is, as explained by Stahel, to create the highest possible use value for the longest possible time while consuming as few material resources and energy as possible” [STA 97]. PSSs have some specific characteristics, well summarized by Geum and Park [GEU 11]: PSS integrate products and services, combine value creation and environmental performance (measured by a decrease in the environmental impact) and they
also induce a change toward functional economy (the ownership is not transferred to the customer, but rather retained by the producer).

According to the product service ratio that forms the PSS, different types of PSS can be characterized with various sustainability potentials. The following typology (Table 1.1) is usually retained (Geum & Park [GEU 10], Tukker et al. [TUK 04, TUK 06]) and links the type of PSS with functional economy.

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
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<tbody>
<tr>
<td>Product-oriented</td>
<td>Services are just added to an existing product system to guarantee the functionality and durability of the product owned by a customer</td>
</tr>
<tr>
<td>Use-oriented</td>
<td>Services intensify the use of the products. The use or the availability of the product is sold but the product is not owned by the customer (product renting, sharing, pooling)</td>
</tr>
<tr>
<td>Result-oriented</td>
<td>The only true “need-oriented” PSS. A result or a capability is sold instead of a product. One actor becomes responsible for all costs of delivering a result and hence has a great incentive to use materials and energy optimally</td>
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Table 1.1. The typology of product–service systems (Source: [GEU 10, TUK 04, TUK 06])

In addition to the characteristics and typology of PSS, this literature provides methodologies for their design and strategic planning (Aurich et al. [AUR 10], Geum and Park [GEU 10, GEU 11], Morelly [MOR 06]). The definition of design methodologies aims to provide management tools for planning, forecasting and administrating the step-by-step development of PSS. The systemic characteristics of PSS (integration of products and services, involvement of various actors, lifecycle approach) need to be taken into account; in other words, “the effective design of PSS is a key to success” [GEU 11]. The presentation of these design methods and tools goes beyond the scope of this chapter, but nevertheless two important aspects are emphasized. The first is the interaction among the stakeholders of a company induced by PSS development: “a PSS is a social construction” [MOR 06, p. 1496]. The definition of a service itself, apart from its current characteristics (intangibility, immateriality), implies an interaction with the user (Gallouj and Weinstein [GAL 97]). The integration of products and services within PSS and the supply of solutions thus call for partnerships
between different stakeholders, namely customers and providers of parts of the PSS, or of necessary complementary knowledge. Many of the above mentioned scholars stress this point. Some of them propose methods to map the actors involved in a PSS [MOR 06]. The second aspect is the link between PSS and ecodesign, which is also worth noticing. The supply of services is part of an ecodesign strategy: “The environmental impact can be minimized by providing the appropriate service activities during the product lifecycle or delivering the desired function itself, rather than providing the tangible products” [GEU 10, p. 411]. Moreover, Aurich et al. [AUR 10] propose to develop PSS lifecycle management (LCM) methods. They explain that with PSS development, “companies have to shift their focus from designing and selling products only, to supporting and accompanying their usage and end-of-life. So, they have to take care about lifecycle phases that are usually outside the traditional buyer–seller relationship, such as take-back, recovery of products and materials, reuse and refurbishment as well as remanufacturing. Contrary to other business models, the LCM of PSS focuses on the design and the realization of required user functionalities over the whole product life cycle”.

The development of solutions that combine different forms of innovation can also be independent of environmental considerations and a result of the willingness of companies to be closer to the individual needs of consumers. A current example is innovation for the elderly dependent. Several terms coexist to name technologies dedicated to the frail and dependent elderly. The most popular is “gerontechnology” invented by Graafmans in 1989. Gerontechnology, as a scientific discipline, is “the study of technology and aging for the improving the daily lives of the elderly” (Bouma and Graafmans [BOU 92]). But the term also refers to technological products based on ICT, robotics and home automation, and NBIC (nanotechnologies, biotechnologies, artificial intelligence, cognitive sciences). Other terms are also found in the literature such as “gerontechnological innovation” (Neven [NEV 15]), “silver innovation” (Kohlbacher et al. [KOH 15]) and “welfare technology” (Ostlund et al. [OST 15]). They all put forward the technological dimension of innovations.

Within the ICT, the “Internet of Things” corresponds to a progressive transformation of the Internet into an extensive network linking several billion human beings and tens of billions of objects. These connected objects are found in applications across many fields, ranging from of security (connected pendants, fall detectors in the home), mobility (connected
wheelchairs) or health and care services (connected pillboxes). Robotics offers a whole range of robot prototypes (dedicated to security and home protection, rehabilitation). Social service robots can interact with the user and encourage participation in certain activities (travel, domestic tasks, surveillance and entertainment). In the field of health, technologies act on reduced capabilities, notably through cataract surgery, hip and knee arthroplasty, cochlear implants, as well as in the application of genetics, biomaterials and biological engineering (artificial retinas, artificial pancreas, artificial hearts, artificial bladders, etc.). NBIC propose to integrate nanotechnologies with human functions. Cerebral implants are already able to command technical assistants (such as wheelchairs), stimulate the muscles of the disabled or govern technical extensions of the body (via exoskeletons). They thus open up considerable prospects in terms of prolonging life expectancy in terms of good health. Nanotechnologies make it possible to envisage the manipulation of matter for human beings at the molecular level by manipulating atom by atom. Biotechnology has made significant progress in the field of genetic engineering. The increase in computing speeds and the emergence of artificial intelligence make it possible to create automata whose intelligence could ultimately exceed that of man. As such the cross-fertilization of these areas is promising. However, the innovations developed in the Silver Economy are not just technological in nature.

A French study carried out by the Research Network on Innovation (Laperche (ed.), [LAP 16]) – included a survey on the Silver Valley\(^1\) stakeholders in France and a literature review on several technologies (robotics, home automation) and fields of application (food, mobility, care services). It highlighted various forms of innovation, not limited to technology. In particular, 70.6% of respondents said they were proposing “solutions” that combine products, services, new business and new organizational methods (see Figure 1.1). This is the case for home automation solutions: objects connected to the house and associated

\(^1\) Silver Valley is a cluster of private and public players of the Silver Economy, with the objective of creating favorable conditions for the development of a market dedicated to senior citizens, see http://www.silvervalley.fr. The survey of Silver Valley stakeholders from December 15, 2014 to February 10, 2015 (51 respondents), concerned the company profile, the type of activities developed, the resources and innovation strategies implemented, and the constraints facing the dissemination of innovation management.
with support services. This is also the case for elderly care services that may rely on robotics.

**Figure 1.1.** Forms of innovation in the silver economy in France (51 respondents). Source: [LAP 16]. For a color version of the figure, see www.iste.co.uk/laperche/knowledgecapital.zip

This result led us to propose a new term to describe innovations dedicated to the elderly: that of “geront’innovations”. By adapting the OECD definition of innovation (Oslo manual), geront’innovation is defined as “the implementation of a new product (good or service or a combination thereof) or a new or significantly improved process, a new marketing method or a new organizational method that benefits frail, elderly, and/or dependent people” [LAP 16, p. 27–28].

Figure 1.2 represents an “innovation tree”, the scientific fields, the key technologies and the areas covered by the geront’innovations. This representation makes it possible to better understand the process that leads to their development, but also to visualize the domains/sectors in which the geront’innovations, which combine the various forms of innovation, are “flourishing”.
Innovation is therefore increasingly multifaceted and it profits from technical possibilities as offered by interoperability, making it possible to approach as closely as possible the individual needs and demands of each consumer, while seeking to meet new objectives (e.g. taking into account environmental constraints).

1.1.3. How are innovation activities organized? The innovation models

The organization of the many activities that are part of the innovation process (research of scientists and scholars, engineering applications, launching activities by marketing and commercialization services) was first conceived as a linear model in which each of the phases of R&D (basic research, applied research and development) come after one another (see Figure 1.3).
In this figure, each phase pursues a goal and is carried out in a different place (basic research at the university or the public research laboratories, applied research and technological development at the industrial laboratory). The three phases mark the progress of scientific and technical discoveries, from the idea of a product or service to its conception and exploitation. This is the transition from a stock of knowledge produced by basic research through to invention, resulting from applied research, and then in terms of innovation. To quote Kline and Rosenberg [KLI 86, pp. 285–286]: “These events are implicitly visualized as flowing smoothly down a one-way street, much as if they were the ‘begats’ of the Bible”.

The origin of this linear model is often attributed to a report by the Director of the US Office for Scientific Research and Development, Bush’s *Science: The Endless Frontier* [BUS 45]. Yet, as Godin [GOD 06] points out, Bush has emphasized the relationship between science and socioeconomic progress but the report does not give a detailed description of this model. In his article, Godin retraces the history of this model and defines three essential steps. The first began at the beginning of the 20th Century and continued up until 1945, marked by the ideal of pure research and the definition of links between pure and applied research. A secondary stage takes its beginnings in the 1930s up until the early 1960s, when a third term – development – emerged, giving rise to this three-stage model of innovation: basic research–applied research–development. The third period that began in the 1950s extended the model to include production and
dissemination activities. Ultimately, according to Godin, the model owes less to the report of Bush than to the work of the industrialists, consultants, business schools and finally economists who have lately taken up this question. Similarly, the author emphasizes the role played by the production of statistical tools, first by the National Science Foundation (NSF) in the United States and then by the OECD (first publication of the Frascati Manual in 1963) in the stabilization, diffusion and longevity of this model: “Statistics solidified a model in progress into one taken for granted – a social fact” [GOD 06, p. 647]).

However, this model was strongly criticized because it avoided the phenomena of feedback between each phase, or because the role of demand was neglected, coming into play only at the end of the process. It seemed to correspond to the neoclassical theoretical representation of growth in which technical progress and *a fortiori* scientific and technical discoveries are considered as being outside the sphere of the economy. From the 1980s, technical progress and innovation began to be understood as endogenous phenomena within the sphere of the economy. Indeed, interactions (via contracts and the mobility of scientific and technical work) between all types of public and private institutions devoted to scientific and technical activity have been more fully included in the analysis of innovation processes.

