

Reconfiguring the firm from a system perspective

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Abstract

This paper aims at exploring some methodological issues which emerge in dealing with the firm as a system. A consistent background of this system approach is found by revisiting some seminal contributions in the theory of the firm, while an actual system methodology is put forward to actually implement it. Four dimensions are identified (the capabilities dimension, the legal dimension, the organizational dimension and the institutional dimension) to define the firm in a system way and for each of them the firm setting is detected in terms of firm (system) configurations and firm (system) structures. In so doing, a generic definition of the firm is reached, as an evolving 'organized complexity', resulting from the dynamic combination of the actual structures one can observe for each firm dimension. More concrete definitions can in turn be obtained by setting the system methodology at work in trying to identify actual firm structures.

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0. Introduction

That the firm should be conceived as a system currently appears a sort of common sense in economics¹. Several contributions, and pertaining to diverse disciplines, have in fact suggested to consider the firm as a set of constitutive ‘elements’ (e.g. individual agents, production units, organizational departments, firm divisions, etc.) among which there are pervasive ‘relationships’ (in terms of production flows, information, power, control, etc.), making the firm itself something more than, and diverse from, the sum of its parts².

This basic system rational, generally termed ‘holistic principle’, has been differently specified, but in fact represents the most robust (or just the most popular?) connection between the notion of the firm and the system analysis that economic theory has established consistently. The relevant examples are numerous, so that extracting just some of them is inevitably arbitrary, but still enlightening. In the theory of the firm, for instance, Dietrich (1994) shows that the need to endorse a system kind of view emerges even when one sticks to the traditional transaction cost paradigm: going ‘beyond’ its standard approach, and encapsulating the criticism to it, in fact naturally leads one to see the firm as a “complex system of strategic control”, which interacts in a dynamic way with its outer environment. The firm-system relationship also pervades many contributions in the field of industrial economics, especially those which adhere to an evolutionary perspective: in Kay (1997), for example, a variety of issues (such as vertical integration, corporate specialization, and diversification) are addressed by treating the firm as “a non-decomposable system”, and examining the role that linkages of different kinds have in driving the nature of corporate strategies and in shaping the decisional process. System analysis is an essential tool in the newly emerged field of economics of innovation, focusing on innovation as an interactive, institutional and contextual process: not only does innovation consistently occurs in “innovation systems” of firms and institutions at the national, regional or sectoral level (Edquist, 2000), but also the firms which populate them have to be seen as “cognitive systems” of capabilities or routines, on which, as Zollo and Winter (1999) put it, their dynamics rest. Finally, the centrality of system theory for the firm analysis appears even greater when the firm is conceived, following an organization economics perspective, as a learning organization: Aoki’s description of the Japanese firm as a “system of attributes” is just one of the most well-known examples (Aoki, 1994). But what’s really beyond this diffuse system analogy? What can we really learn from the system theory in dealing with the firm?

In order to answer to these questions, in this paper we argue that the firm-system parallel could, and indeed should, be further extended and refined. More precisely, we deem that the because of its constitutive features, the firm, as a matter of fact, naturally satisfies some interesting system properties: independence, non-decomposability, negentropy, just to mention the most important. Accordingly, system theory, with its rigorous and sophisticated concepts and tools of analysis, turns out to be an inescapable starting point for any serious investigation of the firm³. Indeed, this will be the first argument on which we will concentrate in this paper: Section 2, in this last respect, will be nothing but an actual recognition of the

¹ As early as in 1962 Cyert and March, two of the fathers of the modern theory of the firm, recognised that “[the] implicit assumption that the firm represents a conflict *system* susceptible to useful descriptions in terms of a superordinate goal (whether profit maximization or some other) is shared by most economists” (Cyert and March, 1962, p. 670, our emphasis).

² Such contributions span from the theory of the firm to industrial economics, from economics of innovation to economics of organization, just to mention a few.

³ To be sure, such an argument has already started to be pursued in other fields of analysis in economics. In the investigation of industrial districts and spatial clusters, for example, the resort to the theory of complexity and, in particular, of ‘complex adaptive systems’ and ‘spontaneous emergence’ (Holland, 2002) reveals an extremely promising research program.

need to enrich our 'tool-box' for the firm exploration. But there's more. Also once we have recognised that system theory, rather than simple system propositions, should be used, how can we actually set system theory at work in dealing with the firm?

