1

The Emergence of the Functional Economy: Context and Approaches

The Functional Economy and product-service systems are theories that emerged as a response to the Fordist model crisis. The oil crises of the 1970s evidenced the dependence of our societies on certain raw materials. Some companies became aware of the limitations of generating value solely from the volume of products sold. The financial crisis of 2008, a crisis of "governance without a government" (Rosenau and Czempiel 1992), raised awareness about the fragility of financial systems as well as the place and responsibility of public authorities (the federal reserve's monetary policy, the role of states as victims and accomplices of the chain of events) and the precariousness of economic equilibria.

Confronted with these crises, the industrial system responded in several ways. Some companies explored growth drivers for industrial production, without calling into question the Fordist growth standard nor the relationship to work. Other companies looked for a new model to break away from industrial productivism (section 1.1).

The development of the Functional Economy (in the broad sense) was initiated by servitization movements, whose performances significantly increased with the use of new information and communication technologies. Services also became professionalized, and new, more cognitive services complemented the range of traditional services (e.g. consulting companies). The second movement that boosted the Functional Economy was the actors' growing concern for the environment and the ecological transition. Companies explored new ways of producing to better respect the environment. Some of them incorporated clean technologies. From a theoretical viewpoint, those companies continued to believe that research and innovation would solve sustainability problems. However, and despite the efforts made, the companies continued to proceed according to the Fordist growth standard. Those technologies were often "end of pipe", and the production model was not overhauled. In theoretical terms, other thought patterns exist, such as the proponents of degrowth, who consider that reducing the production of goods and services is the only way to preserve the environment (Georgescu-Roegen 1979). This model is interesting insofar as it challenges the idea that an increase in the GDP (produced wealth) leads to an increase in social well-being and highlights the rebound effect and the dangers of recycling. Finally, other authors have attempted to set in motion an alternative development model to Fordist growth; let us now highlight these developments. These new production dynamics will be the subject of our first section (section 1.1.1).

In the last 15 years, the Functional Economy has encountered increased legitimacy, with the political recognition of its interest in the energy transition. The Grenelle Environment Forum (Worksite 31 from Grenelle 2 was entirely dedicated to the *Functional Economy*), the REP (Extended Producer Responsibility) streams, recognized by the law since 1975 and updated with the AGEC law (French Law No. 2020-105 of February 10, 2020), the ample political and financial support for these new models coming from certain regions, ADEME, from the French Ministry of Ecological Transition are all approaches that contribute to the institutionalization of the Functional Economy in political decisions (section 1.1.2).

Research work does not use the same language, and does not have the same scope, for designating and identifying the Functional Economy, to the point that we could speak of various functional economies. Different epistemic communities claim to be part of this form of exchange or can be included under this notion. We will specify them in this section (section 1.2).

The main conceptual constructions that refer to or claim to belong to the Functional Economy can be separated into several categories. After discussing the origin of the Functional Economy, we will present the research related to the service-based society and to *product-service systems*, more akin to the Functional Economy in the context of market activities. These works are dominant in the English-speaking world. We will then present *the functional and cooperative economy* (FCE) as an alternative to the Fordian production and consumption model. This work emphasizes the importance of cooperative relationships (or even *"coopéraction" within and between "functional ecosystems" or "business ecosystems"*) and *territorialized* value, which involve a non-market dimension (trust, creation of common heritage). This work is highly present in France and Belgium. We will then present the framework research related to *the Functional Economy*, who is also essentially French. French research differs from previous works because it addresses broader questions than just the Functional Economy and explores more non-market modes of coordination.

The notion of Functional Economy is intertwined with other concepts, such as the circular economy or industrial ecology. Since the concepts of circular economy and Functional Economy are not stabilized, depending on the authors, different boundaries exist between these notions under construction. We will discuss the common features between these notions and the accompanying phenomena (section 1.3).

1.1. Towards a service and environmental model

The emergence of the approaches in Functional Economy and product-service systems took place in a context of transformation of the productive system (section 1.1.1). First conducted by researchers, then studied by large companies attentive to societal developments and tested by visionary business leaders, these approaches are being institutionalized by public organizations. These organizations seek to support projects inspired by these models and to include the use of these models in legal texts (section 1.1.2).

1.1.1. *New production dynamics*

Experiments with the Functional Economy have developed in the last 15 years. Companies have shifted towards this model along different paths (Corporate Social Responsibility, the circular economy, sustainable development). The awareness of the need to change models (section 1.1.1.1), made possible the search for new growth opportunities without truly changing the standard, or the search for an alternative model. Whatever the path, these experiences are based on new production dynamics, and in particular on the economy's tertiarization and servitization (section 1.1.1.2), the information processing and movement enabled by (new) information and communication technologies (section 1.1.1.3), the development of the cooperation and knowledge society (section 1.1.1.4), as well as an increasing concern for the environment (section 1.1.1.5).

1.1.1.1. *Calling Fordist growth into question*

The Fordist industrial model, which sustained growth during the 30 years post World War II, is based on the dissemination of mass production and consumption. Mechanization, automation and the search for economies of scale promoted productivity gains. The standardization of products made quality control easier. Profitability, based on the ratio between profit and capital, corresponded to the managers' expectations. The sustainability of this model is based on the sale of an ever-increasing volume of production, related to an increase in the consumption of consumer and capital goods (Buclet 2010). Fueled by wages from these industries, households were able to follow this movement.

This growth standard, based on productivity gains and the production of an ever-increasing volume of goods, became anchored in people's minds especially after the 1980s, when the domination of financial markets based on short-term financial profitability reinforced that pattern. However, several socio-economic developments called this model into question:

– The saturation of the capital goods markets in industrialized countries, and the subsequent international competition on this type of product – fueled by the emergence of new industrial countries with a high intensity of unskilled labor such as South-East Asia, China, Latin America – limited the chances of increasing consumption by market extension. Rising competition and market fluctuations led companies to quickly diversify their products for them to stand out using incremental innovations, but the need for speed called into question the relocation of large companies, as well as the organization of Taylorist production.

– In the 1960s, the Fordist organization of work and production was heavily criticized by unions and workers (who accepted the arduousness of factory work less and less). In addition, the absence of social recognition led to a profound questioning of labor (appearance of strikes, absenteeism, high staff turnover, etc.). Even though enriched and improved by task rotation, the relationship to work became decreasingly accepted.

– The oil shocks of the 1970s resulted in a gradual decline in the industry share in the GDP and in the destruction of a third of industrial jobs after 1973[1]. This deindustrialization[2] process first affected the sectors in crisis (textiles, shipbuilding, steel, etc.) and continued well into the 1980s. The end of Fordist growth, marked by these early 1970s crises, is considered by economists as a cycle transition based on a new technological regime (Nelson and Winter 1982). Large companies become aware of their dependence on energy resources and raw materials and started pondering new growth opportunities.

Often dependent on orders from large companies, Small and Medium Enterprises (SME) become exhausted trying to respond to more random orders on time, while managers struggled to motivate their employees, who found their jobs meaningless. Companies had to look for new growth models.

1 The number of unemployed rose from 400,000 in 1973 (3% of the active population) to 1 million in 1975. Close to 6.2 million in 1973 in industrial activities, employment fell by over a third in these activities. This fall began again after 2000, and it is now below the 4 million mark – less than one employee in six (15.2%), compared to over one in four, 30 years ago.

2 In France, the industry lost 36% of its workforce between 1980 and 2007 (i.e. 1.9 million jobs).The weight of industry in the GDP in value terms fell from 24% to 14% between 1980 and 2007. Before the first oil shock, high growth was based on sustained productivity gains.

Reflection on these new models went hand in hand with the evolution of service activities, as will be shown in section 1.1.1.2.

1.1.1.2. *The development of services*

In parallel to the industry's decline, a phase of economy tertiarization continues to develop. Since the first oil shock, the productive organization of industrialized countries has been transformed.

Today, service activities represent over 75% of GDP and absorb employment in the majority of developed countries (almost 79% in France in 2022, compared to 60% in 1970)[3] (Figure 1.1). In fact, in 60 years, employment has become overwhelmingly tertiary and governed by wages. According to INSEE, in 1978, a quarter of French employment took place in the industrial sector (58. 7% in the tertiary sector), whereas it represented only 13.3% in 2018 (76.1% for the tertiary sector)[4].

> A service activity is essentially characterized by the provision of a technical or intellectual service. Unlike an industrial activity, it cannot be exclusively described by the characteristics of a tangible good acquired by the customer. Its final product is intangible, neither storable nor transportable. Also called "tertiary activities", services comprise a vast field of activities: commerce, transportation, financial activities, real estate, business services, services to individuals, education, health and social action.

Box 1.1. *Definition of a service activity (source: INSEE)*[5]

3 59.6% in 1970; 78.56% (estimate) in 2022. Available at: https://data.oecd.org/fr/natincome/valeur-ajoutee-par-activite.htm.

4 See: https://www.insee.fr/fr/statistiques/4277675?sommaire=4318291.

5 See: https://www.insee.fr/fr/metadonnees/definition/c1161.

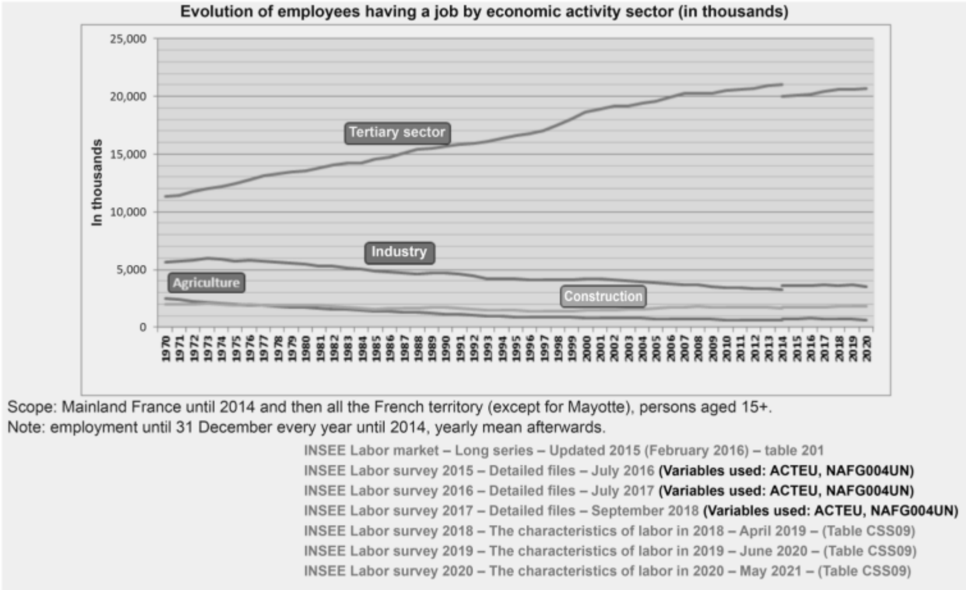


Figure 1.1. *Evolution of employed workers by sector of economic activity (in thousands).*
See: http://www.statapprendre.education.fr/insee/emploi/secteurs/secteursevolutionsecteur.htm.
For a color version of this figure, see www.iste.co.uk/merlinbrogniart/functional.zip

Service activities have always been an integral part of industrial systems. By means of outsourcing practices, industrial systems try to improve their performance and reduce costs (Le Cotonnec and Vinet 1998). In this way, business services (and also to individuals) continued to develop in order to meet new needs (financial, insurance, distribution, etc.). These could be activities outside the company's nucleus (catering, cleaning) or support activities essential for the service (transportation, logistics, maintenance, temporary services). The reorganization of production models, like the just-in-time flow strategy, had led to the massive development of new needs in terms of transportation and logistical means related to tertiary activities (Boutillier et al. 2014). After the 2000s, company demands increased further, together with service professionalization, made possible by improving technologies and developing company skills (Merlin-Brogniart 2021). The complexity of the economy and market fluctuations generated the need for expertise and the search for flexibility (Fimbel 2003). Outsourcing concerned non-strategic functional positions in the company (such as IT, payroll, logistics), as well as strategic functions (certain commercial tasks, R&D services) (Hoarau 2004).