These are designed according to interactive and systemic models that emphasize the interactions between the R&D phases and market integration (see consumer tastes, quality requirements) throughout the process leading to innovation (Kline and Rosenberg [KLI 86], Rothwell [ROT 94]); the latter who emphasized five models of innovation since the 1950s). Therefore, in these models, technology evolves throughout its diffusion. The marketing of an invention generally leads to multiple improvements that are essential to its success. Similarly, if scientific developments can lead to innovation, then innovation can also take place without an established scientific theory having preceded it. Kline and Rosenberg [KLI 86, p. 288] cite the example of the bicycle that was an essential innovation, despite the absence of a theory explaining the stability of the man/bicycle couple. We must attribute to Kline and Rosenberg [KLI 86] the best known representation of the interactive model of innovation (see Figure 1.4).
In this model, there is no longer a single path between each of the phases of the innovation process, but rather five paths. The first is the central, linear link between design, production and the market (the central chain of innovation). Nevertheless, the potential market is taken into account upstream of the process; this main path is characterized by the arrows denoted here as C. The second path is juxtaposed to the first by feedbacks f and F, which emphasize the links and the activity back and forth between each stage of the innovation process. Scientific development in the form of knowledge already available (link K) does not appear upstream but irrigates the whole of the central chain. If this knowledge is not sufficient to solve the problems posed in the central chain, then research is mobilized to develop new knowledge (K and R Links); the third path. Of course, science can be at the origin of new technological developments, which will most often be radical in nature (arrow D); this is the fourth path of innovation. The last path, symbolized by arrows I and S, highlights the fields that technological innovations can open for research.
In this model, the different phases of research are intertwined, to the point that the terms basic research, applied research and development have disappeared in favor of “research” or “R&D”. This is due to the growing rapprochement between the academic world and the business world. On the one hand, universities and public research centers have as their new mission (the “third mission”) the commercialization of research (we will return to this in Chapter 2), which should strengthen their contribution to economic growth and enable them to build up autonomous budgets. This impels them to not only carry out fundamental research but also applied research more likely to appeal to investor companies. The pivotal period of the 1970s was marked by the exhaustion of Fordist modes of production, based in particular on the mass production of standardized goods. This model, dominant in the postwar years of growth, justified price competition. It was well suited to a linear model of innovation, where the major programs of basic and applied research, especially in the military sector, provided techniques that could be developed on a large scale in the form of new products and processes. The crisis of the Fordist model (which in particular reflects the saturation of the demand of national markets for standardized capital goods) has gradually led companies to differentiate their offering. Innovation has thus become a key element of their strategy. In the 1980s, the openness and liberalization of markets (goods and services, finance, labor) made innovation the driving force behind the competition between firms on the world market stage. Hence, the willingness of companies to cooperate more closely with public research, on the one hand by increasing their internal research staff and on the other hand by financing public research in order to access as soon as possible, and possibly exclusively, its results. To the extent that, it is becoming increasingly difficult to define the exact border where basic research ends and applied research begins. Finally, the market no longer appears at the end of the chain but tends to be taken into account upstream of any innovation project. Market research has become the key element of any business venture. Advertising helps to shape consumer needs and choices, as well explained by Galbraith in the late 1960s [GAL 74].

The nature of technological change is another factor that explains the increasingly fuzzy boundary between the various phases of R&D and justifies the existence of an interactive model of innovation. In biotechnology or in genomics, for example, the boundary between the R&D phases is increasingly tenuous. Research carried out in universities and public research centers therefore almost naturally combines the theoretical and practical aspects and makes the results potentially exploitable; hence, the emergence of numerous university spin-offs (Droganova [DRO 12]). These
fields of research that combine theory and practice are now increasing in number. For example, linguistics is traditionally regarded as basic research; nowadays, however, it is closely associated with software advancements being made in the computer industry. The researchers’ awareness as to the possibility of linking the two activities together, in view of the financial resources generated by the commercialization of their research results (which will be able to finance their future research), has accelerated the association between basic research and applied research.

However, according to Godin, models that are alternative to the linear model, such as the interactive model, are more like “modern art” than a true analytical framework [GOD 06, p. 660]. This is due to the fact that innovation indicators still correspond to the linear model of innovation; indicators that seek to measure knowledge flows and the interactions between actors in the innovation process are still under construction. The longevity of the linear model is also, as Joly [JOL 17] explains, in the definition of public policies of innovation. An example of such is set by the Lisbon strategy, whose objective was to reach 3% of European GDP. The implicit or explicit assertion of that policy is that “Science is the solution, society the problem”: science will develop because of more R&D investment and innovation will be successful if the society becomes more entrepreneurial and more enthusiastic about new technologies [JOL 17, p. 84]. In addition, it is in the interest of innovation stakeholders to remain committed to this linear model. Since the linear model values basic research, some researchers seek to maintain it as it is. This is also true of firms who are the main beneficiaries of public innovation policies, which allocate a high share of support (through tax credit for example) to R&D performers. One of the reasons for the longevity of the linear model also lies in its simplicity of comprehension and use, as the two authors we have cited emphasize. In the same reasoning, we can refer to the fact that in the management of their innovation projects, companies (mostly large ones) very often use a “linear” scale developed by NASA in the 1970s (and extended since) (Mankins [MAN 09]). This Technological Readiness Level (TRL) scale was originally intended to be a tool for evaluating technological programs, showing the different stages of their maturation, and has been adopted by many organizations, both public institutions and firms. It consists of nine stages, from the most basic research (TRL1) to the application of technology in real-world conditions (TRL9).
Assessing Specific Technology "Functional Maturity"  
Technology Readiness Levels (TRLs)

Figure 1.5. Scale: technology readiness levels. Source: [MAN 09]

While the practical application of the interactive model of innovation is not widely observable, it has however become an analytical and conceptual norm. It paved the way for the analysis of the interaction networks inherent to the innovation processes.

1.1.4. Measuring innovation

Innovation is a multifaceted phenomenon and cannot easily be confined to a standard indicator, as is the case for example, in measuring economic growth which despite the limitations of this indicator is demonstrated by the gross domestic product. R&D and patents have long been regarded as key indicators of innovation, the former measuring the means allocated to innovation and the second measuring the results of the activity.
The measurement of R&D is based on data collected from companies and research organizations according to the codification carried out by the seventh edition of the Frascati Manual, published in 2015 [OEC 15a]. A distinction is made between gross domestic expenditure on R&D (GERD), which refers to total expenditure (current and fixed capital) on R&D performed by all enterprises, the State, higher education and the private non-profit sector of the economy. These expenditures include R&D financed from funds abroad, but exclude the financing of R&D activities performed abroad. This indicator is expressed in millions of U.S. dollars and as a percentage of GDP [OEC 15, Chapter 4]. It can also be broken down by measuring the Business Enterprise Expenditure on R&D (BERD) or Higher Education Expenditure on R&D (HERD), the State sector and private non-profit institutions expenditures in R&D. The intensity of R&D is measured by the ratio of R&D expenditure to GDP for a country or the ratio of R&D expenditure to turnover for companies.

The global R&D capacity, as measured by public and private investment, doubled during the period from 1990 to 2014 (Figure 1.6(a)). This increase in global R&D capacity can be explained in particular by growth in business spending, which has expanded faster than public expenditure in R&D (Figure 1.6(b)). The financial crises that marked the period (the crisis of the emerging countries in the early 1990s, the start-up crisis of the new economy in 2001 and the financial crisis of 2008) have led to cyclical reductions in companies’ R&D investments. However, the behavior of companies is rather counter-cyclical, in that they rely on innovation to restart the growth of their activities. This was confirmed following the 2008 crisis by several quantitative and qualitative studies (Archibugi et al. [ARC 13], Laperche et al. [LAP 11]). The strong growth in overall R&D investment over the period from 1990 to 2014 is also explained by the sharp increase in spending in emerging countries such as China, which can be compared to the decline in the triad countries: the United States, Europe and Japan.

One of the major limitations of this indicator is that R&D is mainly focused on science and technology and it has difficulty capturing spending so as to bring about other forms of innovation, such as organizational or marketing innovations. Services that make up an important part of the new solutions offered by firms are better measured by the marketing expenses, which do not even come into the measurement of R&D. Also, expenditures by small firms (which rarely employ researchers) for organizational or
commercial innovation are not recorded and as such are not considered as innovative. This is true, for example, in the agri-food sector, which is traditionally considered to not be very innovative, while finer indicators show that innovations are numerous (Tanguy [TAN 16]).

![Figure 1.6. R&D investment over the period from 1990 to 2014. Source: OECD [OEC 16a]. For a color version of the figure, see www.iste.co.uk/laperche/knowledgecapital.zip](image)

Patent is an industrial property right granted to an inventor for a period of 20 years, often used as a result indicator for innovation performance. It has the advantage of being an indicator that is both available and reliable and whose databases are public since it is managed by national intellectual property institutes. Worldwide patent filing statistics show strong growth in patent filings from the 1970s (Figure 1.7). Patent filings tripled between 1985 and 2014. While the Triad countries for a long time used to attract the most patent filings, China has since surpassed them, by quite a lot since the early 2010s, showing at once the attractiveness of this country for the exploitation of inventions but also the strengthening of its capacities for innovation.
However, as an indicator of innovation, the patent also suffers from many limitations. First, it only measures the “inventions” that are subject to patent filing, leaving aside all other possible forms of innovation. Many inventions are also not patented, especially if they do not meet the novelty, inventive step and industrial application criteria. A useful but not new invention (already incorporated into the state of the art, that is, all that has been made public at the time of filing) will normally not pass the report stage of research carried out by the industrial property institute. Moreover, a registered patent does not always result in an innovation, that is, a new product launched on the market, or a new process integrated into the production process. Many patented inventions remain unexploited, often for strategic reasons. Patents are used as “lures” intended, for example, to deceive competitors on the technological trajectories being pursued. Dormant or submarine patents are also very common. In this case, patents are not exploited because the outlook for profits is lower than the costs incurred by placing the product on the market. The company holding the patent may also lack the resources necessary to exploit the invention. It may prefer to wait for the complete profitability of the preceding invention before launching a new one (in such instances we can speak of technological Malthusianism) (Walsh et al. [WAL 16]). Criticism was also expressed about the quality of patents, particularly those issued in the United States in the years 1990–2000, given the favorable attitude of the country to inventors. In fact, the criteria for patentability have in many instances been poorly respected, leading to the proliferation of low-quality patents and numerous disputes and trials. In any case, the statistics would thus be distorted by the
multiplication of these “rotten” patents. Another difficulty related to the measurement of patents lies in the fact that patents are only effective tools of protection in the countries where the protection has been claimed (apart from the unitary patent in Europe, the use of which is still dependent on the ratification of certain agreements among signatory countries). To avoid counting them several times, statisticians have therefore defined an indicator called a patent family, which refers to a set of patents filed in several countries (i.e. patent offices) that protect the same invention. For example, the “triadic patent families” are a set of patents filed with three of the main offices, namely the European Patent Office (EPO), the Japanese Patent Office (JPO) and the United States Patent and Trademark Office (USPTO) (OECD [OEC 05]).