In this last respect, several alternatives are of course possible, but all gravitate around an inescapable imperative: considering both system 'elements' and 'relationships' in a relevant way. In a relatively simple organization, such as a soccer football team, for example, the identity of the players, their individual capabilities (and their related earnings), and their tactical relationships are the unique (this is not to say simple) ingredients to be relevant in approaching a certain team in a system way: both in static terms – such as for example in arranging the team before the start of the regular season – and in dynamic terms – such as in reconfiguring the team tactic to the matches or even in reconfiguring its composition during the regular season. Accordingly, the technical point of view of the trainer, and the financial point of view of the team president are the most important, if not even, the unique, so to say, 'lenses' through which a team and its evolving performance over time need to be read following a system perspective⁴. But real life usually offers instances of definitively more complicate systems. Consider, for example, the case of an iceberg. Indeed, although it is apparently, from the outside, monolithic, on the other hand an iceberg is actually made up of ice-sheets whose internal molecular structure has a system architecture. What is more, the journey an iceberg undertakes over time, i.e. its dynamics, is actually manifold, rather than a pure change of location. Indeed, not only does the size and the shape of the tip of the iceberg (the part which rises above the sea surface) changes, but the same also occurs to its base (the part which projects into the water); to these changes we should add the internal ones which involve, for example, the degree of gas compression inside the iceberg and that of the algae which grows within it. Let us observe that these (and possibly other) changes occur simultaneously, and that they contribute to the iceberg evolution all together. However, each of these dimensions of change, in order to be observed, call for a different lens: a pair of binoculars, to observe the evolution of the tip, a sub-aqueous mask, to better visualize the dynamics of the base, and a acoustic sound to get inside and monitor the material state of the iceberg. With respect to the iceberg, therefore, as with respect to other complex system, the relevance criteria moves from the relevance of the system elements and relationships which are considered to that of the lens, or glasses, that are used to observe them.

This is also the case as far as the firm is concerned: a manifold process of change also characterizes the firm dynamics, given that its evolution has occurred, and occurs, along different 'paths' (organizational, legal, etc.) whose investigation requires an appropriate lens. Furthermore, as in the case of the iceberg, sticking to a certain lens of analysis does not allow to the researcher to investigate more than one path at the time: the problem thus becomes that of choosing the proper lens for the analysis of each path. But which lens?

Here we come at a crucial point, given that an inappropriate lens would not show any system 'signal' albeit the system works and evolves: what's about if we tried to predict our iceberg evolution just by monitoring its daily location? The internal structure of the ice-sheets would keep on changing although unnoticed, possibly determining effects that we won't be able to evaluate: such as the overflow of a river because of the ice smelting. Luckily, a 'good' biologist, who has observed the actual evolution of many icebergs, and who has studied their history over reasonably long periods of time, is aware of the fact that he will also need some other lenses in addition to a binocular. The same holds true with respect to the firm. As we will argue in the third part of the paper, namely Section 3, a good researcher of the firm, on the basis of the relevant literature and possibly on his personal findings, should be aware of the fact that the firm has historically evolved along four main paths, that is with respect to

⁴ Of course we might also consider the point of view which emerges from the lens of the team fans and supporters, but this and others lenses will not be so relevant as the previous two.

four dimensions: (i) technological (or better to say, capability dimension); (ii) legal; (iii) organizational; (iv) institutional. If we are persuaded by this argument, which we will actually refer to as the ‘firm wisdom’, the problem of the lenses gets nearly automatically solved: we need four lenses, one for each of the four dimensions. And what can we observe through them?

The answer to this question that we will provide in this paper, mainly methodological in its nature, will be just partial. Indeed, in Section 3 we will limit ourselves to identify the generic firm elements and connections that one can detect by using these four lenses. From their combination four different kinds of configuration emerge to which we will also refer in generic terms. Of course, both the system configurations and properties of the firm should be specified. However, the actual specification of the identity and of the relationships of the firm elements, along with the kind of modularization in which they combine, calls for an empirical perspective which is on a different ground with respect to that of the present methodological paper. Accordingly, such an exercise is postponed to the following item of our research agenda: a point that we will discuss in the conclusions of the paper (Section 4).