This consumption of market services was caused both by industrial companies, which reorganized themselves on the basis of outsourcing (mainly services), as well as by service providers, who themselves resorted to outsourcing. Thus, the content of the companies' production evolved, increasingly rich in intangible components (INSEE 2008).

The development of service activities also targeted households. Since the 1960s, the distribution of the household budget has changed. Households devote an increasingly larger share, in value, to services. More precisely, the shares reserved for food and clothing have been reduced, in favor of housing, transportation, health, communication and leisure. Nowadays, services represent a preponderant part of the household budget.

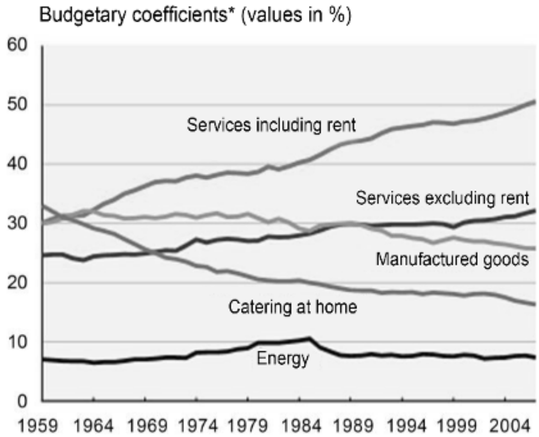


Figure 1.2. *Growing share of services in household consumption expenditure (source: National Accounts, Base 2000 (INSEE 2009)) (budget coefficients are calculated here, including imputed expenses). For a color version of this figure, see www.iste.co.uk/merlinbrogniart/functional.zip*

The question of the Functional Economy is closely related to the development of tertiary activities in the economy. It is also articulated with the reorganization of the production of industrial activities. In this service dynamic, new ways of understanding customer expectations (either from professional or individual customers), are emerging. Some companies simply add services to the production of existing goods (insurance, maintenance, etc.), without their productive system being too disrupted. This new organization makes it possible to increase the value of production and to build customer loyalty. Other companies consider restructuring their services by providing a global response to their customers' needs. No longer is it a question of selling goods to the customer, but of offering a service including the maintenance of goods, or a resource supply service, such as the proposal of thermal comfort. These new service proposals fall within the characteristics of the service economy. These characteristics are co-production (the solution is co-produced with the customer), the absence of an exchange of property rights (the capital goods used by the customer remain in the possession of the service provider), the service relationship (which induces geographical and cultural proximity constraints and implies a notion of trust) and the need to synchronize production times between the service provider and the beneficiary's availability.

The service economy encourages reflection on the creation of value associated with such services. It is in this shift that the service relationship plays the essential role we designate as the Functional Economy. It requires the implementation of a different economic model and company management. The best-known companies having chosen this transformation are Michelin, Rank Xerox and IBM (Du Tertre 2007). The Functional Economy makes greater use of intangible resources (trust, skills, etc.), which are more complex to identify and measure. The evolution of information and communication technologies, which will be discussed in the following section, lets us manage part of this complexity.

1.1.1.3. *Information and communication technologies*

Essentially relying on oil, chemistry and aeronautics in the post-war period, the Fordist industrial regime was succeeded by another technological regime at the beginning of the 1990s, based on information technology and biotechnologies, as well as on actor strategies, leading to real systemic changes (Vivien et al. 2012). In particular, low-cost micro-electronic instruments made it possible to obtain greater flexibility (Boutillier et al. 2014).

Today, companies benefit from the potential of new information and communication technologies, and more generally, from the digital economy. These technologies, which support information creation, transmission, dissemination, sharing and exchange, can be used for processing complex information and data much more quickly. They combine the use of telecommunications (Internet and networks), computing (for coding and processing information) and the audiovisual element. They require investment in information and communication technology (ICT) tools, such as integrated management software packages (Enterprise Resource Planning, ERP), Customer Relationship Management (CRM) software, market software packages or "in-house" applications.

The organization of productive activities around a service dynamic forces the company to process a lot of information about the customer (analysis of customer data, study of their behavior, uses, events encountered). It requires adaptation to the versatility of customer behavior, in real time. This adaptation involves the processing and interpretation of a large amount of information on customer uses, or on events encountered during the service. The management of this complexity and the opportunities for integration gains are facilitated by the use of information and communication technologies.

The implementation of global solutions involving several partners and stakeholders makes data communication, and more broadly, the mastery of these technologies, essential. The uses are diverse within the framework of the Functional Economy, including the development of internal networks such as the intranet or local networks, virtual platforms connecting suppliers and demanders, social networks, or even logistics tracking systems such as RFID (Radio Frequency Identification), which enables the tracking of products and waste. The supply of integrated solutions will prove all the more efficient when combined with information transfer tools between partners. However, these tools represent a significant investment.

This means that their use is strongly dependent on the company's size and the field of activity (Figure 1.3). This digitized information will be associated with human interventions related to the provision of services. It will boost the knowledge of providers.

1.1.1.4. *From a knowledge society to a cooperation society*

The reference to a knowledge economy and networks (Castells 1998) is still often used by politicians. The term *knowledge society* succeeded that of *information society*, used throughout the 1990s to highlight the impact of computers and networks on the economy. According to Breton (2005), the knowledge society is located in a "context of apology for science", in the sense that knowledge can be assimilated to techno-science and scientific knowledge to information (knowledge being considered from the operational perspective of new technologies). In that view, the main activity, "producing and disseminating knowledge", would be the ultimate goal of the service activity (Alix 2011). The cooperation and knowledge transfer between researchers and industrial companies (bottom-down and asymmetrical flow) in the 1960s and 1970s was followed in the 1980s by the idea of knowledge co-production by a multiplicity of actors. Finally, the emergence of new challenges, such as the concern for the environment, awakened the social dynamic, which became involved in this co-production, especially through participatory approaches.

	In the company		Along the supply chain	Using collaborative tools	
	Integrated management software	**Customer relationship management[1] application**		**Working tools**	**Design tools**
10 to 49 workers,	33	24	11	17	7
including ICT sectors	*51*	*56*	*10*	*61*	*21*
50 to 249 workers,	67	45	25	49	18
including ICT sectors	*81*	*71*	*21*	*81*	*37*
250+ workers,	80	61	39	78	36
including ICT sectors	*89*	*79*	*35*	*95*	*49*
Total,	**38**	**28**	**13**	**22**	**9**
including ICT sectors	***58***	***59***	***13***	***66***	***25***

1. Excluding real-time interaction tools for interacting with the customer (chat, instant messaging, real-time browsing, shared screen, etc.).

Note: ICT sector companies represent 5% of companies hiring over 10 employees in France and included in the study field of this survey ICT-companies in 2017.

Interpretation: in 2017, 33% of companies with 10–49 employees used integrated management software.

Scope: companies hiring 10+ workers, based in France, mainly trade sectors, excluding the agricultural, financing and insurance sectors, declaring that they have internet access and using at least one computer.

Source: INSEE, 2017 ICT-companies survey.

Figure 1.3. *Electronic sharing of information by company size, in 2017, in % (source: 2017 ICT-companies survey (INSEE 2019)).See: https://www.insee.fr/fr/statistiques/fichier/4238625/NUM19_F2-8.pdf*

Knowledge then became the object of bidirectional communication between the core (research) and society (Alix 2007, 2011). This partnership, now turned into *knowledge economy*, was driven by the Treaty of Lisbon (2000), which promoted intensifying the production of knowledge and innovation, States having become "facilitators" rather than tutelary authorities. In this innovation production, social collectives took on importance in dialogues and experiments, alongside knowledge-producing experts, who had been relegated as scientific and economic actors. This societal mobilization would only work provided that the proposed projects matched their interests and conformed to their values. The relationship between science and society is changing. Other authors use the term *collective intelligence*, particularly in the context of the construction of territorial projects (Janin and Landel 2022, p. 212). In public meetings, these actor collectives define shared principles, observation methods, the search for solutions adapted to the context and the passage to action:

> Through a shared understanding of the context, collective intelligence can contribute to co-constructing a transversal transition, thanks to the diversity of stakeholders, appropriable by those who become involved (Janin and Landel 2022, p. 213).

It is opposed to projects made from expert diagnoses then proposed or imposed on populations. This collective participation is frequently found in Functional Economy experiments, specifically in territorial projects bringing together the collective actor, companies and citizens.

In the professional world, supply complexity leads companies to seek knowledge from other companies, because the level of knowledge required to develop a complex supply is such that a single company rarely has sufficient internal skills to embark on it alone. Companies engaging in

Functional Economy trajectories modify their knowledge capital (Laperche 2017), made up of internal, and also external resources, obtained through partnerships or cooperation (customers, suppliers, universities, local or regional institutions, etc.), with the support of public institutions or associations, or training. The supply is increasingly co-constructed among actors (companies, organizations, even customers or citizens) to provide *useful effects* or new use values. This cooperation between the actors, called ***coopéraction*** by the Functional Economy authors (Huet and Choplin 2012), is a movement that creates value in *situated transactions*, no longer materialized in goods. This cooperative relationship, which is at the heart of value creation, is also called the "relational market" (Moati 2009), "partnership economy" (Renault 2007) or even "cooperative transactions" (Zacklad 2007).

1.1.1.5. *Ecological challenges*

Two major periods (beginning in 1970 and ending in 1980, then beginning in 1990 and ending in 2000) show how the perception of the relationship between economy and environment evolved. These periods were paced by two reports: on the one hand, the Meadows report, which emphasized the harmful repercussions of economic growth (1972), and on the other hand, the Brundtland report (1987) (Lacroix and Zaccaï 2010).

1.1.1.5.1. 1960s and 1970s: a limited perception of ecological challenges

The first period (1960s and 1970s), marked by the oil crises, established the heavy energy dependence on which industrial production relies. The rise in the price of energy and raw materials undoubtedly contributed to increasing concerns about the environment. But the industrial model was not called into question at the moment. The government essentially put in place restrictive measures for saving and recycling raw materials (Lacroix and Zaccaï 2010).