On this basis, World Intellectual Property Organization (WIPO) conducted a study of the 100 largest patent filers in the world based on the number of patent families between 2003 and 2012 [WIP 15]. These are from Japan (55), the Republic of Korea (15) China (10), the United States (9), Germany (5), Taiwan-China (1) and France (1). The list is made up mainly of multinational firms but includes four Chinese universities among the top 100. The main sectors are ICT, electrical machinery and the transport sector. Japanese companies dominate the top 10 (see Table 1.2) and the company Panasonic is ranked as the top patent filer in the 2000s, as was already the case in the 1990s and 1980s. The only French company in the top 100 is Peugeot-Citroen, ranked 75th with 8,679 patent families over the period of 2003–2012.

Of course, indicators of innovation are not limited to these two indicators. The number of researchers, the number of scientific publications and the sums of venture capital invested in the financing of innovative enterprises, other types of intellectual property rights (trademarks, designs and models), the turnover from innovation, the dissemination of key technologies, etc., are also counted. This better understanding of the innovation process results, not with a reduction in the study of traditional indicators, but with a refinement of the evaluations used to measure the efforts and performances of innovation by using other indicators. For example, at the level of the company, statisticians seek to better measure non-R&D intangible investments (e.g. software and databases) or the interactions being developed with other companies or institutions (see [OEC 10]). At the country level, indicator tables and synthetic indicators are also used to measure innovation.
<table>
<thead>
<tr>
<th>Applicant</th>
<th>Origin</th>
<th>Total number of patent families (2003–2012)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panasonic Corporation</td>
<td>Japan</td>
<td>111,653</td>
</tr>
<tr>
<td>Samsung Electronics</td>
<td>Republic of Korea</td>
<td>95,852</td>
</tr>
<tr>
<td>Canon</td>
<td>Japan</td>
<td>74,193</td>
</tr>
<tr>
<td>Toyota Jidosha</td>
<td>Japan</td>
<td>73,220</td>
</tr>
<tr>
<td>Toshiba</td>
<td>Japan</td>
<td>65,151</td>
</tr>
<tr>
<td>LG Electronics</td>
<td>Republic of Korea</td>
<td>64,593</td>
</tr>
<tr>
<td>Seiko Epson</td>
<td>Japan</td>
<td>62,305</td>
</tr>
<tr>
<td>International Business Machines (IBM)</td>
<td>United States of America</td>
<td>45,473</td>
</tr>
<tr>
<td>Ricoh</td>
<td>Japan</td>
<td>45,306</td>
</tr>
<tr>
<td>Sony</td>
<td>Japan</td>
<td>44,261</td>
</tr>
</tbody>
</table>

**Table 1.2. Top 10 patent filer in the world (2003–2012).**
*Source: [WIP 15] (extract from the top 100)*

The European Innovation Scoreboard (which has existed since 2001), for example, provides a synthetic indicator that allows countries to be ranked according to their innovation performance. Four categories of countries are defined: modest innovators, moderate innovators, notable innovators and champions of innovation. The results for 2016 are as follows.

Sweden, Denmark, Finland, Germany and the Netherlands appear to be the champions of innovation, positioning themselves at least 20% above the European average. Notable or strong innovators include Ireland, Belgium, the United Kingdom, Luxembourg, Austria, France and Slovenia. Their results are slightly higher or nearer to the European average. The performance of moderate innovators is between 50% and 90% the European average. This category includes many countries in Eastern and Southern Europe such as Cyprus, Estonia, Malta, Czech Republic, Italy, Portugal, Greece, Spain, Hungary, Slovakia, Poland, Lithuania, Latvia and Croatia. Finally, the modest innovators, Romania and Bulgaria, perform 50% below the European average.
This synthetic indicator – the Summary Innovation Index – is based on three main categories of indicators (enablers, firm activities, outputs), which have eight dimensions of innovation: human resources; open, excellent research systems; finance and support; firm investments; linkages and entrepreneurship; intellectual assets; innovators and economic effects. In total, the average results of the countries are measured on the basis of 25 indicators (see Figure 1.9).
Such an indicator makes it possible to monitor the performance of the European Union according to each country over time, but also serves as a guide for the definition of public policies that can be adapted to address the specific problems encountered in each country. One notable outcome is that the innovation champions perform similarly in each of the eight dimensions of innovation measured. As such, this result reinforces the opinion that the overall strength of the national innovation system plays a key role in the performance of innovation.

The opening of innovation’s black box thus reveals many activities, which are articulated and measured in several ways. In order to create new products, processes, marketing methods and types of organization, the company must constitute a “knowledge capital”. The next step is to better understand its origins and the roles it plays in the activities of firms.

1.2. Knowledge capital: definition and roles

1.2.1. From scientific and technical knowledge to knowledge capital

Knowledge is traditionally linked to the individual and is acquired by a continuous mental activity. This first definition focuses on the production of knowledge. Within the firm, innovation must therefore be thought of as an endogenous process: it is the result of a motivated investment in human resources (researchers, engineers), material (scientific and technical instruments, machines) and intangible ones (R&D databases, software). This investment contributes to produce knowledge that will eventually be transformed into goods, services and processes. However, this definition hides all the economic intelligence activities, which are nevertheless essential.

Indeed, the composition of what we call Knowledge Capital requires the research and acquisition of scientific, technical and commercial information that can not only enrich, but also shape or systematize the knowledge being produced within the company. We can therefore define the scientific and technical knowledge of the company as a set of acquired knowledge combined with the scientific, technical and commercial information gained through productive activities and continuous economic intelligence.
To understand this, it is useful to recall the difference between *information* and *knowledge*. This can be studied as a difference in terms of content of knowledge, information and data. It can also be based off of the way of measuring each of them. In the first instance (see Figure 1.10), knowledge appears as a nested “Russian doll”. It is defined as a set of formatted information. Information corresponds to a set of data and the data corresponds to a set of facts.

![Diagram showing the relationship between knowledge, information, and data](image)

**Figure 1.10. Knowledge: a Russian doll. Source: Author**

While this approach is interesting, it may itself be restrictive in the application of terms. Economists have highlighted the common characteristics of information and knowledge and have often treated them in a synonymous way. According to Machlup [MAC 84], knowledge (the same applies to information) is characterized by a high fixed production cost and a zero or near-zero reproduction cost. This is explained by the characteristics attributed to these specific goods, in particular their non-exclusiveness (i.e. the impossibility of excluding users even if they do not contribute to the financing of the good) and non-rivalry (which means that the consumption by one individual does not diminish the amount available to others). Hence, as scrutinized by Arrow, the problems of incentivizing firms to invest in knowledge production [ARR 62a]. However, these properties of knowledge and information are somewhat altered when strategies of appropriation are
implemented by companies and supported by public authorities. We will come back to this point further on.

Others have sought to highlight the differences between information and knowledge and thus to dissociate them by relying precisely on the meaning given to information by cybernetics, that is to say, a set of data. For example, Foray states that “knowledge is fundamentally a matter of cognitive capability. Information, on the other hand, takes the shape of structured and formatted data that remain passive and inert until used by those with the knowledge needed to interpret and process them” [FOR 04, p. 4].

A second perspective on how to differentiate the two terms – which is not incompatible with the previous view – is by looking at how knowledge and information can be accounted for: knowledge can be viewed as a stock and information as a flow. This recognition makes it possible to distinguish the internal production of knowledge (knowledge as a stock) and the activity of economic intelligence that feeds the process of knowledge production. Knowledge (stock) and information (flows) thus appear to be complementary.

Knowledge is associated with the individual. It is the fruit of the intellectual processes of understanding, learning and behavior. Therefore, knowledge is first and foremost embodied in individuals and in the collective memory of the social whole. In the case of the firm, scientific and technical knowledge is incorporated into the individuals (knowledge and expertise of researchers, engineers, workers) and in the collective memory of the company (“routines” if we adopt evolutionary vocabulary, translated for example into specific production procedures). It is also incorporated into the machines, objects and products created by the members of the company and used in its scientific and technical activities.

Knowledge, but also information, can be codified, that is, written and indexed, and made explicitly available in a “directory” or it can be tacit. According to Polanyi, tacit knowledge expresses the idea that “we can know more than we can tell” [POL 66]. It is contained in the know-how of individuals and transmitted through learning by doing (Arrow [ARR 62b]), using (especially advanced technologies) (Rosenberg [ROS 82]) or interacting (Lundvall [LUN 92]). The role of tacit knowledge is fundamental as it makes it possible for the company to appropriate the knowledge capital
that it holds; however, this makes it more difficult, for example more time-consuming to diffuse knowledge to competitors.

The example of the chocolate mousse recipe makes it possible to differentiate between the codified and tacit character of the knowledge.

On the website www.marmiton.org, the recipe for chocolate mousse is as follows:

- “separate the whites from the yolks”;
- “soften the chocolate in a saucepan in a bain-marie”;
- “remove from heat, then add yolks and sugar”;
- “beat the whites into a firm white peak and gently fold into the mixture with a spatula”;
- “pour into a bowl or dessert glasses and cool for 1 or 2 hours minimum”.

This recipe is, presented like this and for the novice in the kitchen, codified information. If the novice tries to reproduce it, s/he will implement a learning process and this recipe will become knowledge for him. Nonetheless, will it lead to the desired result, which in this case is the creation of aerated chocolate foam and not a chocolate cream? Indeed, “tacit” elements are hidden in this recipe. In particular, the phrase “beat the whites into a firm white peak and gently fold into the mixture with a spatula” is essential. It is sufficiently explicit for those who have already practiced chocolate mousse (they already have the know-how, obtained through learning by doing) or for those who have watched the gestures made by someone else (learning by interaction). For the novice, gently folding the mixture with a spatula can lead to “breaking the white peaks” if the gait of the spatula, which must “roll” around the white peaks, is not respected... This key element is tacit knowledge, which is difficult to explain and is held as know-how by the one who has gone through the learning process. If this know-how is not acquired, the result will not be a mousse, but a chocolate cream!