As we have anticipated, the present paper has a twofold objective, that is: (i) to provide some methodological arguments to take system theory seriously in dealing with the firm, and (ii) to offer a simple methodology to actually set it at work. Before engaging in such an ambitious goal, however, we should start by saying that an invitation to take system theory seriously in dealing with the firm can be traced through a sort of *fil rouge* which links together some seminal contributions in the theory of the firm. Indeed, it seems to us that the ‘fathers’ of an actual theory of the firm paved a way towards a system view of the firm which the modern theory of the firm has just partially followed. In this sense, as we will argue in the next section, focusing on the system theory would mean to bring the theory of the firm back to its natural path.

1. The ‘actual’ system view of the firm: the contribution of the “fathers” of the firm

The traces of an ‘actual’ system view within the economic theory of the firm appears evident when we briefly sketch its historical evolution and, in particular, when we refer to its origins. Although early work in the field can be found also before, the 1950s and the 1960s are in general considered the years of its ‘taking off’ (Foss, 1999). Indeed, the studies of that time represented a crucial turning point for the economic theory of the firm, providing both new developments in the traditional, let us say neoclassical models, and new directions for the research on the subject.

More precisely, while the supporting function of the neoclassical theory of the firm (the so called ‘production function view’⁵) with respect to the main issues of economic analysis (i.e. the determination of equilibrium prices and the efficient allocation of economic resources) was widely recognized, in the same period serious doubts started to be raised about its actual utility for an effective analysis of the ‘modern corporation’: definitively more articulated than an individual firm, the only one to be somehow consistent with the standard neoclassical approach. Criticism and remedies emerged from different perspectives: but two in particular. On the one side, remarkable scholars such as Baumol (1959), Bain (1956), Sylos Labini (1962) and Modigliani (1958) argued that the traditional neoclassical model of the firm should have been ‘amended’, mainly by setting it at work in a more realistic oligopolistic

⁵ Such a view is quite clearly caricaturised by Boulding in his 1943 overview paper “The theory of the firm in the last ten years”, where he writes that “[the theory of the firm] is exactly analogous to the analysis of the reactions of a consumer by means of indifference curves. Indeed, a consumer is merely a ‘firm’ whose product is ‘utility’” (Boulding, 1943, p. 799). As Foss recognises, this amounts to consider the theory of the firm as completely subordinated to price theory.

market structure and by encapsulating in it the decisional process of the firm in terms of price⁶. On the other hand, other outstanding figures such as Penrose (1959), Cyert and March (1963) and Marris (1964) claimed for a more substantial departure from the standard neoclassical model, for them unable to investigate the actual operating behavior of a corporation, and thus recommended to inspect its functions, nature and growing mechanisms.

These two different approaches actually paved the way for two paths of development of the theory of the firm, which had different fortunes. The former rapidly gained the stage in the economic debate on the firm, and became one of research programs from whose intricate (i.e. non linear) interaction the modern theory of the firm took the nature of a contractual view, either in Williamson's version of a set of incomplete contracts (Williamson, 1975; 1985), or in that proposed by Hart and colleagues of a set of property contracts with asymmetric information (Grossman and Hart, 1986; Hart and More, 1990)⁷. The latter approach, instead, was subsequently relegated at the margin of the purely economic debate on the topic as a more apparent (and dangerous) heterodoxy. Although the two approaches were somehow complementary, dealing with different but still interrelated problems⁸, the alternative outcome of their evolution has been very critical for the concept of the firm that economic theory has come to distill from them. Indeed, some crucial insights developed by the latter approach, although extremely promising and pertinent, remained largely unexplored. That of the system nature of the firm is one of them, so that a certain reappraisal of the 'bad-fathers' of the firm is quite important.