1.1.1.5.2. End of the 1980s: gradual awareness about ecological challenges

It was only with the Brundtland report (1987), and then the Rio conference (1992), that the established order between economic growth and the environment was questioned. Towards the end of the 1980s, local or regional concerns (air, water, flora and fauna, acid rain, nuclear power) gave way to global issues (hole in the ozone layer, loss of biodiversity, climate change). Pressure came from both producers and consumers to adhere to an alternative political paradigm featuring sustainable development. This geographical extension of environmental problems gave rise to the search for international agreements. In France, sustainable development was integrated as a guiding goal by the Barnier Law in 1995 (Lacroix and Zaccaï 2010). The instruments used were incentive-based, focusing on green technologies, as well as on new, more ecological products. Unlike the first period, international organizations and governments emphasized the positive aspects of economic growth on the environment (e.g. eco-industries) (Lacroix and Zaccaï 2010). Externalities, both positive and negative, started being taken into account by companies. In actual fact, however, it was still economic growth that took precedence over environmental concerns.

> We speak of "externalities" when the actions of an economic agent have a positive or negative impact on the well-being and behavior of other agents, and this impact is not taken into account in the calculations of the agent who generates it. Externalities can be either positive or negative.
>
> Examples: geographical areas with a high density of industrial and service activities promote knowledge transfer (the externality is analyzed here as a free production factor for the companies which benefit from it).

Pollution generated by an industrial site constitutes a negative externality, because the cost of depollution is borne by the entire community, rather than the polluting company.

These externalities, particularly negative ones, can be internalized by companies (limiting pollution at the source, transforming waste into resources for other activities, implementing the Polluter-Pays Principle, etc.).

Box 1.2. *Definition of the term “externality”, or “external effects”*

In France, these environmental concerns were reflected in the transformations of ministerial institutions with, for example, the development of a ministry in charge of the Environment (1971). In the past, questions relating to the environment were handled by several ministries (Charvolin 2001). In the 1990s, various environmental organizations were created (DIREN, ADEME, INERIS, IFEN), as well as multi-actor think-tanks (Lacroix and Zaccaï 2010). It was only in the 2000s that the Functional Economy, as a new sustainable model, became institutionalized in texts and taken into account in political decisions.

1.1.2. *The Functional Economy in political decisions*

Every country has a different history of the institutionalization of this concept, as well as connections with the notion of circular economy. To avoid a complex analysis, we will limit ourselves to the French context.

1.1.2.1. *Advances in French expertise*

The Grenelle 1 programming law of August 3, 2009 represented a decisive step in making the new *business models* contemplating environmental concerns known. The Grenelle texts operationalized some of the previous proposals and continued with the participatory approach between stakeholders (consultation instruments). They brought French legislation into compliance with European texts and transformed energy constraints into market opportunities (insulating materials industry, energy systems, etc.). The circular economy became popular after the works from the Grenelle Environment Forum in 2007, with its operational phase (Phase IV), which consecrated the Functional Economy as the subject of a specific project: Worksite 31. The project's mission was to highlight the possibilities of a transition towards an economy lower in carbon, energy and non-renewable natural resources, by extending the lifespan of goods, but without reducing trade and services offered (in other words, without promoting a deindustrialized economy). Note that the proponents of the two approaches that we will discuss in section 1.2 – *Functional Economy* and *functional and cooperative economy* – worked together on Worksite 31. These approaches all combine social and political sciences.

The Grenelle Environment Forum was followed by the translation, on different occasions, of the Functional Economy into the law. Article 6 of the French Public Procurement Code stipulates that each purchase must give rise to reflection on the needs formulated, according to their functional characteristics. Whenever possible, technical specificities should be established as to take into account functionality criteria (e.g. the use of a less polluting product, rental rather than purchase, pooling of supplies and services).

Among the main orientations of Worksite 31, we can note:

– identifying obstacles to the establishment of a Functional Economy and assessing its potential (in particular, for public markets);

– constituting an educational portal on the environmental impact of products (such as carbon footprint, life cycle analysis, ecological footprint, etc.) relying on transparent bases;

– developing eco-design through professional training, tax measures, the encouragement of innovation;

– studying fiscal instruments to support the substitution of the sale of services for the sale of goods.

Box 1.3. *Worksite 31 (source: Worksite 31 mission letter, December 26, 2007)*

Since 2006, the French Public Procurement Code has required public buyers to take into account the concerns of responsible purchasing. The Functional Economy is one of the solutions proposed, particularly in view of the economic crisis context.

1.1.2.2. *The Functional Economy in the energy transition*

As we have seen in the context of public procurement, the implementation of a Functional Economy has mainly been encouraged through incentives and obligations (Club CLEF and CIRIDD 2019). Following the works of the Grenelle, the Functional Economy was integrated as a solution in numerous texts relating to the environment.

1.1.2.2.1. Sustainable public procurement

References to functional and cooperative economy approaches are made in the schemes for the promotion of socially and ecologically responsible purchasing (SPAR or SPASER) in connection with the National Action Plan for Sustainable Public Procurement (PNAAPD). Article 13 of the French Law No. 2014-856 of July 31, 2014 (relating to the Social and Solidarity Economy) established the obligation to adopt a scheme for the promotion of socially responsible public purchasing for public purchasers procuring over 100 million euros, net of tax (notably local authorities and their groups).

1.1.2.2.2. Waste prevention

The promotion of the functional and cooperative economy is also included in texts relating to waste prevention. Approaches to the functional and cooperative economy are present there, to such an extent that these approaches are a pillar of the circular economy. This is the case of the PLPDMAs (local programs for the prevention of household and assimilated waste), compulsory since January 1, 2012. Since 2015 (publication of the energy transition law for green growth), the French waste prevention policy has been part of the transition towards the circular economy. The 2015 calls for zero waste projects (*territoires zéro déchet, zéro gaspillage*, TZDZG) as well as the zero waste and circular economy contracts (*contrats d'objectifs déchets et économie circulaire*, CODEC), launched at the national level by the French Ministry of Ecology in 2014 and 2015, aimed to support local territories in the implementation of circular economy policies (ADEME 2020). The French NOTRe law (New Territorial Organization of the Republic) of August 2015 gave the regions planning powers in waste management and the circular economy. Their mission was to build a regional waste prevention and management plan (PRPGD), including a regional scheme in favor of the circular economy. The 2014–2020 national waste prevention program (PNPD) and the third national waste prevention plan (PNPD) for the period 2021–2027, formalized on March 27, 2023, explain the progress of the AGEC law and its application decrees relating to the REP sectors (Extended Producer Responsibility), and, more recently, to the climate and resilience law. This summary document aiming to reduce household and business waste flows is structured into five axes and 47 measures. It provides support for the actors in the Functional Economy.

1.1.2.2.3. The French law relating to the energy transition for green growth of August 17, 2015

The Functional Economy is also present in the French law relating to the energy transition for green growth of August 17, 2015. It plans to "study the possibility of converting part of the aid or public allowances paid in monetary form to individuals, in use value, in application of the Functional Economy". Following this law, the Prime Minister presented the government's roadmap towards the circular economy (FREC) on April 23, 2018, which includes 50 operational measures to move to a circular model. Measure 8 plans to "strengthen the supply of reemployment, compensation and Functional Economy actors". It is related to the 2030 UN Sustainable Development Goals Agenda, and the goal of "establishing sustainable consumption and production patterns".

Article 68 of French Law No. 2020-105 of February 10, 2020 relating to the fight against waste and the circular economy provided that "within one year from the promulgation of this law, the government will submit a report to the Parliament on the actions implemented enabling the development of the use and Functional Economy[6]".

1.1.2.2.4. Links between public institutions and FCE clubs

The French Ministry of Ecological Transition and ADEME, a public industrial and commercial establishment placed under the supervision of said ministry, promote Functional Economy approaches. They support the French circular economy[7] platform, the European Institute for the Functional and Cooperative Economy, by pursuing projects and making documentary resources available.

6 Available at: https://www.legifrance.gouv.fr/jorf/article_jo/JORFARTI000041553833 [Accessed May 12, 2023].
7 See: https://www.economiecirculaire.org/.

For example, since 2014, ADEME has supported work on the functional and cooperative economy (FCE) by creating FCE referent positions and organizing workshops around this theme with the FCE[8] Club.

ADEME worked in 2017 on this new economic model with the ATEMIS intervention and research laboratory, in collaboration with multiple stakeholders. This collaboration led to the production of a document relating to a "positive prospective vision in 2050"[9]. ADEME (2017) gives the following definition of the Functional Economy, considered as:

> [A model] providing companies, individuals or territories with integrated solutions of services and goods based on the sale of performance of use or use and not on the simple sale of goods. These solutions must allow less consumption of natural resources from a circular economy perspective. , an increase in the well-being of people and economic development.

ADEME regularly produces publications on this model (ADEME 2017), research programs[10], and organizes award ceremonies for professionals, such as the Business and Environment award, set up by the ministry and ADEME in partnership with BPI France, CPME and *Actu Environnement*, which rewards companies integrating

8 Like the creation of the *Peer Cities* workshop, pilot transition territories, supported by the EI-FCE, co-piloted by ATEMIS and the city of Loos-en-Gohelle.

9 See: https://librairie.ademe.fr/dechets-economie-circulaire/3633-vers-une-economie-de-la-travailnalite-a-haute-valeur-environnemental-et-sociale-en-2050.html.

10 Like the research-intervention program for the sustainable development of territories, launched in 2020, Territory of services and cooperation (Coop'ter).

environment and development sustainability into their activities[11].

1.2. The Functional Economy approaches

The Functional Economy is a concept still under construction. It takes part in discussions on new economic models combining economic growth with environmental preservation, by reducing the consumption of materials (natural resources, raw materials, energy, etc.).

However, this model does not have a consensual character as the notion of sustainable development does (Boutillier et al. 2014), although it clearly echoes the proposals which emerged after the 1980s transformation period.

The use of the term "*économie de fonctionnalité*" is a French scientific specificity (Serra 2018). It is a translation of the founding concept of *Functional Economy*, proposed by Stahel (1997). Some English-speaking authors such as Mont (2002) use it to refer to the initial works of Giarini and Stahel (1989). English-speaking authors use the reference to the *service society*, with the terms *eco-efficient services* (Hockerts 1999; Meijkamp 2000; Bartolomeo et al. 2003), *servitization* (White et al. 1999), *servicizing* (Toffel 2002), or even the reference to the service supply, which results from this exchange, through the use of the term *product-service system* (Tukker 2004).

In French-speaking research, the Functional Economy is defined above all as the capacity to "sell the use of a good rather than the good itself" (Rifkin 2000; Erkman 2004; Bourg and Buclet 2005), but the scope of this capacity can be

11 This prize, for example, was awarded in 2015 to the company Clarlight, created in 2014, which sells light rather than equipment (lighting), or the tire company Michelin, which sells kilometers traveled rather than tires, which it refurbishes for heavy goods vehicle customers.

broader or narrower. This sale of a use or a result has the particularity of not leading to an ownership transfer between the provider and the customer. Stahel's original conception (1997) is more open regarding this second characteristic. In French-speaking approaches, the search for a reduction in environmental impact is essential to characterize the Functional Economy[12] (Gaglio et al. 2011), or at least in the most innovative developments pertaining to these models (Buclet 2014).