The same reasoning can be applied to freely circulate patent documents. The invention that a patent document contains must be reproducible by a person skilled in the art in question. Here again the reproduction cannot be instantaneous because of the tacit knowledge that must be acquired through learning, a process which is often long.

**Box 1.2. Codified knowledge, tacit knowledge and chocolate mousse**
The company’s scientific and technical knowledge thus forms a stock that can be used by the company. This stock is constantly evolving in a changing economy and this trend tends to call into question the existence of a zero marginal cost, which would go hand in hand with the identical reproduction of the stock of knowledge.

Scientific and technical information, as a flow, thus appears as both an input and an output of knowledge (see Figure 1.11). Information and knowledge are therefore neither synonymous, nor dissociable: they are complementary. Information is a written, visual or audible description of knowledge, codified or tacit. It consists of images, published and disseminated, of events, behaviors and facts of the physical, biological, natural and human world. The word ‘information’ comes from the Latin informare (date of apparition: 1190). It essentially means to give a form, a meaning. Information is thus endowed with a structuring power.

Knowledge and information are thus intrinsically linked: the flow of information entering the company has a structuring power over the accumulated knowledge. This information flow allows for the organization of accumulated knowledge for a specific purpose: to create a new product, for example. However, knowledge, like information, is the fruit of work. Knowledge implies work that is theoretical but also practical, aimed at improving the understanding of natural and social facts. Information describes and disseminates this knowledge produced by work and involves additional work in selecting the most relevant knowledge elements. This means that information is the disseminated result of knowledge.

Not all knowledge will become information. Either because it has not reached a sufficient degree of formalization to be able to achieve a better understanding of natural and social facts (knowledge is still only a series of hypothesis), or because it is of no immediate use for the purpose of commercial transformation of individual or collective knowledge.

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2 This meaning is first granted to the verb “to inform” in the dictionary of Furetiere “To give the form”. It is found in Littre (19th Century) for the word “information”: “Philosophical term. Action to inform, to give form”. The verb “to inform”, in the proper sense, is a “Philosophical term. To give form”, and figuratively, “Gives form to the mind and consequently warns, instructs”.

In order to arrive at the notion of knowledge capital, attention must be paid to the specific use of knowledge by the firm. In what case can a resource be classified as capital? When it is used in a production process. This is the case, for example, with science, which, when integrated into production, becomes a productive force of capital (Marx [MAR 67], Uzunidis [UZU 03]).

We can define the knowledge capital as the set of scientific and technical information and knowledge produced, acquired, combined and systematized by one or several firms within a particular productive objective and, more broadly, within a process of value creation. Knowledge capital (see Figure 1.12) refers to the accumulated knowledge of one or several linked firms. It is embedded in the individuals (know-how), the machines, the technologies and the routines of the enterprise. It is continuously enriched by the information flows and is used in the production process or, more globally, in the value creation process. The knowledge capital is more than the sum of its parts: a process of cross fertilization between all the sources of information and knowledge makes it so that the return from the use of this combined set of information and knowledge is higher than the return from the use of these pieces of information and knowledge taken separately. Thus, knowledge capital is a dynamic concept – a process – that defines the knowledge accumulated by one or several firms and which is continuously enriched and combined in different ways. This productive aim – the creation of value – is the main characteristic which turns knowledge into “capital”.

**Figure 1.11. Information, input and output of knowledge. Source: Author**
Studying the knowledge capital of firms makes it possible to understand how they generate new knowledge and how they transform this knowledge into (technological, organizational and commercial) innovation. The information is collected on markets through intelligence strategies, through access to patent information, through the purchase of technology, and the signing of licenses and other cooperation contracts. It is integrated into the knowledge stock through learning processes, which are the basic elements in the transformation of information (flow) into knowledge (stock). The use of the knowledge stock depends on the market and production opportunities, and on the degree of maturity of the developed technologies.

The concept of knowledge capital is mainly analytical and aims to go deeper in its understanding of the content of the black box that is the firms’ innovation process. It thus complements but also differs from the “knowledge-based capital” (KBC) recently developed by the OECD [OEC 13a]. The aim of the KBC concept is to list and better measure the intangible assets invested in by firms, such as data, software, patents, designs, new organizational processes and firm-specific skills. They are divided into three groups: computerized information, innovative property and economic competency (see also Corrado et al. [COR 05]). Another division is often kept in mind when dealing with “intellectual capital” (IC), broadly defined as a sum of useful knowledge that can be converted into value (Edvinsson and Malone [EDV 97]): human capital (knowledge, know-how, life skills), relational capital (external relations with clients and suppliers) and structural
capital (databases, organizational routines, culture) (Mignon and Walliser [MIG 15]).

The ultimate goal of the KBC or IC concepts is to provide evidence for the economic value of intangible assets; that is to say, to study their impact on growth, productivity, competitiveness and innovation of firms in order to promote policy measures adapted to a broad vision of innovation. However, according to Zambon and Monciardini [ZAM 15], most studies on this subject are focused on the measurement and reporting of intangible assets and neglect the analysis of their specific role in the value creation process.

They are, nonetheless, useful concepts since they allow for the quantitative assessment of the contribution of intangible assets. In this sense, they complement our approach to the firm’s knowledge capital, and the need to be more accurate in the listing of intangible assets that contribute to innovation. However, these certainly need to be linked to other managerial concepts if they are to lead to a dynamic vision of the innovation process, as also suggested by Užiené [UŽI 15]. Moreover, although intangible assets are crucial to the firm’s innovation strategy, tangible ones also contain knowledge as a form of dead labor, included in tools, machines and production processes. These tangible assets are, according to us, essential to the innovation process, as much as the intangible ones. Our concept of knowledge capital in this regard therefore has a larger scope.

The use of knowledge capital in the process of creating value in the enterprise can take two forms:

– the sale of this knowledge capital to another company (for example the sale of software). In this case, the knowledge capital is transferred to another company (and others) that will use it in its production process;

– the use of this knowledge capital in the company’s own production process. In the second case, knowledge capital can be considered as both a means of producing goods, as a tool for cohesion of worker collectives (or teams) and as a tool capable of reducing the time that the production process usually requires. It is these forms of productive use that we are interested in for the rest of this section.

1.2.2. The productive use of knowledge capital

Our approach to knowledge capital can be described as dynamic. Knowledge capital is constantly changing and it is this constant
transformation that justifies the importance that it bestows on companies. At the origin of this dynamic process is scientific and technical information in particular, but there is also commercial information. It is through the structuring power of information that knowledge capital becomes a means of producing new commodities. It is also because of information that it acts as a means of cohesion within groups or “work collectives”. The acquisition, processing and dissemination of some of the information contained within the knowledge capital finally makes it possible to reduce the process time of production as well as the placing of goods on the market.

1.2.2.1. Knowledge capital and the production of new goods and services

The scientific and technical information and knowledge that make up knowledge capital have been, since the beginning of industrial capitalism, essential inputs in the production of new commodities. This is the first aspect of its role in the production process. Information has an organizing role: integrated into a stock of knowledge, it allows one to orient it for a different application, or as a means to strengthen the existing one.

The constitution of knowledge capital requires the gathering of various inputs; that is to say, human resources (researchers, engineers), materials (machines, tools) and information (patents, software and free information databases). The company seeks to integrate new scientific and technical information and knowledge that will in turn enrich the knowledge already accumulated through the use of various means: the salary of the personnel, the activity of economic intelligence, the cooperation with other firms and external institutions, and the intramural and extramural execution of research development. We shall return to these in Chapter 2, which will explore the evolution of knowledge capital formation strategies over time.

The combination of new scientific and technical information to the knowledge already accumulated by the company makes it possible to use it productively, by developing new products and services or by improving them. Therefore, the protection of this knowledge capital is fundamental. The performance of firms depends on their capacity to appropriate this knowledge capital and generate income from it. The appropriation of knowledge by the firm begins with the sphere of production and signifies the formation, the productive use and the protection of this knowledge as capital. The protection of knowledge capital is the subject of rigorous strategies (use
of intellectual property, secrecy, lead time over competitors). For more on this topic, see Chapter 3.

1.2.2.2. Knowledge capital and the cohesion of work collectives

Knowledge capital also plays a key role in the cohesion of working groups. Durkheim at the end of the 19th Century coined the concept of “organic solidarity” that results from the learning processes, which gives the working group its truly collective character. The work collective, or “collective worker” in Marxist terminology, is at the origin of the processing of scientific information acquired outside of the company, and therefore of the enrichment and (re)production of knowledge capital. It is also this working group that ensures the productive use of knowledge capital.

The work collective is a result of the interweaving of the fragmented scientific and technical know-how of the paid employees. The circulation of scientific and technical know-how and information within the working group in turn conditions the existence, functioning and cohesion of the work collective. The latter, once well defined within the boundaries of the firm, is at the time of the network firm and open innovation, extended beyond its borders (see Chapter 2). Therefore, the diffusion of knowledge capital to beyond the boundaries of the company is fundamental to ensure the cohesion of its teams. Scientific and technical information can then be studied, taking into account the terms developed by information theory and cybernetics, as a means of controlling, commanding and directing work collectives toward clearly defined goals in the same way that information typically plays this role within the machine or within society in general (Wiener [WIE 48]).

Knowledge production is increasingly taking place within knowledge communities (Amin and Cohendet [AMI 04]), a unifying term that helps understand the different forms of communities (e.g. communities of practice, epistemic communities). At the origin of the concept, communities of practice (Brown and Duguid [BRO 91], Lave and Wenger [LAV 91]) present themselves as informal groups of individuals making exchanges in terms of practices within the framework interactive norms built via learning, without hierarchy and production of knowledge in specific areas. The typical example is that of open-source communities. As explained by Barbaroux et al. [BAR 16], companies are increasingly aware of the importance of these knowledge communities as a vehicle for innovation. The example
developed in the literature is that of IBM, which gave birth to the notion of communities of practices, where the company “looks for the alignment between the activity of a community and its strategic orientations, while preserving the self-organized and spontaneous character of the community” [BAR 16, p. 77]. In other words, we could say that the goal is to take advantage of the creativity that is a result of this type of organizational flexibility, in the form of a community, in order to strengthen the firm’s knowledge capital.

These multiple roles of knowledge capital justify corporate investment in its constitution and protection. Then again, in modern times there is an increase in the dissemination of scientific and technical information being integrated into advertising, and via sophisticated and rapid tools (e.g. the Internet). In other words, modern communication accelerates the dissemination of information. The quest for information, but also its increased diffusion, is explained by the fact that knowledge capital is not only used, even if it is its primary role, as a means of creating value during the productive process. It is also used to reduce the duration of the entire production process, whether at the investment stage, the production stage or the marketing of the goods.