At the outset, that the two approaches were actually conflicting can be appreciated through an accurate evaluation of the 'sources'. Edith Penrose, for example, although moving from a 'relevance' methodological criterion first expressed by Baumol (1959, Ch. 1, par. 6)⁹, rejected as "inconvenient" and "misleading" the use, instead typical of the former approach, of a "price-and-output decision maker" idea of the firm to analyze the growing organization of a corporation. This is evidently what she means when she writes that "[i]f the study of the process of growth of firms is a legitimate purpose of economic analysis, [...] the 'newer concept of the firm' is of importance, but it should be clearly defined as a concept to be used for a different purpose from that of the traditional one" (Penrose, 1959, f.p. 14). A different approach, she argues, is needed when one just thinks of three incontrovertible facts. First, production and market processes involved different mechanisms of coordination of the 'participants': while in a free market buyers and sellers are autonomous and just connected by a contract, in the production process all the 'applicants' are the members of an administrative unit, so they are linked by authority. Second, if the firm applies a specific long term strategy, the interaction between the market and the firm is no more a dependence relationship of the latter from the former, as entailed instead by the traditional models. Third, the organization of the firm is specific and can be activated and changed, adapting to its external environment.

These and other elements clearly endorse an idea of the firm which is quite different from that of the standard neoclassical approach, and also from its later amendments, and are rather consistent with an *organizational* concept of the firm, in turn of system nature. In fact, as

⁶ This is not to say, of course, that these models reflect the same identical approach to the firm, but just that they share a common rational.

⁷ The explicit nature of this relationship is quite difficult to disentangle and will not be considered here. For our purposes, suffice it to recognise that the former approach we have identified in the development of the economic theory of the firm interacted with a contractual view of the firm which represents the orthodoxy in its analysis.

⁸ More precisely, the latter approach was interested in the behavioral mechanisms which enable the firm to act as a subject in the market pricing process, that is the subject of the former. In particular, its focus was on the way in which the decision-making process affects the internal structure of a business corporation and its dynamics.

⁹ According to whom a theory succeeds in explaining a phenomenon only if it pays attention to those empirical hypothesis whose effects turn out to be relevant for its explanation.

Penrose wrote, “the general view of the administrative functioning of a firm set forth here not differ fundamentally from the concepts underlying the analysis of Simon, Barnard, Papandreu, and similar ‘*organization theorists*’” (Penrose, 1959, f. p. 16, our own emphasis). In this last respect, Marris (1964, Ch. 3) was even more explicit and defined the firm as a pure *administrative organization*, ‘just’ characterized by a productive process. And this was also the basic assumption from which Cyert and March (1959) moved in order to develop the basic ideas of “A Behavioral Theory of the Firm” (Cyert and March, 1962). The ‘heterodox’ approach that we are analyzing therefore presents an important *trait d’union*: the crucial role of the organization in the analysis of the nature and of the functioning of the modern firm, a seminal intuition for which we are indebted to Herbert Simon. Indeed, the work by Simon on organizations underpin the research program that we are considering and, as we will see, characterizes the view of the firm that it builds up on it as ‘actually’ systemic.

A certain system view already emerges from the early pages of the Introduction to the celebrated “Administrative Behavior” (Simon, 1947). Within it Simon in fact refers to an organization as: (i) a network of *communications and relationships*, (ii) set up inside a *group of human beings*, (iii) in order to attain a *common specific purpose*. The first of this three organization building blocks clearly make of it a system-like of concepts: the focus on the connections which relate the system components is in fact essential for the definition of a system. Also the second building block refers to a system feature, which has to do with the identity of the system participants: each participant has a specific aim and gets selected by the organization on the basis of the purpose of the organization itself. If, for example, the organization is an industrial firm that produces shoes to sell on the market (the example is taken from Chapter 1 of Simon’s book), the group which constitutes the business organization includes the managers, the workers and the customers. Each of the group members has a specific economic aim, and often their aims are conflicting one with the other. However, conflicts are avoided in favor of the common target, pursued by the hierarchical directives. This last fact makes of the third organizational building block another relevant system feature. Indeed, the purpose of one organization is, at the same time, the reason for which an organization is built up, and the criterion on the basis of which the ‘participants’ to the network are selected. Accordingly, the organization becomes a purposive administrative instrument used, in the firm case, by a business group to attain a specific economic object: the organization participants and their features can thus be clearly separated from the organism created to carry on a specific economic activity. Furthermore, also the problems the firm faces can be analyzed by referring to two distinct analytical moments: that which refers to the techno-economic unit, and that which refers to its operating units. In so doing, following Simon the firm can be identified with its distinguishing problems (concerning its constitution, its evolution, etc.) while the administrative entity can be identified with its behavior: in other words, the former constitutes a system (an “open system”), the latter represents its organization (Selznick, 1949; Emery and Trist, 1960).