These range from the sales of functional solutions associating goods and services in an integrated manner (in the sense of the product-service system (Tukker 2004)) to new multi-actor territorial economic dynamics (Du Tertre 2011), revealing a variety of adaptations of the concept of Functional Economy, both in an operational and a theoretical sense (Van Niel 2014). It is possible to segment theoretical approaches depending on several criteria – for example, according to their relationship to the environment, to the territory or even the degree of integration of non-market schemes (Serra 2018). In the following sections, we will present the genesis of this concept: its origins, different approaches depending on their relationship to the original works and the way in which they assimilate non-market schemes. To offer an overview of these conceptions, we will end this section 1.2.1 with the summary table developed by Serra (2018), which reflects the terminology used to designate the forms of exchange attached to the Functional Economy.

1.2.1. *The origins*

The origin of the concept of Functional Economy is attributed to Stahel and Giarini. Stahel (2006) gives the following definition:

12 The functional and cooperative economy was initially called the functional and sustainable development economy.

> The Functional Service Economy, which optimizes the use or function of goods and services, focuses on the management of existing wealth in the form of goods, knowledge and natural capital. The economic objective of the Functional Service Economy is to create the highest possible use value for the longest possible time while consuming as few material resources and energy as possible (Stahel 2006, p. 145).

But the start of this reflection goes back to the Rome club. Following the Meadows report (1972), the Rome club asked Giarini and Stahel for their own report, subsequently published under the name *The Limits to Certainty: Facing Risks in the New Service Economy* (1989), in which they explained how a "new service society" can respond to the limits of the mass production and consumption model. In their 1989 book, these authors recalled how, by increasing the productivity of manufacturing activities, technical progress first made it possible to reduce the use of rare resources, and the way in which the specialization of activities made trade and market development necessary. This industrial revolution cycle maintained the utopia of certainty and led to its limits (*the limits to certainty*):

– On the one hand, the monetization of resources (through the privatization of nature) and the attribution of a cost of access to such resources, and on the other hand, the improvement of productivity and market development led to resource scarcity.

– The increase in the volume of waste associated with this production created the need for an investment in recycling, which was nonetheless limited by the prohibitive costs of recycling and the physical quality of waste.

– Finally, the share of productive activities in value creation decreased in production yield in favor of service activities in the product life cycle (R&D, distribution, storage, insurance, financing, maintenance, after-sales service). However, the assessment systems failed to take into consideration this change in value.

Giarini and Stahel foreshadowed the end of the megacycle of the industrial revolution and the advent of a new service economy which would make it possible to generate value by decoupling growth from the use of physical resources:

– by moving from a linear organization of production to a circularized organization around the product life cycle (called *resource efficiency strategies*);

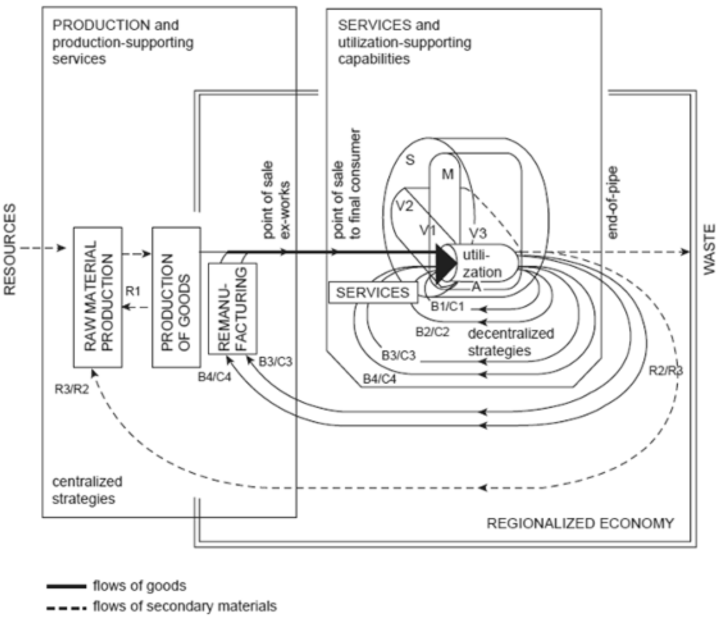
– through the development of new methods for defining and assessing value.

The term *Functional Economy* (Stahel 1997), then *functional service economy* (Stahel 2006), were not used in this first report, but appeared somewhat later in other works by Walter Stahel. It is this term which is at the origin of the French translation of ***économie de (la) fonctionnalité***. The English equivalent of this notion is the concept of *service economy*, more often used by Giarini (2005).

This 1989 book integrated pioneering reflections from work on the life cycle and the circular economy, by analyzing efficiency strategies in the use of resources required for the production and use of goods manufactured along these five phases of the life cycle, with loop effects (Figure 1.4): the product's design phase, production, distribution, use of the goods produced, and finally, the recycling and processing of materials at the end of their life (Giarini and Stahel 1989). Different strategies for optimizing the use of goods were presented as a function of the optimization of their material production conditions and their recycling possibilities.

Note that within these phases, services contribute significantly to extending the product life cycle. They play a key role in prevention strategies against waste resulting from commercial activities (Merlin-Brogniart 2021). The product distribution phase is intensive as a function of services. Feedback loops presented in the productive system are primarily obtained from services. Thus, strategies for extending the life of goods/components, reconditioning, reuse (e.g. transportation service, logistics, consulting service), or even technological updating (such as the IT service) (B/C) and recycling (R) are carried out with the support of the services and their capacity to support use. Certain phases rely on the outsourcing of service functions from industrial companies (such as the product design phase). We can note that service activities also participate in the extraction and exploitation of resources, as support services for the production of goods (e.g. transportation and logistics services, IT services, marketing-communication, packaging, sales, etc.), and can also generate negative externalities related to energy consumption, which increases the environmental pressure.

Commercial waste prevention strategies (V) call for new business models. This is where the Functional Economy is located, as it relies on uses and no longer on the purchase of goods: the sale of use, multiple and shared uses, pooling, the sale of a result or a performance. But these functional systems rely on other strategies, such as long-lasting or eco-designed goods (strategy A) – to support the service – and more generally systems that increase the good's lifespan (strategies B and C) and finally, the establishment of service systems associated with the creation of loops (the 4Rs) – end of life of the service support.



CLOSING THE MATERIAL LOOPS

I. Strategies for slowing down the flow of matter through the economy
   A. Long-life goods: Philips induction lamp, Ecosys printer
   B. Product-life extension of goods:
      B1. Reuse: reusuable glass bottles
      B2. Repair: car windscreen, flat tire
      B3. Rebuild: retreaded tires, renovated buildings
      B4. Technology upgrading: Xerox copier 5088, PC-AT,
   C. Product-life extension of components:
      C1. Reuse: refill printer cartridges, roof tiles
      C2. Repair: welding of broken machine parts
      C3. Rebuild: revacuum insulating windows
      C4. Technology upgrading: upgrading of jet engines to new noise standards
   D. Remarketing new products from waste (product-life extension into new fields)
II. Strategies for reducing the volume of matter through the economy
   M. Multifunctional goods: Siemens 'FAX', Swiss Army knife, adaptable spanner
   S. System solutions: micro cogeneration of cold or heat and power, road rail

CLOSING THE LIABILITY LOOPS

I. Strategies for a cradle-to-cradle product responsibility
   V. Commercial or marketing strategies
      V1. Selling use instead of goods: operational leasing of cars, aircraft, trucks, construction equipment, medical equipment, photocopiers, apartment rentals
      V2. Selling shared-use services: laundromat, hotels (beds),
      V3. Selling services instead of products: lubrication quality instead of engine oil
      V4. Selling results instead of products: pest- and weedfree fields instead of agro chemicals, individual transport instead of cars
      V5. Monetary bring-back rewards: 10-year cash-back guarantee

Figure 1.4. *Resource efficiency strategies in a service economy focusing on "use" (Source: Giarini and Stahel (1989, p. 84))*

In this analysis, the producers of goods are not the only stakeholders involved in the creation and capture of service value: consumers, qualified as *prosumers*, can engage in production or service activities and create use themselves as consumers by repairing or participating in the recycling of goods. This book also provides reflections not only on the establishment of a *circularization* of production, via these material loops strategies, but also on the questions of responsibility of the actors in the functioning of the systems presented. The approaches we will now explain rely on this pioneering work to varying degrees or exploit the strengths of the new service society in their work.

It should be noted that, in *The Limits to Certainty*, the authors are situated in "weak" sustainability with regard to the environment (Serra 2018), in the sense that they do not challenge the dominant wealth creation regime, sustainability being understood as the extension of the lifespan and use of capital goods. The Functional Economy will then be interpreted as sustainable thanks to its capacity for dematerialization, which decouples wealth creation from environmental pressure (Stahel 1997).

1.2.2. *"Product-service systems"*

The numerous works classified under this category are grouped around the designation PSS (Product-Service Systems) (Hockerts 1999), which can be associated with the concept of Functional Economy. Even though they do not always refer to it, these works are a continuation of those by Giarini and Stahel (1989) – in the sense that, for these authors, the dematerialization favored by the service economy would be a solution to attain sustainable growth. The exhaustion of Fordist-type productive models has led certain companies to associate services with their initial supply, in order to obtain new growth opportunities, or to stand out from the competition. These approaches, which influence one another, essentially study market activities and are part of work in engineering, economics and management science.

Historically, the provision of additional services to the product sold (such as credit facilities, maintenance, after-sales service) was integrated very early by certain companies. These services are part of the servitization process in the industrial and agricultural sectors (Giarini and Stahel 1989). Some of this work focuses on servitization strategies (Toffel 2002) (servitization, servicizing). In other works, more managerial studies identify the *product-related services* (Vandermerwe and Rada 1988; Anderson and Narus 1995; Furrer 1997). Finally, some authors consider that obtaining sustainable competitive growth can be achieved by the use of goods as well as by the use of services to establish the proposed function (Goedkoop et al. 1999; Mont 2002; Baines et al. 2007). These product-service systems can be offered by a firm alone or in partnership with other companies. In certain cases, the consumer can also participate in the production of the supply (Tischner et al. 2002; Tukker and Tischner 2006).

Servitization is the transition dynamic from manufacturing activities to a supply incorporating services, to varying degrees. This scientific community, first established in the Netherlands, Scandinavia and Italy, spread across Europe, Asia and the United States. These authors study the characteristics of services compared to those of goods, analyze the types of configuration and organization enabling the transition from the sale of a product to the sale of an integrated supply of products and services, the types of interaction, and the nature of the value created with and for the customer, as well as the advantages and disadvantages of different strategies associated with the product-service supply (Furrer 1997; Baines et al. 2009). Other works associated with servitization instead use the term *servicizing*. These works, developed in the United States (University of Massachusetts), focus on reducing the environmental impact and extending producer responsibility. They warn against the risks associated with servitization (information asymmetry, bilateral dependence, technological obsolescence) (Toffel 2002). In these works, reducing the use of materials is seen as an opportunity to create value (Rothenberg 2007).

The concept of *functional sales* (Lindahl and Ölundh 2001) is similar to that of servitization and PSS and joins the servitization dynamic of manufacturing industries. *Eco-efficient services* are analyzed as innovation strategies – commercial offers – aimed at changing consumer behavior, with a view to reducing the environmental impact associated with consumption. In Meijkamp's definition (2000, p. 35 (translation by Serra (2018))), "eco-efficient services are services, relating to any type of product, in which certain ownership rights are retained by the producer". Ownership rights over the product are as follows: right to use, right to profit from the product, right to sell or destroy the product, right to modify the product's properties and right to exclude other actors from its use (Serra 2018). For certain authors (Neely 2008; Baines et al. 2009), servitization constitutes organizational innovation strategies, whereas the PSS, eco-efficient services or functional sales, constitutes the *business models* associated with such strategies. Eco-efficient services are found in Tukker's PSS typology (2004), which is today mainly used by the scientific community conducting research on PSS. This type of classification is also popularized under the name of *product-service* ***continuum*** (Oliva and Kallenberg 2003).