1.2.2.3. Information processing and decision-making in the era of big data

The work of acquiring and collecting new information available on the market and integrating it into the knowledge capital takes the form of economic and technological intelligence activities (consultation of patent databases, trade fairs, specialized press, data processing). These activities give to companies the possibility increasing the speed of their technological, productive and commercial choices as well as avoiding errors and redundancies.

This activity of research and information processing has always existed in the world of business. As early as the 17th Century, then big commercial companies were already sending out informants on horseback across Europe to find out the economic evolution and consumer tastes. However, it has taken on new dimensions along history and in this era of Big Data (see Box 1.3).

This activity of processing data and scientific and technical information, which is already organized as a system (for example patent documents), or which is not, such as intermediate results of scientific works, etc., also accelerates the choice of the means of production that the company must
acquire in order to implement the production. The greater speed of information (due to advancements in the means of communication) also limits the delivery time of the means of production, in particular those which take an immaterial form (software, databases, etc.). Furthermore, the globalized organization of firms (see Chapter 2) makes it possible to monitor internationalized technology and recruit skilled personnel, rich in “human capital” and therefore in scientific and technical knowledge, wherever they may be found. The selection of future employees is facilitated by collection and processing of information in various locations.

To define Big Data, it is usual to refer to the four Vs: volume, variety, velocity, value. A fifth V can also be considered: veracity. With information technologies (Internet-related), new media (tablets, mobile phones, connected devices) and the multiple sources and forms of information, the amount of data a firm has to manage has reached a very large size and requires new approaches and tools (such as data- and text-mining, profiling techniques, visual analysis) to store, process and utilize them. The term Big Data refers to “a set of methods and tools used to process and interpret large quantities of data that are generated by the increasing digitization of content, the monitoring of human activities and disseminating the Internet of Things” [OEC 15b]. These are processes and techniques that enable organizations to create, manipulate and manage data on a large scale (Hopkins and Evelson [HOP 11]), as well as to extract new know-how in order to create new economic value (Monino and Sedkaoui [MON 16, p. 10]). It also gives rise to new professions, such as the Data Scientist, whose mission it is to sort data and transform it into information that can feed into the company’s stock of knowledge.

These Big Data technologies, according to the OECD [OEC 16a], are among the ten most important technologies in the economy and society. They offer opportunities for companies to both manage their activities and improve their decision-making, but also to adapt the offer to the needs of consumers. Companies’ interest in these techniques can be found in patent filings (linked to Big Data technologies, the Internet of Things, quantum computing and telecommunications), which, according to the OECD, has seen double-digit growth rates in recent years.

**Box 1.3. Processing information in the era of big data**

During the production process, delays are also reduced through the use of sophisticated technical methods (the Internet, intranet, databases), which multiply the flows of codified scientific and technical information. The
internal dissemination of scientific and technical information thus consolidates the work collectives and increases labor productivity.

1.2.2.4. The regulated dissemination of knowledge capital

Finally, the external dissemination of some of the information that constitutes knowledge capital makes it possible to reduce the time needed to market the goods and services produced by the company. In order to sell the goods, the company of today distributes scientific and technical information (not exclusively, but these are a decisive part of the disseminated information, which also concerns price, form, etc.). This information lends credibility to the product, to educate consumers (or to define and make fundamental the use of the goods) and to retain them (in a period of great uncertainty, the risk involved will be reduced). Advertising that conveys scientific and technical information was used early on by industrialists to accelerate the sale of goods and to consolidate their power in the market, and still, the current technical means of communication strengthens this power. The large-scale processing of collected data also makes it possible to adapt an offer to the needs of the consumer. For example (Monino and Sedkaoui [MON 16, p. 27]), by collecting and processing the histories made by consumers on its website (purchase and search history), Amazon in turn can offer them a range of targeted literature. Nike on the other hand offers its customers a complete ecosystem in order to manage their physical activity, which also gives them the possibility of suggesting specific products to them.

This dissemination of scientific and technical information is also followed by the job of collecting and analyzing the impact on the consumer. Opinion surveys, questionnaires, etc. serve as a basis that will guide the next cycle of productive capital development. These direct the productive work (design, production) but also the choice of the means of production upstream and the employees best able to develop them. The innovation process, which is now interactive and no longer linear, explains the increasing intertwining of the stages of the production process and of all the activities being carried out (scientific work, productive work, marketing work). The collection and dissemination of information, usually considered as characteristic of the commercialization stage now serves as a basis for the new production process, and takes place at the investment stage, even before the actual production of goods. The aim is to shorten further still this difficult stage of the transformation of commodities into cash.

The time required to complete the production process will depend, of course, on market prospects: supply and demand. But it can be technically
reduced by the voluntary dissemination of scientific and technical information, which encourages a more rapid resumption of the production process.

1.3. The theoretical origins of knowledge capital

The concept of knowledge capital is based on the definition and evolution of three key concepts in economics and management science: Knowledge, The Firm and Capital. The contributions of contemporary theories of the firm and of innovation are decisive for the better understanding of knowledge capital. Nevertheless, the contributions of pioneering economists must also be highlighted.

1.3.1. Contemporary theories of the firm and of innovation

It is possible to backdate contemporary economic analyses of the firm to the 1930s, when the first published works began challenging the validity of the assumptions of pure and perfect competition. The neoclassical approach, dominant since the end of the 19th Century, reduces all production activity to simply a technical production function linking input (raw materials, services) to output (finished products) and a company to an individual, at the same time its owner and its manager. Similarly, neoclassical economists first considered technical progress as outside the sphere of the economy (this is called “exogenous technical progress”, that is to say technical progress acting as a *deus ex machina*). In neoclassical growth models (Solow [SOL 56, SOL 57]) technical progress is a residue of the production function whereby the fundamental factors of production are capital and labor. Knowledge has long been regarded as a non-appropriable, public good.

Berle and Means [BER 32] broke from the neoclassical identification between the owner and the manager of the firm, in the context of the concentration phenomenon in the United States, which led to the domination of large firms in the markets. The works of Robinson [ROB 33] and Chamberlin [CHA 33] also questioned the existence of pure and perfect competition, thus permitting a better understanding on the variety of firms (in terms of size and economic strength). It was also in the 1930s that Coase published the article *The Nature of the Firm* (1937), which addressed the simple question “why does the firm exist?”. Considering that the market is imperfect, he defined the firm as a form of administrative coordination,
alternative to market coordination. Market coordination, which is achieved through the price mechanism, is a source of costs: search and information costs (finding adequate prices); bargaining and decision-making costs (costs of negotiating separate contracts); policing and enforcement costs (costs related to supervising other parties’ actions). These costs – to be later termed as “transaction costs” – are eliminated by the firm, which for Coase therefore justifies its existence. Although it had little influence at the time, this article was resumed by Williamson in the 1970s and marks the birth of transactional approaches.

Multiple approaches on the enterprise, along numerous lines of diverse interrogations, were developed during the 20th Century. But to what extent do these theories allow us to understand and analyze the contemporary realities facing the firm, and which can be summarized in a few key words: innovation, networks, globalization and finance? To what extent do they enable us to better understand the needs and modalities for the composition and use of knowledge capital by firms?

Different theoretical approaches developed during the 20th Century sought to overcome or enrich the neoclassical approach, which reduces the firm to an individual, imbued with perfect rationality (that implies a complete knowledge and understanding with which to choose among all the available alternatives, and the ability to evaluate and compare both the current and future consequences for each of these alternatives) and capable of logically pursuing the objective that best maximizes profits. This objective stems from an ideal vision of the functioning of markets, in which the pursuit of self-interest serves the general interest. The absence of a theory of the firm (that is to say, the firm considered as a “black box”) is explained by the major questions raised by this school of thought – market efficiency and price mechanism – which occur in the sphere of the market, as opposed to the sphere of production.

We can consider that the theories of the firm during the 20th Century have in essence taken two paths (even if some of these approaches have a somewhat hybrid status): some of them, those relying on the questioning of perfect rationality, consider firms to be complex organizations whose decision-making processes, power structures, factors of differentiation and evolution, must be explained. These contributions are essential for understanding the role and methods of building the knowledge capital. The other group seek to enrich the neoclassical approach, based on perfect rationality, by analyzing the firm not as an agent but rather as a set of agents
associated through contracts (a nexus of contracts), the coordination of which must be understood (see also Coriat and Weinstein [COR 95]).

1.3.1.1. The firm as a complex organization

The analysis of the firm as an organization is based on a new approach of rationality, “bounded rationality”, as proposed by Simon [SIM 59]. According to this approach, agent behavior results from a search for the best possible decision for a given situation, wherein it is impossible to know all the alternatives, let alone all the possible outcomes. The objective of maximization is therefore replaced by that of satisfaction: an agent does not seek the action that gives the best result under given conditions, but an action leading to a result that can be deemed satisfactory.

The behavioral theory of the firm is interested in the decision-making processes within the company and builds on the foundational work of Simon on bounded rationality. The firm, for Cyert and March, is composed of a coalition of groups with different interests (traders, financiers, industrialists) [CYE 63], and seeks a compromise through a process of learning and the development of routines. The firm seeks to satisfy (attain a given level of profit, a certain market share, a particular sales target) rather than maximize.

At the same time, the managerial approach (Chandler [CHA 77], Galbraith [GAL 74]) was developed alongside the increase, in the United States and Europe, of market domination by large enterprises and the development of mass production and mass consumption. The firm is defined, in line with that of Penrose [PEN 59], as a set of productive resources organized within an administrative framework. The main question of the authors concerns the power structure within the company, with that acquired by managers and organized into a “technostructure”, that is to say, according to Galbraith, “the association of men of diverse technical knowledge, experiences or other talent which modern industrial technology and planning require” [GAL 74, p. 74]. As a consequence, for Chandler, “The visible hand of management replaced the invisible hand of market forces” [CHA 77, p. 12]. The power of management and the technostructure, characteristic of modern large-scale enterprises, are justified by the uncertainty inherent to the functioning of imperfect markets, the need for modern technology and the intensification of consumer demand.