On the basis of the previous considerations there’s no doubt that Simon’s approach is intrinsically systemic, and that as such, strongly affected those later systemic analyses of the firm that referred to it. Before moving to these latter contributions, we should however recognise that an earlier and different system view of the firm can be found in the work of other two ‘fathers’ of the theory of the firm: that is in the seminal contribution with which Berle and Means path-broke the analysis of the separation between ‘ownership’ and ‘control’ (Berle and Means, 1932). In this notable contribution the firm, or better to say, the corporation, is considered as a network of different business interests, embodied by different system participants: the owners of the capital, the workers engaged in the production activity, the customers attracted by the value of the firm goods, and the managers that keep the control of the firm (Berle and Means, 1932, section four, Ch. 4). The simultaneous presence of these interests, often contrasting among them, along with the separation of the firm ownership (held

by the shareholders) from its control (held by the managers), and of a significant power concentration in the hands of the managers, pose typical system problems which, for the authors, are at the basis of the firm choices in terms of governance problem, protection of property rights and safeguard of the “public interest”.

Let us observe that, unlike Simon’s system view, referred to an administrative and organizational perspective, the systemic approach put forward by Berle and Means is characterized by a legal perspective, that is a perspective which pays attention, also and above all, to the consequences that the evolution of the entrepreneurial role has on the allocation of responsibility and control within the firm¹⁰. Further peculiarities characterize a third system view of the firm, that put forward by Penrose which, although influenced, as we said, by Simon’s organizational account, presents important elements of originality, especially as far as the role of the firm resources and (as we would call them nowadays) capabilities. Indeed, Penrose describes the firm as “a collection of productive resources the disposal of which between different uses and overtime is determined by administrative decision” (Penrose, 1959, p. 24). More precisely, each techno-economic unit within the firm holds two kinds of resources: physical resources (tangible assets, such as plants, equipments, land, natural resources, by-products, waste products and unsold goods), and human resources (unskilled and skilled labor, financial, legal technical and managerial staff). What is more relevant for a system view of the firm, however, is the idea that, although all the resources of a firm play a role in its production processes, being part of a network of activities carried on to succeed in this aim, however “it is never *resources* themselves that are the ‘inputs’ in the production process, but only the *service* that the resources can render” (Penrose, 1959, p. 25)¹¹. Once again, a certain independence property emerges also from this further system account: the agent, conceived as a ‘bundle of potential services’ is clearly distinguished by the use of its skills (just the services), in turn completely defined only when they are involved in an activity or in a specific function.

While already Penrose argued that the firm has specific goals and implements a suitable organization to reach them, a ‘fully equipped’ systemic analysis of the firm can be found only in Cyert and March (1962). Indeed, they were the first to represent the firm as a ‘conflict system’, that is as a set of basic units having a preference ordering, which is inconsistent with the resources of the system itself. According to them, this is the reason for which conflicts arise around the constitution and the organization (in the sense of arrangement) of the firm, and that’s also why such conflicts are dealt with by bargaining over the goals the business organization must achieve (Cyert and March, 1962). Because of these features, the firm is conceived as a ‘political coalition’ that transfers its inherent conflicts to the organization, which in turn copes with them in its decision making process, involving several activities, such as: forecasting the competitors behavior, forecasting the consumer demand, estimating the firm costs, specifying the firm objectives, evaluating the firm plan, re-examining previous decisions and selecting the relative alternative (Cyert and March, 1959; Cyert and March, 1963, Ch. 3). As a result the firm can be conceived as an adaptive rational system characterized by the following properties:

¹⁰ The origin of this legal perspective is usually associated to the work of Ronald Coase, but quite imprecisely. In fact, although the contract represents the main key word of the approach he put forward in *The nature of the firm*, (Coase, 1937), the approach itself is not a legal one. This appears evident by considering that with that essay Coase hopes “[...] to show [...] that a definition of a firm may be obtained which is not only realistic in that it corresponds to what is meant by a firm in the real world, but is tractable by two of the most powerful instruments of economic analysis developed by Marshall, the idea of the margin and that of substitution” (Coase, 1937, p. 386).