1.2.2.1. *Tukker's classification of PSS (2004)*

There are many authors using the terminology "*product-service systems*". This field of analysis saw a peak in publications in 2010 (Serra 2018). In the report on PSS commissioned by the Dutch Ministry of the Environment and the Dutch Ministry of Foreign Affairs in 1999, Goedkoop et al. provided the definition at the start of their study (Box 1.4).

> A PSS is a marketable set of products and services capable of satisfying a user's need. [The PSS] is provided by either a single company or an alliance of companies. It can encompass products (or just one) plus additional services. A service can be combined with a product, and both can be equally important for a function. (Goedkoop et al, 1999, p. 18 in Pourranjbar and Shokouhyar (2023)).

Box 1.4. *The PSS according to Goedkoop et al. (1999)*

Tukker's typology (2004, p. 248) proposes eight types of PSS based on three main categories: product-oriented PSS, use-oriented PSS and result-oriented PSS (Figure 1.5).

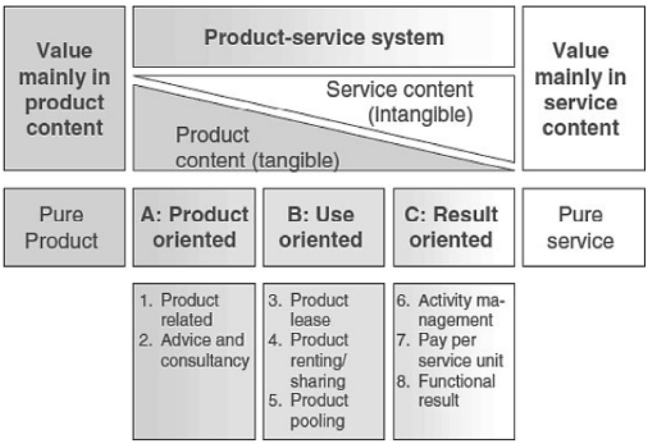


Figure 1.5. *Tukker's typology (Tukker 2004)*

Product-oriented PSS offer an additional service to the product sold. In this context, the company's productive concept is not modified.

Today, a large number of companies offer this type of service associated with the sale of goods, allowing either to support the sale (financing, training, insurance) or to solve problems related to the product's purchase (after-sales service, maintenance, product recovery at end of life, etc.). The mode of transaction always remains focused on the product's ownership transfer to the customer. Within this category, he distinguishes between *service-oriented products* (those we have just stated), and, on the contrary, the services that optimize the product's use, called *opinion and advice*.

Like the result-oriented PSS, the second type of PSS, the use-oriented PSS, is based on a more innovative productive configuration, since the producer's responsibility is extended.

Ownership of the rented/shared material asset remains in the hands of the service producer, which leads him to take care of the maintenance and control of the physical support concerned.

In the use-oriented PSS, the physical medium always plays an important role. This category has three subcategories: the *product rental model*, where the consumer pays a rent granting unlimited use of a good for a given period; the *product rental and sharing model*, where the use of the good is sequential; the *product pooling* or *product sharing* model, where the use of the good is simultaneous between users.

Product-oriented PSS	This business model is based on the sale of a good, to which the provider adds supplementary services. *Product-Related Service.* These services can be added during the product use phase. For example, maintenance, financing, recovery and recycling. *Advice and Consultancy.* Services that optimize product use by the customer. For example, advice.
Use-oriented PSS	In this model, the supplier retains product ownership, but the physical medium still plays an important role. *Product-lease.* The consumer pays a rent granting unlimited use of a good for a given period. The producer is in charge of maintenance and controls the good. For example, financial *leasing*, automobile or computer equipment. *Product Renting/Sharing.* The use of the good is sequential. Over time, the good will be used by several customers. For example, short-term rental, household appliances, bike sharing, car sharing, clothing and accessories. *Product Pooling* or *Product Sharing*. The use of the good is simultaneous between users. For example, public transportation and carpooling.
Result-oriented PSS	The service is based on a commitment to results or a performance to be obtained. No product (good or service) is predetermined to meet the use provided. *Activity Management: outsourcing.* The management of activities is delegated to a service provider or third party. The contract includes results indicators. For example, office cleaning activity and office canteen. *Pay Per Unit Use.* The good is no longer purchased or rented by the customer: it is the function performed which constitutes the object of the transaction. For example, Xerox and the pay-per-copy, Michelin and payment per kilometer driven. *Functional Result.* The supplier commits to the result, not the means to achieve it. For example, climatic comfort.

Table 1.1. *The different types of PSS and examples (source: inspired by (Tukker 2004; Serra 2018))*

1.2.2.2. *The environment*

Finally, for result-oriented PSS, the goal is to sell a solution to the customer, regardless of how that result is reached. The producer guarantees the satisfaction of the consumer's needs, whatever the combination of products and services used (Van Niel 2014). In other words, customers may very well not be informed about how the company gets organized to meet their needs (Buclet 2014). Furthermore, in this model, all expenses related to the implementation of this range of solutions fall under the responsibility of the producer. In the *business management subcategory: outsourcing*, the management of activities is delegated to a provider or a third party. The contract includes results indicators. In the *payment per unit of use subcategory*, it is the function fulfilled which constitutes the object of the transaction: the good is no longer purchased or rented by the customer. In the *functional result subcategory*, the supplier commits to the result and not to the means of achieving it. In this form of PSS, the risk is greater for the provider due to the obligation to achieve results. Table 1.1 summarizes these categories and associates them with examples.

While some of the approaches have assessed the impact of these activities on economic growth and environmental decoupling since the end of the 1990s (e.g. Goedkoop et al. (1999)), the link to the environment was not necessarily established in the first definitions that were produced. With the evolution of concern for the environment, this environmental dimension is far more present nowadays. We propose Mont's (2002) definition of PSS (Box 1.5), which reflects the importance given by these approaches to economic competitiveness, customer satisfaction and environmental impact.

A PSS is a "system of products, services, supporting networks and infrastructure that is designed to be: competitive, satisfy customer needs and have a lower environmental impact than traditional business models."

Box 1.5. *Mont's definition of PSS (source: Mont (2002, p. 240))*

Some of these authors attempt to show how the service society makes it possible to reduce environmental impact by using product life cycle analyses (LCAs). Goedkoop et al. (1999) compare a classic sales activity with the environmental impact produced by the new activity providing the PSS at the different stages of the product life cycle. The environmental burden considered includes the energy and material intensity of production, as well as the discharges (emission waste) resulting from it. These authors indicate that most of the time, the service industry has a less significant impact on the environment than the same function fulfilled by a good. However, this is not always the case, and it is therefore necessary to check this impact for each product-service system experience. Following the same principle, Tukker (2004) proposes an environmental impact reduction index according to the type of product-service system. He considers resource efficiency, such as product maintenance and recovery, which extends the good's lifespan, the product's design over its life cycle (increased use through sharing) or even green technologies.

The potential for reducing environmental impact depends on the types of product-service systems. Certain configurations may not improve (or could even deteriorate) the impact. This is the case of leasing, when the consumer does not take care of the good, or when short-term rental is associated with an increase in distribution flows (increase in energy impact). Result-oriented product-service systems are the only category that systematically reduces the environmental impact. This reduction is more or less strong, depending on the configuration. The study by Laperche and Picard (2013) reached the same conclusion. This study covers 10 CAC 40 (Paris stock index) industrial companies. The analysis of eco-innovative strategies shows that the majority of product-service systems generated by these companies are complementary services to the goods already produced. The internal organizational implications are often marginal. On the contrary, when the addition of services concerns the life cycle management associated with the products, the changes in innovation management are more important. In point of fact, they can hardly be achieved by an isolated firm (e.g. innovations associated with the emergence of new practices, such as mobility), because innovation involves cooperation with other actors (external innovation and open innovation).

1.2.3. *Functional and cooperative economy*

This development was mainly proposed in France, after the beginning of the 2000s, by Christian Du Tertre, the Functional Economy and Sustainable Development Club and the ATEMIS firm (Merlin-Brogniart 2020). These actors created the European Institute for the Functional and Cooperative Economy (EI-FCE)[13]. The approach to the functional and cooperative economy is part of "alternative" approaches (Sidoli 2017). These authors were looking for a new development regime, in which "value is no longer be apprehended in products and services as such, but by the 'useful effects' their integration provides in terms of use" (Gaglio et al. 2011, p. 2).

This approach was first called *functional and sustainable development economy*, before being renamed *functional and cooperative economy*. With regard to Stahel's works (1997,

13 This 1901 law association brings together researchers, consultants, local authorities, as well as several territorial functional clubs (the original acronym in French being IE-EFC).

2006), this conception of the Functional Economy focuses on performance, the intangible economy (Du Tertre 2006, 2007, 2011), the functional ecosystem (Lauriol 2011) and employment.

These authors highlight four fundamental directions which constitute the functional and cooperative economy (Gaglio et al. 2011, pp. 6–9).

– "Valuing the notion of solution as well as a systemic and territorialized approach towards the Functional Economy": the authors stress the need for the "assembler" company to shift the scope of challenges when building their proposed "solution". What differs from traditional solutions is that this solution must be built by mobilizing stakeholders at the origin of needs (and not built ex nihilo by providers), in order to identify potential use conflicts experienced by the actors.

– "Insisting on cooperation inherent in the Functional Economy and the question of work": companies can propose new forms of cooperation – horizontal (between companies) and vertical (within organizations) – in which the questions of work content and well-being at work are essential.

– "Inventing endogenous institutional schemes for the Functional Economy supply": according to these authors, thinking in terms of the functional sphere (mobility, health, housing) rather than a sectoral approach leads to the establishment of new regulatory territorial institutions at the subnational level.

– "For a constructivist and non-functionalist vision of the Functional Economy": the term "functional" is discussed by these authors. The latter should not be considered in relation to the service – which may be useful or not in itself (in a logic of adding or removing options) – but the function should be constructed by the stakeholders, depending on their vision at a given moment, to address a customer problem satisfaction.

These four directions are built around four development logics: the service logic, the broadening of the notion of performance, the functional ecosystem and the relationship to work.

1.2.3.1. *Service logic and the intangible dimension*

Service logic is the basis of their work. The Functional Economy is defined by the following dynamic:

> Building new economic perspectives in *useful effects* (referred to as "solutions") provided by the integration of the use of products and services makes it possible, on the one hand, to take charge of the environmental and social externalities of production and consumption, and on the other, to consider a development model associated with the decline of material resources and the growth of intangible resources (Gaglio et al. 2011, p. 2).