Penrose’s analysis of the firm as a collection of resources to be managed is at the heart of the theoretical approach called the resource-based view (RBV), in which researchers – especially those in strategic management –
are interested in the skills, dynamics and absorptive capacities which enable firms to enhance their performance, particularly in the area of innovation (Wernefelt [WER 84]).

Evolutionary theory also takes ground in these preceding approaches (behavioral and managerial approaches of the firm), but has also been enriched by the work of industrial economists seeking to enter ‘inside the black box’ that is technology (Rosenberg [ROS 82]). Here, the main line of questionings concerns the coherence of the firm (that is the degree of proximity between the activities of a large modern firm) and the question of its evolution (any changes in the portfolio of activities or even its main activity) (Coriat and Weinstein [COR 95], Dosi et al. [DOS 90]).

The evolutionary school of thought, as well as the RBV, have been particularly interested in the subject of change. Evolutionary theory, which originated with Nelson and Winter [NEL 82], focuses on the behavior of economic agents and in particular on the behavior of organizations, considered as economic systems themselves. Their evolutions and objectives are defined through the processes of learning and coordination, according to search procedures which in turn must lead to satisfactory results. The adoption of the hypothesis of bounded rationality is explained by the importance of the uncertainty by which organizations act and interact. Among the questions posed on the evolutionary theory of the firm ([DOS 90], see also [COR 95]), one encounters:

– the question regarding the coherence of the firm (that is, the degree of proximity between the activities of a large modern firm);

– the question of the evolution of the firm (that is a change in the portfolio of activities or the principle activity itself).

At this point, it is this second question that is of particular interest. The evolution of the firm, according to evolutionary theory, follows the process described in Figure 1.13.

The learning process is a process whereby experimentation and repetition make tasks faster and less time-consuming, wherein new opportunities created by various modes of operation are constantly being tested. This cumulative process engenders the production of knowledge, which becomes manifest in organizational routines, defined as interaction models, and which become effective solutions to specific problems. They form an organizational memory, integrated into the skills of the employees themselves, as well as into documents, archives and artifacts [NEL 82].
These tacit routines are constituted as “specific assets” for the firm and are difficult to transfer. The firm evolves along a path determined by the skills accumulated through learning. These specific assets therefore determine the evolutionary path or trajectory of the firm. The secondary assets or complementary assets (to the main asset), along the value chain will allow the firm to change direction. The evolutionary theory of the firm thus makes it possible to understand the endogenous transformation of the firm over time [DOS 90].

![Diagram](image)

**Figure 1.13. The evolution of the firm. Source: Author**

If accumulated skills make it possible to differentiate firms and strengthen their competitive advantage, they can also constitute a sort of competency trap (Levitt and March [LEV 88]. Dependency on a given path expresses precisely this “forced” evolution of the firm, constrained as it were by past investments. Embroiled in their routines, companies can neglect new technological opportunities or changes within the economic environment. In the context of technological change, lock-in situations can be explained through the increasing returns of adoption and by the phenomena of institutional and strategic inertia. This same reasoning can be applied to the firm.

In the wake of evolutionary theories that have had the merit of underlining the dual nature of knowledge, both codified and tacit, the

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3 In the economy of transaction costs, whose chief representative is O.E. Williamson, a specific asset refers to an investment that cannot be redeployed to alternative uses without losing its productive value.
question of the non-appropriability of knowledge (its characteristics as a public good) has been investigated further. Indeed, the tacit nature of knowledge at least makes its appropriation possible in part (Dosi et al. [DOS 00], Nelson & Winter [NEL 82]). This makes it possible to distance oneself from a particular vision according to which knowledge is assimilated into information and is associated with a public good. This vision was based on the fact that knowledge, being not excludable, is difficult to control and generates positive externalities. The fact that it does not destroy itself confers on it the property of non-rivalry, which has important implications in terms of cost and price. Moreover, knowledge is cumulative, which means that it can be used infinitely and accumulates through every successive use. As a result, the dilemma facing knowledge and information lies in the fact that private return (the return on investment for the firm) is lower than the social return (the return for the whole society assessed by knowledge externalities). However, the tacit nature of knowledge diminishes its uncontrollable character. Similarly, the use of knowledge often requires specific skills and tools (complementary assets) that increase its cost of use and reproduction and thus limit its transmission (Foray [FOR 04]). This work has contributed to a vision where appropriation is possible, in part. Moreover, to increase private returns without reducing social returns, incentives and appropriate public policy must be developed. The typical example is the patent which, by conferring a monopoly on the inventor, makes it possible to increase the private return, while at the same time fostering the diffusion of knowledge; the monopoly conferred is only temporary and after 20 years, the invention falls into the public domain. The new growth theories have engaged with these arguments and combine, with public intervention, the market as a place for the allocation and appropriation (through intellectual property rights, routines) of the fundamental elements of growth (Romer [ROM 90]).

The importance of tacit knowledge and its interactions with explicit knowledge is also at the heart of management studies concerned with the genesis of knowledge within organizations. This is the case, for example, with the work of Nonaka and his co-authors, on the genesis and circulation of knowledge in the organization. This makes use of the SECI model (Socialization Externalization Combination Internalization) (Nonaka and Takeuchi [NON 95]), whereupon organizational innovation emerges from the interaction between explicit and tacit knowledge, coupled with a circulation of knowledge at the individual and interorganizational levels (for a detailed presentation, see Barbaroux et al. [BAR 16], Lièvre et al. [LIÈ 16]). We can consider that this process for the genesis of knowledge makes
it possible to detail the activities at work within the stock of central knowledge in terms of our structure of knowledge capital. Likewise, the Concept and Knowledge (C-K) approach is focused on the issues of creativity and design, and brings further elements on the generation of knowledge within organizations (Hatchuel and Weil [HAT 09], Le Masson and Mcmahon [LEM 16]).

The literature on the production and dissemination of knowledge within organizations is integrated into the resource-based theory, which has been based from its beginnings on the work Penrose. The authors put particular emphasis on the role of competences (including key competences (Prahalad and Hamel [PRA 90])) and capabilities in explaining the competitive advantage of firms. Capabilities, able to develop new specific assets and reassemble them into organizational routines, are called “dynamic capabilities” by Teece et al. [TEE 97]. They refer to “the firm’s ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments” [TEE 97]. The study of how dynamic capabilities are developed is the focus of the cognitive theory of the firm, according to which “Knowledge constitutes the most crucial asset and hence, the ability to develop and employ knowledge is the most crucial organization capability” [NOO 09, p. 11]. Among these dynamic capabilities, absorptive capacity is central to the analysis of the formation of enterprise knowledge capital. Absorptive capacity was first defined by Cohen and Levinthal [COH 90] as the firm’s ability to recognize the value of new information, transform it into knowledge, assimilate it and apply it to for commercial purposes. Four dimensions of absorptive capacity are usually identified: acquisition, assimilation, transformation and exploitation [ZAH 02]. “Acquisition refers to a firm’s capability to identify and acquire externally generated knowledge that is critical to its operations” [ZAH 02, p. 189]; “assimilation refers to the firm’s routines and processes that allow it to analyze, process, interpret, and understand the information obtained from external sources” [ZAH 02, p. 189]; “transformation denotes a firm’s capability to develop and refine the routines that facilitate combining existing knowledge and the newly acquired and assimilated knowledge” [ZAH 02, p. 190]; “exploitation reflects a firm’s ability to harvest and incorporate knowledge into its operation” [ZAH 02, p. 190]. These four dimensions of absorptive capacity are considered as essential in order to build and sustain a competitive advantage over competitors, especially in a context of growing open innovation.
According to us, the absorptive capacity refers to the central part of the knowledge capital in our scheme, as follows.

![Diagram of absorptive capacity and knowledge capital](image)

**Figure 1.14. Absorptive capacity and Knowledge capital**  
*Source: Author. For a color version of the figure, see www.iste.co.uk/laperche/knowledgecapital.zip*

The learning process is a way to integrate (assimilation) the information flows coming from outside the enterprise (acquisition). They are transformed (transformation) into knowledge and integrated in the knowledge stock of the enterprise. This knowledge is then exploited through the various forms of innovation or integrated as such in another production process (exploitation).

A second set of theories consider the firm as a set of agents linked through contracts. Notwithstanding the fact that we rely on the approaches of the firm as complex organizations, this second set of theories makes it possible to insist on the contractual dimension, fundamental in the current modalities for the constitution of knowledge capital.

### 1.3.1.2. The firm as a nexus of contracts

The work of Williamson [WIL 75, WIL 85], which extends the analysis of Coase, has a somewhat hybrid status in the theories of the firm. On the one hand, Williamson adheres to the theory of bounded rationality, but considers the firm as a system of contracts between individual agents. Due to imperfect information, signed contracts are incomplete (it is impossible to predict any contingencies). In particular, if the investments are specific (not reusable outside of the transaction), opportunistic behavior on the part of certain agents seeking to take hold of the transaction remains possible, and
therefore justifies the existence of a governance structure (a hierarchy) to make decisions in unforeseen situations.

Another branch, which arises from Coase’s work, also defines the firm as a nexus of contracts, retaining the hypothesis of perfect rationality and thus remaining in line with the neo-classical analytical foundations (Coriat and Wienstein [COR 10]). In agency theories (Jensen and Meckling [JEN 76]), as with the theory of property rights (Alchian and Demsetz [ALC 72]), the company “nexus of contract” no longer exists on its own: it is a “legal fiction”. It cannot have an objective since it cannot be reduced to an individual. There is also no relationship in terms of authority and therefore no opposition between the firm and the market, as was the case in Coase’s analysis. Individuals with inputs (capital, labor) enter freely into contractual relationships and seek to maximize their own utility. On this common basis, the questions of these theories differ and yet they are complementary. The object of the theory of property rights is to study the impact of property rights on behaviors and on the economy as a whole. The agency’s theory is concerned with the coordination of interindividual relations (principal–agent) and serves as a basis for analyzing the question of corporate governance. Who runs the business? The owners (the shareholders, the principal) or the managers (the agents)? Under this approach, shareholders, the owners of capital, delegate to managers the right to control this. Nevertheless, it is necessary to ensure that the managers act in the interests of the shareholders. This theme became predominant in the 1980s in the real economy, both by the liberalization of financial markets and by repeated management scandals. Shareholders (who play the role of principal) seek the highest possible value creation, while managers (the agents) may have other objectives. Problems of “moral hazard” (e.g. insufficient effort) and “adverse selection” (taking advantage of the information at hand) can create agency problems that need to be addressed by a set of incentives (financial incentives for managers, role and composition of boards, codes of governance, competition in the manager labor market, capital structure, use of external finance, implicit contracts, etc.). While finance dominates and firms’ productive investments (their innovation strategy) are constrained by the possibility of rapid gains made in the financial markets through the multiplication and sophistication of financial products, the firm appears to result in a shareholder/manager showdown driven by a single goal, maximizing value for the shareholder.

The theory of incomplete contracts (Grossman and Hart [GRO 86], Hart and Moore [HAR 90]) also has a somewhat hybrid status in that it recognizes the opposition of firm and market (like Williamson) and the existence of a
relationship of authority, while maintaining the hypothesis of perfect rationality. Authority is the result of the distribution of property rights. The theory of incomplete contracts thus links the theory of transaction costs and that of property rights. Integration results from the incompleteness of the contracts; however, this is not the result of a limited cognitive capacity on the part of the agents, but rather of the impossibility of verifying the commitments included in the contracts. In such a case, it is the owner of the assets who will decide on their use. Asset ownership is thus a source of power.

<table>
<thead>
<tr>
<th>Theoretical approach and lead authors</th>
<th>Definition of the firm</th>
<th>The central issues</th>
<th>Objective(s) of the company</th>
</tr>
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<tr>
<td>Neo-classical approach</td>
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<td>Efficiency of the market, price mechanism</td>
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<tr>
<td>Behavioral approach (Cyert and March)</td>
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<td>Study of the decision-making processes</td>
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<tr>
<td>Managerial theory (Penrose, Chandler and Galbraith)</td>
<td></td>
<td>Power structure</td>
<td>Various objectives of the “technostructure”: autonomy, growth, technical virtuosity (profit remains the basis)</td>
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<tr>
<td>Resource-based view (Penrose Wernefelt, Teece, Hamel and Prahalad; Nooteboom, Cohen and Levinthal)</td>
<td>Place of innovation and of resource production</td>
<td>Skills, competences, dynamic capabilities, absorption capacity</td>
<td>Various objectives of the groups constituting the organization (profit remains the basis)</td>
</tr>
<tr>
<td>Evolutionary theory (Nelson and Winter; Dosi; Teece)</td>
<td></td>
<td>Coherence and evolution of the firm</td>
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</tr>
<tr>
<td>Transaction costs theories (Coase; Williamson)</td>
<td>Governance structure “hierarchy”</td>
<td>Reason for the existence of the firm and study of its transactions (transaction cost theory)</td>
<td>Possibility of opportunism given the fact of incomplete contracts: various objectives</td>
</tr>
</tbody>
</table>
Several observations can be made from this brief overview of the contemporary theories of the firm.

First, they create a toolkit with which to study the many contemporary themes, such as the question of the evolution of firms and the role that knowledge plays in this dynamic, the conflicts of interest between the stakeholders, the impact of “shareholder values” on resource allocation decisions and so on. However, this toolbox is divided into two large compartments, characterized by very different working hypotheses: on the one hand is the hypothesis of perfect rationality and maximizing behaviors (which for some work together), and on the other hand is the bounded rationality that opens the way to a variety of objectives for others. As a result, the issues dealt with are also compartmentalized. While competence-based approaches and evolutionary theory make it possible to study knowledge production and innovation, contractual approaches focus more on issues of coordination, control and incentives. This divergence in the analysis frameworks makes it difficult to combine the different tools for the study of the same phenomenon (such as a growth in the size of the company, its capacity to innovate, etc.).

Second, the tools themselves, whatever they are, are the subject of many criticisms. These relate, for example, to the lack of realism in the theories. In the agency theory, why is the manager considered as an agent of the shareholder when they, following the logic of this theoretical approach, bring in the capital and yet do not own the firm? If he is considered to be an...
agent, why would he be the sole agent of the shareholders and not of all the other stakeholders (consumers, suppliers) of the company (Coriat and Weinstein [COR 10])? Above all, the agency theory, as well the contractual approaches, does not recognize the firm as an entity in its own right, whereas in reality the firm holds assets and is itself the object of commercial transactions (Weinstein [WEI 12]). Finally, agency theory suggests that the financial compensation granted to managers has the effect of aligning the interests of managers and shareholders but also increases the company’s performance. However, in real-world situations, market performance does not necessarily go hand-in-hand with innovation, but more often results from a reduction in investment and from the development of speculation (Lazonic [LAZ 12]). Criticisms can also be attributed to the “tools” developed by resource-based approaches and evolutionary theories. Resource-based approaches have grown stronger in recent years with multiple definitions that often reflect a closer reflection of reality. Nevertheless, there is also a split between these approaches, between those authors who remain close to the traditional assumptions (perfect rationality) and the others who do not. While the former are criticized for lack of realism, the latter are criticized for having a weak methodological basis (Foss and Stieglitz [FOS 12]). In all cases, including those approaches closer to reality, empirical verification remains insufficient, as they are essentially centered on the study of large enterprises. Evolutionary theory is often criticized for being an endogenous explanation of the change it proposes and for poorly taking into consideration the economic, social and political environment when analyzing the changes taking place within a firm and/or its activities.

1.3.2. The contribution of pioneer economists in the definition of knowledge capital

The notion of knowledge capital is built on the main evolutions of theories on the firm and on knowledge. Nevertheless, the contribution of pioneer authors, especially of classical economists, must not be overlooked. We emphasize, on the one hand, the contributions of Adam Smith and Jean-Baptiste Say in the analysis of the origins of the advancements being made in scientific and technical knowledge. On the other hand, we also return to the essential writings of Karl Marx concerning the establishment of the collective worker and, alternatively, the analysis of the use of knowledge as a productive force of capital.
1.3.2.1. Technical progress as an endogenous process

Smith was interested in the institutional framework necessary for the production and exploitation of production techniques. In this way, he highlighted the complexity of the relationship between science and technology in the production process and offered an explanation for the role of labor organization (the division of labor) in increasing the stock of knowledge and the number of inventions. The analysis of Say acknowledges the fundamental role of the entrepreneur in the production process and as a fundamental agent for technical improvement.

The organization of labor, that is to say the technical and social division of labor, is, in Smith’s analysis, at the origin of technical developments: “labour is facilitated and abridged by the application of proper machinery. It is unnecessary to give any example. I shall only observe, therefore, that the invention of all those machines by which labour is so much facilitated and abridged seems to have been originally owing to the division of labour” [SMI 76, p. 20]. In the manufacture of pins, the technical division of labor increases the skill of the workers and encourages them to improve their work tools, to invent a large number of machines thereby reducing and shortening working time. “A great part of the machinery made use of in those manufactures in which labour is most subdivided, was originally the invention of common workmen, who, being each of them employed in some very simple operation, naturally turned their thoughts toward finding out easier and readier methods of performing it” [SMI 76, p. 20]. To these pragmatic technical developments – independent from scientific theories – ensuing from the technical division of labor and implemented by the workers themselves, are added those resulting from the social division of labor. “Many improvements have been made by the ingenuity of the makers of the machines, when to make them became the business of peculiar trade; and some by that of those who are called philosophers or men of speculation, whose trade it is, not to do anything, but to observe everything; and who, upon that account, are often capable of combining together the powers of the most distant and dissimilar objects” [SMI 76, p. 21]. The second source of technical progress is therefore the productive application of formal scientific knowledge. The subdivision of “speculative” intellectual activities into different branches in which scholars specialize, has the same advantages as the technical division of labor (skill, time gains), and “more work is done upon the whole, and the quantity of science is considerably increased by it” [SMI, 76, p. 22].
In the analysis of Say, the recognition of a specific activity implemented by a particular economic agent also highlights the endogenous nature of technical progress and the creation of knowledge production. The entrepreneur has an essential role in the economic activity because he is a creator of wealth, and because, thanks to his charisma and his capacity for judgment, he stimulates all forms of economic activity. The work of the “implementation by the entrepreneur”, which lies between the work of the “research by the scientist” and the “execution by the worker”, is at the origin of technical developments. It is in this that the entrepreneur of Say relates to Schumpeter: according to Say, the entrepreneur takes advantage of the highest and humblest faculties of humanity, receiving them from the scholar and transmitting them to the worker. In addition to the work of the entrepreneur – which consists of the acquisition of the knowledge which is at the basis of the art he wishes to implement, the gathering of the tools of implementation necessary to the creation of a product, followed by the presidency of its implementation – the role of the scientist occupies an equally fundamental place. S/he conveys to the entrepreneur the knowledge of “natural laws” and “the nature of the things on which he must act, or which he must employ as instruments”. His or her work, which consists of collecting, arranging, preserving and increasing knowledge daily, makes it possible to escape the illusion of “chance” and thus undoubtedly takes part in the production of wealth since the truths the scientists teach are, for Say, the basis for all the arts [SAY 96, pp. 321–322].

1.3.2.2. Knowledge: productive factor or social relation?

For some classical economists, knowledge is regarded as a productive input at the service of the individual to abridge and facilitate their work (Smith), and it is an inalterable property of the individual (Say). Marx considers this to be on the contrary, and advocates that knowledge arises from, nourishes and crystallizes the antagonistic mode of production and therefore the social relation between capital and labor. The tools of work (knowledge) become external to the individual, in opposition to him, transforming him into a superfluous appendage of the machine.

The know-how of individuals appears in Say as the unalterable property of the individual. In his Catechism of Political Economy, he treats the “industrial faculties” (education, the acquired talents which are “the fruit of our cares and our sorrows”) in the chapter “De la propriété” (“On Property”). These faculties are a “capital property” of the individual, which cannot be “alienated” and have “no exchangeable value” [SAY 96, p. 365]. The knowledge embodied in machines (fixed capital) or in the know-how of
individuals (human capital) is thus, in the analyses of the classics, not the fundamental contradiction between labor and capital in the capitalist mode of production. For Smith, the tools of work remain the possession of the individual, not in opposition to him, and the worker consciously uses these to facilitate and abridge his work. The pursuit of individual interests brings about the general interest: that of increasing the productivity of labor and the volume of production.

The instrument or the means of work (the machine) and the potential of work (the knowledge embodied in the machines or in the know-how of the individual) appears as the product of social organization and as the property of those who use them. For Smith, the technical and social division of labor favors technical developments and thereby increases the “productive power of work” through learning by practice. The resulting increase in the output of all arts and crafts leads, if society is “well governed”, to a universal opulence that spreads even to the lowest classes of the people [SMI 76]. Knowledge, the source of wealth and the result of the division of labor, thus appears as being at the service of labor: it is the raw material for the work of the scientist who uses it for the “selfish” aim of his intellectual enrichment (the profession of “philosopher”, according to Smith “does nothing, but observe everything”), the worker’s means of working, which he uses to abridge and facilitate his work by improving his tools of production and, according to Say, the capital of the entrepreneur that creates value.