This service dynamic, however, has a more strategic (or cooperative) rather than sectoral meaning than the service approach, in the sense that this range of solutions relying on a service dynamic is "provided by a group of stakeholders on the basis of the cooperative management of 'an indivisible shared good' resulting from the positive externalities associated with the implementation of this supply over time" (Zacklad 2007, p. 2). These reflections on a new frame of reference, opposed to the currently dominant model, were built from concrete experiences (Gaglio et al. 2011). Following the impetus given by ATEMIS, and then by the EI-FCE, a network of structures, called "clubs" has been developed since 2007, supporting the economic transition based on the functional and cooperative economy dynamics. These "clubs", 12 in number (in 2024), located in mainland France, overseas, as well as internationally (in Brazil), disseminate knowledge on the functional and cooperative economy, network the actors embracing this approach, support business innovation and promote the emergence of collective dynamics by relying on a network of facilitators[14].

1.2.3.2. *Broadening the notion of performance*

The functional and cooperative economy model is based on the search for a new type of performance, consistent with sustainable development. Performance will integrate the management of negative externalities, particularly environmental ones, and the consideration of positive externalities related to services (such as the organization's skills, the team coherence, the organization's relevance or even the development of an intangible collective heritage). The ability to transform information into knowledge and the re-territorialization of the financial sector contribute to the regime's evolution.

1.2.3.3. *A functional ecosystem*

The authors of this approach identify two development stages. The first stage "involves shifting from the sale of goods or services, dissociated from one another, to the contractualization of use performance and/or of useful effects based on their integration". Here, we find the concept of Functional Economy proposed by Stahel. The second stage seeks "to broaden the scope of activities and actors in such a way that the systemic leap that this involves allows the productive ecosystem to take charge of negative environmental and social externalities, identifiable at the

14 List of clubs in 2024: *Club Noé Hauts-de-France, Terres d'FCE Île-de-France, Club CLEF Auvergne-Rhône Alpes, Club INNÉ Normandie, Nekoé Centre Val-de-Loire, Club FCE Grand-Est Strasbourg, Terres d'FCE Occitanie, Terres d'FCE Bassin d'Avignon-Arles-Nîmes, Terres d'FCE Océan Indien, Club Rio de Janeiro, Dynamique FCE Nouvelle-Aquitaine via l'ADI N-A, Dynamique FCE Bourgogne-Franche-Comté.* Available at: https://www.ieefc.eu/reseaux-efc/clubs-territoriaux/ [Accessed January 6, 2024].

territorial level"[15]. To reach this stage, cooperation between actors at a trans-sectoral level is needed. A functional ecosystem relating to a specific function (health, housing, mobility, education, etc.) is co-constructed starting with a territory (Du Tertre 2011). This notion of territorial co-construction has been experimented within the framework of the functional and cooperative economy, for around 15 years, in a certain number of territories, such as the Union zone in Roubaix[16], or the town of Loos-en-Gohelle[17].

1.2.3.4. *The relationship to work*

The particularity of *the functional and cooperative* economy approach is that it makes room for understanding transformation and well-being at work. Setting up a cooperative system, between employees and externally, leads companies to reconsider their practices in terms of marketing, and especially work, the engagement of employees in this new approach, and in terms of management and ergonomics.

1.2.4. *The Functional Economy*

This body of work is also a continuation of that of Giarini and Stahel (1989). Following Serra (2018), we should draw a distinction between these (essentially French) works (Buclet 2014; Maillefert and Robert 2014; Van Niel 2014; Maillefert and Screnci 2016), and those associated with *the functional and cooperative economy*, in the sense that their concerns are a little different. In particular, these authors were

15 Available at: https://www.club-economie-travailnalite.fr/accueil/d%C3%A9finition-de-l-%C3%A9conomie-de-la-travailnalit%C3%A9/ [Accessed June 11, 2023].
16 Available at: https://www.ville-roubaix.fr/wp-content/uploads/2022/09/stratgie-politique-economie-circulaire-version-cm.pdf [Accessed June 11, 2023].
17 Available at: https://loos-en-gohelle.fr/ressources/ [Accessed June 11, 2023].

immediately interested in non-market modes of coordination (Buclet 2014; Maillefert and Robert 2014), which can take place at different moments of the transaction. They analyze the place attributed to the collaborative economy in the typology of Functional Economy models (Maillefert and Robert 2014; Maillefert and Screnci 2016). Furthermore, these works do not consider that the company necessarily plays a central role in exchanges.

These publications, more theoretical in nature, are at the origin of the state-of-the-art analyses on the Functional Economy (Van Niel 2007, 2014; Buclet 2014; Serra 2018). The classifications of the Functional Economy established by these authors indicate that the non-transfer of ownership of physical media between the provider and the user and the broadening of the scope of producer responsibility are common characteristics to the Functional Economy categories. These authors have also studied the bridges between the notions attached to sustainable development (Maillefert and Robert 2014, 2020; Merlin-Brogniart 2017, 2020; Bourdin and Maillefert 2020; Laperche and Merlin-Brogniart 2020). The notion of eco-design in Functional Economy models is analyzed in accordance with the territorial scale or the function considered and in terms of the actors' action (Buclet 2014). These authors question the notion of territory and describe the collective practices of different sustainable models (circular economy, industrial and territorial ecology, Functional Economy) (Maillefert and Robert 2020). Other authors emphasize the changes in consumer behavior required for the establishment of cooperative systems (Van Niel 2014).

It should be stressed that although we differentiated these two approaches in their origins – due to the research spectrum they analyze and their way of proceeding – *the functional and cooperative economy* approach relies more on the monitoring of experimentation by companies and *action* *research*, whereas the *Functional Economy approach* mainly brings together academic researchers. But these two approaches are not hermetic. As we have mentioned, certain authors that we classify under *the functional and cooperative economy or Functional Economy* approach contributed to Worksite 31 during the Grenelle Environment Forum (2017). Furthermore, actors in the functional and cooperative economy approach share their experiences, open conferences and projects with academic researchers, in order to expand the functional and cooperative economy ecosystem of actors and share the knowledge of this model[18].

We propose focusing the analysis of this approach on their study of collaborative consumption, as well as the coordination and relationship with environmental preservation.

1.2.4.1. *Collaborative consumption*

Collective consumption was already apparent in Tukker's (2004) category of product-service systems. However, it appeared as a subset of the use-oriented product-service system category. Van Niel (2014) suggests dissociating this form of exchange from others, because income generation is not the same and, in this exchange, it is the pooling of products' use that makes it possible to obtain the environmental gains. Furthermore, this author proposes keeping only the "use-oriented" and "result-oriented product-service systems" categories from Tukker's classification (2004), which do not imply ownership transfer.

18 See, for example, the Coop'ter program, launched in 2021, led by ATEMIS-LIR and financed by ADEME, which includes the animation of a research community on the Functional Economy. Available at: https://www.atemis-lir.fr/developpement-durable-des-territoires/coopter/; as well as the research community report (2023). Available at: https://librairie.ademe.fr/dechets-economie-circulaire/6225-economie-de-la-fonctionnalite-et-de-la-cooperation.html.

Non-market functional transactions are "forms of sharing goods and services based on reciprocity – what anthropologists and sociologists, in the tradition of Marcel Mauss, also qualify as gift/counter-gift" (Van Niel 2014). According to Van Niel (2014, p. 7), collaborative consumption is made up of a supply "which is used successively by several customers". The author refers to short-term rental, and within this category, distinguishes between market and non-market modes of coordination (self-service mobility, car sharing, bike sharing, local exchange systems (LESs)). In the case of LESs, the exchange is carried out with an alternative currency, which enables the exchange of multiple use functions via working time (services): domestic work, for example. These mechanisms have a local dimension, which reduces transportation-related externalities.

For the same supply, for example, car sharing, it is possible to identify market solutions (Zipcar, Renault Mobility) and non-market solutions (Mobility Carsharing, in Switzerland, which operates through a reciprocity process). With the development of territorial sustainable mobility policies, part of this supply brings together various actors, such as citizens or actors from the associative world, as well as territorial public actors, like the car sharing network "Citiz network" (Serra 2018).

Serra (2018, pp. 279–280) identifies five forms of sharing economy or collective economy, which can be market or non-market (Table 1.2). Their difference lies in the role attributed to currency:

– serves to increase one's wealth;

– used as a simple tool for value equivalence;

– is an object foreign to coordination.

In the first case, the sharing economy can be commercial, like traditional rental companies, either B2B, B2C, C2C or B2G. In a second case, the sharing economy can propose a *third-sector economy* – in other words, a *decommodification* of monetary transactions, when non-profit actors (associations, cooperatives) propose the supply. These models operate on the basis of redistribution or reciprocity principles. The third form is the sharing economy of the alter-economy type, where equivalences are demonetized through the introduction of an alternative currency or gift in exchange for a gift. The fourth category, the public sharing economy, groups the projects carried out by public actors, who supply these collective goods through different forms of delegation to a service provider in the form of a call for tenders. Finally, the last category also involves the deployment of public policies, but does not lead to monetized exchanges (free provision of the good, self-service or not). In these collective solutions, the monetary savings made by users and the reduction in environmental pressure related to the passage towards collective consumption are often put forward as justifications for exchange.

Type of collective consumption	**Characteristics**	**Orchestrating subjects**
Market sharing economy	Professional to professional markets, professionals to individuals, individual to individual. Goods accessible on demand and/or free access. Profit seeking.	Traditional rental companies, vehicle manufacturers, start-ups or NTIC-related companies mastering sharing technologies: Renault, Avis, Zipcar, Gobee Bike, Bolloré, JC Décaux, Clear Channel, Ouicar, Drivy.

Third-sector sharing economy:	Non-market relationships (reciprocity sphere). Pooling (redistribution sphere). Recourse to money for exchange equivalents. Adheres to a community of actions and values.	Cooperatives, associations, non-profit collaborative platforms: Mobility, car sharing, Citiz network.
Sharing alter-economy:	Reciprocity sphere: free loans, chains of donation of objects, donation of time. Organizations to individuals or individual to individual. Recourse to alternative money or other forms of equivalence (value of the relationship, recognition).	Cooperatives, associations, individual initiatives, SEL, non-profit collaborative platforms.
Public sharing economy:	Redistribution sphere. Public service territorial policies. Service delegation to a private or public actor. Recourse to money for equivalent values. Seeking equitable exchange, not profit.	Territorial communities and minor branches: Syndicat Mixte Autolib´, Velib, Lyon Métropole, OBNL Bixi Montréal.
Civic sharing economy:	Redistribution and reciprocity sphere. Available goods for the community. No money transfer is added to traditional collection systems.	Public authorities and territorial communities: Saverdun Town Hall.

Table 1.2. *Forms of collective consumption (source: Serra (2018, p. 279))*

Thus, the collaborative economy has a common scope with the Functional Economy. Collaborative consumption refers to situations in which "one or more people consume economic goods or services in a process which involves engaging in common activities" (Robert et al. 2014, p. 4). Collaborative consumption includes "situations where use takes precedence over product ownership (sharing, loan, rental which can be intermediated by a market) and situations where ownership transfer actually takes place (donation, barter). These have been (re)developed since the early 2000s, in the wake of the collaborative Web or Web 2.0" (Serra 2018, p. 286).

As a result, exchanges in the collaborative economy, which give rise to ownership transfer (for example, bartering), are excluded from the Functional Economy. Other situations: use-oriented product-service systems (free loans or no consumer goods), the book crossing redistribution market (book box, insofar as the book is returned), the sharing of intangible resources such as coworking practices and knowledge sharing communities. However, the motivations for this type of exchange do not necessarily lead to major changes in consumption patterns; some exchanges are motivated by social ties, others by the "good economic deal", by recreational motivations (consumer experience) which can go as far as the "vicious circle of renewed desire" (Robert et al. 2014). As a result, not all collaborative economy experiences correspond to the Functional Economy. In particular, the consequences in terms of environmental pressure will depend on consumer behavior.

1.2.4.2. *Coordination and relationship to environmental preservation*

Buclet (2014) considers the Functional Economy as a new mode of coordination in which the company is no longer necessarily central (Box 1.6). This definition is opposed to other approaches for which the company retains its central role in the production of collective goods (Serra 2018).

The Functional Economy is "an evolution of the economic model in the way of relating between the company and its environment, or a more general overhaul of the relationships between actors, including the central place of the company as a production actor".

Box 1.6. *Definition of the Functional Economy: focus on coordination between the actors (source: Buclet (2014, p. 8))*

Type 1	Selling the good's use rather than the good itself. The function the good addresses is targeted and the good is exclusively produced for this use. Not necessarily eco-design, nor re-design in order to sell the good. For example, Michelin Fleet Solution, operational tire rental on a pay per km driven basis. Also applicable for clothes and jewelry rental.
Type 2	Redesigning a good as a function of its use mode. The physical support for the function is precise and identified, but has been redesigned for a pooled use among users. This re-design does not necessarily imply eco-design practices. For example, Velib and free-service biking services, car sharing.
Type 3	Redefining the scope of an activity and the physical media enabling users to produce the supplied functions. The re-design of goods is required to address the new envisaged function. The practice of eco-design is not systematic. The producers of goods become producers of functions, likely to evolve independently from the physical support proposed. For example, the company Signature, branch from Vince Group, who shifted from the sales of route signaling displays to the sale of information about mobility.
Type 4	The service supplied is based on the multi-modality of supporting physical media available to customers/users. The provider proposes producing various functions by means of a unique physical support media. Eco-design of the physical media. No systematic re-design. For example, Xerox and its document management service based on the rental of multi-modal printers including data index services.

Type 5	Supply of a function in order to meet the needs expressed at the territorial level. A global function is produced by a functions system. Eco-design of the system, not of the physical support. This category constitutes an ideal-type. For example, BIXI Montréal, community mobility services (La Rochelle, Grenoble, …).
Type 6	Co-design of a function (and the physical support). Meets a functional demand. Local production of physical support even reaching self-production or collaborative production at the service of capabilities development. For example, Fab-labs and the availability of software, tools and skills for the design of objects and technical problem-solving.

Table 1.3. *The typology of functional models proposed by (Buclet 2014), simplified by Serra (2018) (source: Serra (2018, p. 293))*

The author refines the Functional Economy typology by listing the models as a function of the actors' intentions and the sustainable development logic used (weak or strong sustainability). This typology integrates cases of Functional Economy inspired in a reflection on product-service systems. The common point of these Functional Economy experiments lies in the fact that the actors producing the functions no longer sell the physical media necessary for this production. The six functionality models proposed by Buclet (2014), summarized in Table 1.3, depend on the following:

– the role of physical support (uniqueness of support and target support, multiplicity of physical supports, pooling of uses);

– the nature of the design of the response to user needs, or the good's redesign, depending on its use;

– taking into account environmental externalities and eco-design practices;

– methods for deploying collective action via pure market coordination, via a cooperation logic or via a logic that escapes the pure market logic (addition of redistribution and reciprocity principles).

Depending on the types studied, market logic fades in favor of cooperative processes between several types of actors. Functional economy types vary depending on the strategies at the origin of these activities: ranging from an eco-design logic, driven by the business world and relying on the internal organization of the company or the sector, to a territorial development logic, based on the coordination of actors, appealing to external organization questions.

1.2.5. *Synopsis*

Table 1.4, proposed by Serra in his thesis (2018, pp. 196–197), references the terms in the literature relating to the Functional Economy (see also Serra and Buclet (2020)). This table compiles most of the approaches presented in the previous points and has the advantage of analytically separating the subcategories which do not fall within the scope of the Functional Economy. Let us stress that the terms used in French or English, sometimes similar, associate different exchange categories and, therefore, tend to generate confusion. However, the common denominator of these approaches is always the optimization of use value.

In this table, we see that the scope of the Functional Economy incorporating product-service system approaches is more extensive with the product-oriented PSS category. According to these approaches, strategies to implement the introduction of services throughout the product life cycle fall under the Functional Economy. This category (product-oriented PSS) is not retained in other Functional Economy approaches (French publications), because it implies the good's ownership transfer from the supplier to the customer. Consequently, the intensity of the producer's intervention in the creation of value (the production of useful effects for the customer) is not modified (Van Niel 2014), which means that the producer's extended responsibility in relation to environmental performance challenges is essential in these approaches. Table 1.4 constitutes a synopsis of our perspective on Functional Economy(ies).

1.3. The Functional Economy and its applications

Organizations wishing to embrace the ecological transition often come across difficulties in detecting the differences and similarities between sustainable models such as the Functional Economy, the circular economy and industrial ecology. This analysis would require substantial developments which are not the subject of this book. To remedy this, we provide some answers to these questions.

1.3.1. *The Functional Economy and the circular economy*

The circular economy is a recent concept and not yet stabilized. Research from the Ellen MacArthur Foundation, created in 2010, structured this notion around the economic potential that the circular economy could bring to businesses and society. Its works present the circular economy as a new industrial model, opposed to the linear model of resource consumption, which results in the extract-manufacture-dispose sequence. This foundation is at the origin of the report entitled "Towards a circular economy", written by McKinsey[19], a specialized consulting firm. The circular

19 Three volumes are proposed: *Arguments économiques en faveur d'une transition accélérée* (2012); *Opportunités pour le secteur des biens de consommation courante* (2013); *Accélérer son adoption à travers les chaînes d'approvisionnement mondial* (2014).

economy is presented as an asset for companies, insofar as it enables a substantial reduction in expenses and greater independence from the supply of raw materials (Gallaud and Laperche 2016). Inspired in varied practices (eco-design, renewable energy, short circuits, industrial ecology, Functional Economy), this model proposes to strengthen consumer loyalty via the use of rental contracts (in other words, the Functional Economy), and to simplify the design of products (material equipment) in order to improve the management of the product's life cycle (especially for facilitating recycling by reducing the materials used).

On the macroeconomic level, reducing negative externalities related to waste production and innovation would improve employment and the population's well-being.

The dissemination of the notion of circular economy, and above all of Functional Economy, takes different forms depending on the country.

In France, the notion of circular economy was publicized thanks to the work of the Grenelle Environment Forum in 2007. ADEME proposed an operational definition, which is now widely used (Box 1.7).

> According to ADEME (2014), the *circular economy* "is an economic system for exchange and production which aims to increase efficiency in the use of resources at all stages of the product's life cycle (goods and services) and to reduce the impact on the environment [...], while developing the well-being of individuals" (ADEME 2014, p. 1)

Box 1.7. *Definition of the circular economy, according to ADEME*

<table>
<tr><td></td><td colspan="2">Out of the field</td><td colspan="8">Within the Functional Economy field</td></tr>
<tr><td rowspan="3">The Functional Economy [STA 97]</td><td colspan="2">Material Loop</td><td colspan="8">Liability Loop</td></tr>
<tr><td colspan="2" rowspan="2">A: Long life goods
B: Product-life extension of goods</td><td colspan="2">V1: Selling use instead of goods</td><td colspan="2">V2: Selling shared-use services</td><td colspan="2">V3: Selling services instead of products</td><td colspan="2">V4: Selling results instead of products</td></tr>
<tr><td colspan="2">M: Multifunctional goods</td><td colspan="2">S: System solutions</td><td colspan="4">V5: Bring Back Reward</td></tr>
<tr><td rowspan="2">Product-Service Systems [TUK 04]</td><td colspan="2">Product oriented</td><td colspan="4">Use-oriented</td><td colspan="4">Result-oriented</td></tr>
<tr><td>Advice and Consultancy</td><td>Product related services</td><td colspan="2">Product Leasing</td><td>Product renting or sharing</td><td>Product pooling</td><td>Activity management</td><td colspan="2">Pay per service unit</td><td>Functional result</td></tr>
<tr><td rowspan="2">Eco-efficient services [HOC 99]</td><td colspan="2">Product-oriented services</td><td colspan="4">Use-oriented services</td><td colspan="4">Need-oriented services</td></tr>
<tr><td>Training and Consulting</td><td>Maintenance and disposal services</td><td colspan="2">Product leasing</td><td>Product renting or sharing</td><td>Product pooling</td><td colspan="2">Facility management</td><td colspan="2">Least-cost supply</td></tr>
<tr><td rowspan="2">Eco-efficient services [MEI 00]</td><td colspan="2" rowspan="2"></td><td colspan="2">Product-life extension</td><td colspan="2">Product-use services</td><td colspan="4">Result Services</td></tr>
<tr><td colspan="2">Operational leasing</td><td>Product sharing</td><td>Product pooling</td><td colspan="2">Facility management</td><td colspan="2">Least-cost planning</td></tr>
<tr><td rowspan="2">Servicizing [STO 09]</td><td colspan="2">Product-oriented</td><td colspan="4">Use-oriented</td><td colspan="4">Result-oriented</td></tr>
<tr><td>Advice and Consultancy</td><td>Product related services</td><td>Product leasing</td><td>Product renting or sharing</td><td>Pay per service unit</td><td>Product pooling</td><td colspan="2">Activity management</td><td colspan="2">Functional Result</td></tr>
</table>

<table>
<tr><th rowspan="2">Functional Economy [VANN 14]</th><th colspan="2">Product-oriented</th><th colspan="6">Use-oriented</th><th colspan="2">Collective consumption</th><th colspan="3">Result-oriented</th></tr>
<tr><td>Advice and Consultancy</td><td>Product related services</td><td colspan="3">Leasing</td><td colspan="3">Functional sales (Pay per service unit)</td><td>Sharin g</td><td>Pooling</td><td>Delegated management</td><td>Performance contracts</td><td>Least-cost planning</td></tr>
<tr><td rowspan="2">Functional and cooperative economy [ROB 14]</td><td colspan="2" rowspan="2">Industrial ecology</td><td colspan="7">Shared-use services (Use-oriented PSS)</td><td colspan="2">Redistribution markets</td><td colspan="2">Collaborative lifestyles</td></tr>
<tr><td>Leasing</td><td colspan="3">Renting</td><td colspan="3">Peer to Peer</td><td>Bartering Exchange</td><td>Gift</td><td colspan="2">Sharing of intangible resources (coworking, crowdfunding)</td></tr>
<tr><td rowspan="2">Functional Economy [BUC 14]</td><td colspan="2" rowspan="2">Circular economy
Industrial economy
Industrial and territorial economy</td><td colspan="8">Use-oriented solutions</td><td colspan="3">Function-oriented solutions</td></tr>
<tr><td colspan="2">Type 1: sale of a use</td><td colspan="3">Type 2: re-design of a good for use</td><td colspan="3">Type 4: multimodal goods</td><td>Type 3: re-design of activities</td><td>Type 5: supply of a territorial function</td><td>Type 6: co-design of functions and physical support means</td></tr>
<tr><td>Functional Economy [TER 10]</td><td colspan="2">Clean industrial model
Industrial ecology
Service economy</td><td colspan="11">Functional and cooperative economy</td></tr>
</table>

Table 1.4. *Categorization of strategies relating to the Functional Economy (source: Serra and Buclet (2020)). For a color version of this table, see www.iste.co.uk/merlinbrogniart/functional.zip*

ADEME identifies seven pillars of the circular economy classified under three areas of action:

– *The supply of economic actors:* a sustainable supply of resources –whether renewable or non-renewable, the eco-design of goods and services, the development of industrial and territorial ecology and implementation of the Functional Economy (use of a service rather than the possession of a good).