For Marx, on the other hand, in the capitalist mode of production, science, as appropriated by capital, is opposed to the worker: “it is not the means of the worker but the means par excellence of his exploitation and his alienation” [FAL 66, p. 62].

In Marx’s analysis, it is technology that creates the antagonism between capital and labor. In the third edition (1821) of On the Principles of Political Economy and Taxation, D. Ricardo, who came before Marx, pointed out the struggle between workers and machines: “machines and labor are in perpetual competition”, wrote Ricardo [RIC 17], in opposition to his first conception that machines improve the fate of the working classes. According to Marx, if this struggle initially takes place between the employee and the instrument of labor (the machine), the antagonism between labor and capital in the capitalist mode of production is itself more fundamental. At first, the employee “revolts against the particular form of the means of production, as being the material basis of the capitalist mode of production...” [MAR 67,
vol. 1, p. 287] and “[...] it took both time and experience before the workpeople learnt to distinguish between machinery and its employment by capital, and to direct their attacks, not against the material instruments of production, but against the mode in which they are used” [MAR 67, p. 288]. This antagonism between labor and capital, embodied by technology, is revealed from the moment when the general knowledge of natural laws becomes the “productive forces of capital”.

The “general work of the human mind”, for Marx, corresponds to all human knowledge pertaining to Nature. It includes “all discoveries and all inventions. In part due to the collaboration amongst the living, and in part on the works of our predecessors” (Marx, Capital, vol. 2, quoted by [FAL 66], p. 113). This scientific knowledge possesses the attributes of free and inexpensive goods: “Science”, writes Marx, “generally speaking, costs the capitalist nothing, a fact that by no means hinders him from exploiting it. The science of others is as much annexed by capital as the labour of others” [MAR 67, p. 333].

Knowledge is not then, at this moment, the expression of a social relation, it is the result of the work done by the scientist, a result which belongs to him. But once captured and “pressed into the service of capital” [MAR 57, p. 635] by the mediation of industry, “Invention then becomes a business, and the application of science to direct production itself becomes a prospect which determines and solicits it” [MAR 57]. Knowledge thus loses its passivity, the scientist is separated from his means of work and the technological applications of science become productive forces essential to an increase in the productivity of labor and the development of productive forces.

Marx highlighted the link between science and technology in the capitalist mode of production. From the moment when the scientist is himself integrated into the production process, his work is appropriated by capital and he is himself separated from his means of work. What the capitalist entrepreneur appropriates is no longer the result of research: free and inexpensive knowledge, but the process of work itself which is at the origin of the production of scientific and technical information and knowledge. He is thus able to direct it according to his own objectives. Knowledge therefore becomes a means of production, the property of the capitalist entrepreneur and applicable to the production processes.
Marx considers that it is through the mediation of industry that the natural sciences cease to be abstract knowledge and become essential forces of production. Indeed, it is the activity of the collective worker, the foundation of large-scale industry, which has an effect on science: “it is only the experience of the collective worker that shows where and how to save, how to implement in the simplest way possible the discoveries already made, what practical difficulties must be overcome when implementing theory – as it is used in the process of production, etc.” (K. Marx, Capital Vol. II, cited by Fallot [FAL op. cit., p. 113]).

Knowledge is incorporated into the know-how of individuals or as fixed capital (machines). In both cases, it cannot be regarded as an individual’s means of labor, but as a means of capital for the exploitation of labor. On the one hand, in the capitalist mode of production based on private property and the private appropriation of the means of production, the know-how of the worker, an integral part of his labor power, is reduced to the rank of a particular commodity: to be sold to and appropriated by the owner of the means of production. On the other hand, “as machinery develops with the accumulation of society’s science, of productive force generally, general social labor presents itself not in labor but in capital”. Therefore, “the productive force of society is measured in fixed capital, exists there in its objective form; and, inversely, the productive force of capital grows with this general progress, which capital appropriates free of charge” [MAR 57, p. 623].

It is therefore the incorporation of scientific information and knowledge into fixed capital, which realizes the transformation of the passive labor of the human mind into a means of production that is essential to the process of production. Scientific and technical information and knowledge are means of production which are essential to the capitalist production process because, on the one hand, it makes it possible to perpetuate and accentuate the relationship between capital and labor: “insofar as the means of labour, as a physical thing, loses its direct form, becomes fixed capital, and confronts the worker physically as capital. In machinery, knowledge appears as alien, external to him; and living labour [appears as] subsumed under self-activating objectified labour. The worker appears as superfluous to the extent that his action is not determined by [capital's] requirements” [MAR 57, p. 623]. On the other hand, the private ownership of the means of production allows the capitalist to increase labor productivity, to save constant capital and to increase the profitability in relation to the competition. It is indeed at the moment when fixed capital enters the scene as a machine in the
production process, and in which the process of production is no longer conditioned by the skill of the worker but by the technological application of science, that the full development of capital may take place. This is why “the tendency of capital is to give production a scientific character; direct labour [is] reduced to a mere moment of this process” [MAR 57, p. 631]. What was the activity of living labor becomes the activity of the machine, “Thus the appropriation of labour by capital confronts the worker in a coarsely sensuous form; capital absorbs labour into itself – ‘as though its body were by love possessed’” [MAR 57, p. 636].

1.3.2.3. The collective worker and the appropriation of knowledge

The development of manufacturing and the introduction of the division of labor give rise to collective know-how, of which the “collective worker” is the sole repository. Learning, the product of the collective nature of work, is accumulated and transmitted through the organic solidarity produced by the division of labor. According to Durkheim, the social division of labor and its specialization produces an organic solidarity, derived from the individual personality acquired through the specialization of the work and which enables society to become “more capable of collective movement, at the same time that each of its elements has more freedom of movement” [DUR 47, paragraph 3]. The capitalist organization of labor, by dividing and subdividing labor, by reducing the individual to a piece of himself, thereby gives birth to the collective worker and engenders solidarity between individuals. More precisely, as K. Marx has long explained, in the capitalist organization of labor, the know-how of the individual is monopolized by the owner of the means of production, so as to identify them as collective workers. “In manufacture, as well as in simple co-operation, the collective working organism is a form of existence of capital. The mechanism that is made up of numerous individual detail labourers belongs to the capitalist”, writes Marx in Capital [MAR 67, p. 248], continuing on to say that “In manufacture, in order to make the collective labourer, and through him capital, rich in social productive power, each labourer must be made poor in individual productive powers” [MAR 67, p. 249].

With regard to the latter, Durkheim writes that with the division and specialization of work “on the one hand, each one depends as much more strictly on society as labor is more divided; and, on the other, the activity of each is as much more personal as it is more specialized”; he continues on to say that, “Doubtless, as circumscribed as it is, it is never completely original. Even in the exercise of our occupation, we conform to usages, to practices which are common to our whole professional brotherhood” [DUR 47, para.
It is through this organic solidarity that learning abilities ensuing from interactions between the work of individuals develops. Through organic solidarity, the technical information contained in this collective know-how is transmitted between individuals, or over time (intergenerational transmission), as well as the customs and practices particular to enterprise: “The workman’s continued repetition of the same simple act, and the concentration of his attention on it, teach him by experience how to attain the desired effect with the minimum of exertion. But since there are always several generations of labourers living at one time, and working together at the manufacture of a given article, the technical skill, the tricks of the trade thus acquired, become established and are accumulated and handed down” [MAR 67, p. 239].

Scientific and technical information and knowledge is the subject of a sophisticated protection strategy. According to Smith, “particular accidents, sometimes natural causes and sometimes particular regulations of police, may, in many commodities, keep up the market price, for a long time together, a good deal above the natural price” ([SMI 76, p. 60]) and therefore generate great profit. Evoking the notion of trade secrets, Smith highlights the imperfection of information. The latter may, in his view, come about from the distance separating the mark from its suppliers. However the “extraordinary profits” engendered by this type of secret are supposed to be ephemeral: “Secrets of this kind, however, it must be acknowledged, can seldom be long kept; and the extraordinary profit can last very little longer than they are kept”. Secrets of manufacturing, derived from learning through practice and allowed by the technical division of labor, on the other hand “are capable of being longer kept than secrets in a trade. A dyer who has found the means of producing a particular color with materials which cost only half the price of those commonly made use of, may, with good management, enjoy the advantage of his discovery as long as he lives, and even leave it as a legacy to his posterity. His extraordinary gains arise from the high price which is paid for his private labour” which consist of the high wages of that labour… they are commonly considered as extraordinary capital profits [SMI 76, p. 60]. While Ricardo’s view on the longevity of trade secrets is more limited, he recognized the advantages that a monopoly of a new discovery or a new machine, can provide: “He, indeed, who made the discovery of the machine, or who first usefully applied it, would enjoy an additional advantage, by making great profits for a time” [RIC 17, p. 263]. However, as has been previously pointed out, the longevity that characterizes the trade secret takes into account collective character of the work that this division produces. In order to increase its longevity, as Marx
emphasizes, manufacturers “preferred, for certain operations that were trade
secrets, to employ half-idiotic persons” [MAR 67, p. 249].

1.3.2.4. A dynamic conception of capital

The concept of knowledge capital also borrows from the classics the
dynamic conception of the notion of capital, which is well appreciated in the
process of accumulating capital in the analysis of Marx. In it a sum of money
M is invested in a productive process in which a commodity C is
transformed by capital and labor (K and L) into a commodity with a higher
value C’ that will be attained by its sale on the market in a greater sum of
money M’, which in turn is projected to be reinvested.

In this approach, capital is not only a stock of resources available for
productive activities. It is a process that indicates the constant renewal and
productive use of this stock. Knowledge capital is therefore not an inert
stock but rather integrates value creation as a key component of its
definition. This perspective on value creation determines the integration of
new information, the combination of information and knowledge, and the
dual process of dissemination/protection. By focusing on the objective –
value creation – we also reintegrate into the analysis tensions linked to the
power relations existing between firms of different sizes and strengths,
which, as we shall study in Chapter 2, are taken into account in the current
context for the constitution and protection of knowledge capital.