– *Consumer demand and behavior:* responsible purchasing, proper use of products, recourse to reuse and repair.

– *Waste management:* the management of unavoidable waste must encourage recycling and, if necessary, energy recovery, which makes it possible to close the loop.

We note that, for ADEME, the Functional Economy is included in the circular economy as a means of action contributing to prevention and encouraging effective resource management. It belongs to the field of action of the supply of economic actors (Figure 1.6).

The French law for energy transition towards green growth (of July 22, 2015) further formalized this concept of the circular economy, under Title IV, “Fight against waste and promotion of the circular economy: from product design to recycling.” This formalization of the Functional Economy within the circular economy is the most common concept mentioned by the actors we interviewed as part of the ToDo Circular project (2022–2023).

Figure 1.6. *The circular economy: three domains, seven pillars (source: ADEME (2014)). For a color version of this figure, see www.iste.co.uk/merlinbrogniart/functional.zip*

The authors adhering to the functional and cooperative economy approach attempt to provide another definition for the Functional Economy, reaching beyond this vision of a pillar of the circular economy, considered too reductive. While the Functional Economy is based on *use extension* (long-life goods), such prolongation is necessarily based on the eco-design of the materials supporting the service. Reflection on the organization of the *systemic solution* would lead to the creation of ecosystem(s) of actors stepping beyond the perimeter of those associated with the circular economy. The Functional Economy is also based on the creation of an *intangible collective heritage* or *common territorial heritage*, capable of revitalizing a region, not only economically and ecologically, but also socially. Reflection on relationships at work and the social dimension (link with the cooperative economy, the social and solidarity economy) would be more in-depth than the concerns and scope generally attributed to the circular economy.

This question of boundaries is directly linked to the conceptions of *the Functional Economy*, of *the functional and cooperative* economy, as well as *product-service systems*, which we presented in this chapter. Insofar as there are minimalist conceptions of the Functional Economy, some of these conceptions can easily fall within the scope of the circular economy. On the contrary, the development of multi-actor and trans-sector complex systemic solutions feeds reflections that exceed the circular economy.

As for the multiplicity of approaches, the same observation can be made for the notion of circular economy. Certain theoretical developments and operationalization forms of the circular economy relate to weak sustainability – in terms of opportunities, for example, the recycling value chains associated with the circular economy are sometimes designed as secondary sectors to the linear model and fail to take into account all the challenges. Since the consequences of economic activity are not considered as a whole (at the macroeconomic level), this can lead to rebound effects (section 1.3.2). Other approaches to the circular economy rely on strong sustainability. Based on these developments, the Functional Economy can be seen as more encompassing.

It seems more judicious to us to consider that these notions are complementary, in the sense that some of their concerns (and their tools) are common, although each of the notions covers a broader scope, associated with the questions that stimulate the researchers from each community, as well as the field actors. For several years, ADEME has been cooperating with ATEMIS-LIR to try to refine the understanding and scope of the functional and cooperative economy.

1.3.2. *The Functional Economy and industrial ecology*

The Functional Economy, industrial ecology and the circular economy all have in common that they seek to operationalize sustainable development by experimenting with approaches aimed at saving and pooling resources, as well as by developing new economic models, rather than merely theorizing about them. These models seek to steer away from the usual production and consumption logic. Industrial ecology is considered as the application of the circular economy at the level of the system of companies, by means of the 3Rs (Reduce, Reuse, Recycle).

In ADEME's definition of the circular economy that we presented in point 1.3.1 (Figure 1.6), the Functional Economy and industrial ecology are considered as two means of action (or pillars) available to the circular economy. This conception is very different from the conception proposed by the researchers at the origin of these notions. With the goal of operationalizing the concept, industrial ecology was first reduced to eco-industrial symbioses. The dominant institutional discourse then led to further restriction of industrial and territorial ecology (ITE), by reducing it to one means of action among others (Buclet 2015, 2021).

Industrial ecology can be represented according to four levers analyzed by Erkman (2001, 2004). This author sees industrial ecology as a systemic approach, which addresses sustainable development issues. These levers make it possible to reduce production costs and pressure on the environment:

– The systematic recovery of waste and by-products. These materials are potential resources and deposits of raw materials to be exploited.

– Losses due to dissipation – energy, polluting emissions from the production process or the products themselves – must be minimized.

– The economy must be dematerialized by minimizing total material flows, while ensuring at least equivalent services (Functional Economy, etc.).

– Energy must be decarbonized. Energy from fossil origin hydrocarbons (coal, oil, gas) should be replaced by renewable energy.

In the 1990s, the founders of industrial ecology focused on reorganizing the existing model, with the intention of finding operational solutions to dematerialize it. It was in 2006, in France, that the National Research Agency organized a prospective reflection workshop on industrial ecology (ARPEGE), in order to refine the definition, scope and challenges of industrial ecology (Adoue and Georgeault 2014).

The Functional Economy is the third lever of industrial ecology. Industrial manufacturers should modify their economic logic by acting on their economic model (reflecting on the sustainability of goods behind the service sold, rather than the exclusive sale of a tangible product) (Adoue and Georgeault 2014).

In France, research applied to industrial ecology has gradually focused on the territory, its challenges and its actors. These analyses gave rise to the emergence of industrial and territorial ecology and territorial ecology (Barles 2007; Barles et al. 2011). The industrial ecology approach seeks to “optimize the management of material and energy flows in order to reduce the impact related to the interactions between the industrial system and natural ecosystems. It is based on intentional collective action, for which the characteristics of the territory in terms of actors' governance are central" (Brullot et al. 2017, p. 174).

As a result, industrial ecology and the Functional Economy share two common principles (Maillefert and Robert 2014; Merlin-Brogniart 2017): the principle of cooperation between actors and that of the relationship with the territory in the productive system (Table 1.5). These models are based on cooperation rather than competition principles (Maillefert and Robert 2014). The industries concerned will implement practices for encouraging pooling and interaction flows between stakeholders. These cooperation forms are rather inter-industrial (Vuidel et al. 2012; Maillefert and Robert 2014). In the case of the Functional Economy, the reduction of the environmental impact is obtained through cooperation between stakeholders during the implementation of a systemic supply, as well as new forms of participatory production and financing (such as crowdsourcing and crowdfunding) (Merlin-Brogniart 2017). In these models, the support for systemic solutions (Functional Economy) and the development of industrial synergies (industrial ecology) is undertaken on a territorial scale. For industrial ecology, *the territorial dimension* is analyzed through the construction, by the actors, of a common goal around collective action (Maillefert and Schalchli 2010). In initiatives arising from the Functional Economy, the systemic supply is studied in view of generating positive social and environmental externalities within the territory. Thus, industrial ecology experiments, as those related to the Functional Economy, often have a geographical proximity dimension which invites the actors to cooperate. Functional economy or industrial ecology projects use and develop resources specific to the territory, whether material or intangible.

Furthermore, Functional Economy and industrial ecology projects come across similar implementation difficulties – economic, technical, informational, organizational and regulatory – which are also common to circular economy projects (Table 1.5).

Goals and Common Principles	**Functional Economy (FE)**	**Industrial ecology (IE)**
Operational models	Operational development form of IE/Form of circular economy.	Application of circular economy.
Cooperation rather than competition principles.	Coproduction dynamic between users, companies, territorial actors/Pooling of uses. Integration/Complementation economy. Creation of a collective common heritage	Inter-industrial cooperation (flow pooling, resource substitution). Creation of a collective territorial heritage.
Systemic solution at the territorial level	Local job creation, professionalization of employees, pooling of local resources and skills, collective learning. Creation of positive environmental externalities (reduction of planned obsolescence, increase in recycling). Environmental policy and regional planning policy tool.	Local job creation. Pooling of local resources and skills, collective learning. Creation of a local ecosystem. Co-production between users (B to B), companies, territorial stakeholders. Environmental policy and regional planning policy tool.
Types of difficulties encountered		
Economic	*Non-profitable, too complex or risky for the company*	*Non-profitable or risky for the company*

Technical	*Technical cooperation is impossible among providers Different modes of working*	*Technical exchange of waste is impossible to achieve (waste stability, flow continuity, …). Unavailable required structure.*
Informational	*Lack of information on skills*	*Lack of information on waste nature and flow. Unavailable / too strategic information*
Organizational	*Lack of understanding among actors (on value sharing, on how to structure the supply system)*	*Company organization is not adapted; lack of involvement from SMEs*
Regulatory	*Lack of stimuli, lack of multi-criteria and multi-actor assessment of performance*	*Lack of stimuli, lack of multi-criteria and multi-actor assessment of performance*

Table 1.5. *Common principles and limitations to industrial ecology and the Functional Economy (source: Merlin-Brogniart (2017, p. 77))*

This first chapter set out the context for the appearance of the notion of the Functional Economy. The conceptual framework in which this notion is based has been presented, as well as the major socio-economic changes and institutional developments which facilitate the development and setting up of this economic model. We have shown that the notion of Functional Economy is a social construction that has not yet been stabilized, which evolves through experiments and analytical frameworks developed by research communities. Furthermore, the diversity of communities and disciplines interested in this new model (economics, ergonomics, law, engineering science, ecology, etc.) contributes to enriching, and also complexifying, the theoretical frameworks relating to this model.

The institutional discourse is not neutral in the way in which these notions are disseminated and continue to be constructed. Sustainable economic models (notably the Functional Economy, but also the circular economy and industrial ecology) obtain legitimacy and notoriety, thanks to institutional dissemination and the way in which the actors appropriate them. In terms of approaches and experiments, the legislative developments issued within the framework of public procurement, sustainable public purchasing and the texts on waste prevention, the development of REP streams and the AGEC law (anti-waste law for a circular economy) and the French law relating to the energy transition towards green growth of August 17, 2015, all contribute to accelerating the implementation of ecosystems around these sustainable models.

From an empirical viewpoint, defining the scope of the Functional Economy comes up against the conception of sustainability pursued by the actors. While the original theoretical conceptions of the Functional Economy were intended to transform the dominant economic model, the operational developments of the Functional Economy do not all go in the direction of this radical transformation, whether in terms of circular economy, Functional Economy or industrial ecology. Consciously or unconsciously, the actors frequently return to known references, resume activity in existing sectors, while appealing to classic exchange reflexes that limit the degree of radicalism of the environmental and social transition.

Based on the notion of economic model and the analysis of innovations (supplemented with examples of Functional Economy experiments), Chapter 2 aims to better understand the elements that companies can put in place to create sustainable value associated with the notion of Functional Economy.