¹¹ The distinction between element and real input of production can be found in the so-called ‘Flow-fund’ model of production by Georgescu-Roegen (Georgescu-Roegen, 1970), where it is the service of each fund (worker or equipment or land) that enters into the production process.

- “1. There exist a number of states of the system. [...]
2. There exists an internal source of disturbance or shock to the system. [...]
1. There exists a number of decision variables internal to the system. [...]
2. Each combination of external shocks and decision variables in the system changes the state of the system. [...]
3. Any decision rule that leads to a preferred state at one point is more likely to be used in the future than it was in the past” (Cyert and March, 1963, pp. 117-118).

The model of the firm which corresponds to these features, called by the authors ‘behavioral theory of the firm’¹², is evidently intrinsically systemic. Indeed, not only allows them to separate the system from its organization, but also to identify some different systems, depending on the functions a certain group of actors wants to carry on and on the correspondent connecting variable. Second, a specific structure of the firm can be recognized for each administrative unit set up by a particular set of participants. Third, the system view put forward by Cyert and March appears broader than those we have analysed before, especially because it seems able to encapsulate aspect of an institutional nature. Finally, let us observe that a firm shaped in the way that Cyert and March do is an adaptive institution, i.e. and institutions which learns from its own experience and reacts to the environment where it operates on the base of its strategic plan.

The behavioural account of the firm contains for sure many seeds to transform a simple system view into a structured system analysis of the firm, that is one which is based on an appropriate system methodology. However, for different reasons, these seeds were not accurately ‘watered’ and a proper system analysis did not grow without difficulties. On the one hand, the modern followers of the behavioural approach, i.e. the evolutionists, although indebted to Cyert and March for having introduced a more realistic concept of the firm ((Nelson and Winter, 1982, Ch.3), mainly extracted from it a way to deal with the firm’s ‘objective’ rather than with the ‘nature’ of the firm: their attention actually shifted on the role of firm elements, i.e. the routines, which by their own acknowledgment are purely organizational (Simon again!). On the other hand, economic theory found some problems in attributing dignity to some (to be sure numerous) contributions which moved from a system concept of the firm, rather than from a contractual one, to analyse the strategic behaviour of the firm: the ‘resource-based view’ inaugurated by Rumelt, Barney and other scholars of strategic management is for sure the container of important contributions which economic theory has just started considering more seriously (see Foss, 1999).

In spite of their alternative fortunes, it seems to us possible to conclude that the analysis of the literature which, in the 1950s and in the 1960s, allowed the economic theory of the firm to take off as an actual theory, clearly suggests the existence of an alternative approach to the contractual theory of the firm. This critical review also reveals the methodological consistency of such an ‘alternative’ approach. Indeed, this theory of the firm clearly shows a certain acquaintance with the system analysis (in the way we will clarify in the next section). Furthermore, it also shows to have adopted an economic paradigm which is quite different from the marginalist one and which encapsulate, among the others: the need for a functional conception of the methodology to study the firm (a "purposive methodology", i.e. one methodology for one specific event), the complexity of the topic under investigation, the existence of conflicts inside the economic subject (the firm), the relevance of a holistic principle, and of an adaptive rather than a maximizing perspective. For us, these and other elements of such a paradigm naturally call for the explicit adoption of a system methodology, a point we will develop in the next section.

¹² To be sure, as all the authors of the second approach to the development of the economic theory of the firm quoted in this section share the idea of a decision-making organization coupled with the firm, they can be included in the behavioural theory of the firm.

2. The firm as a system and the system methodology

As we have said in the introduction to this paper, viewing the firm as a system is a quite common practice in several economic disciplines. In the previous section, we have also seen that in some early contributions of the economic theory of the firm, later followed up by more recent contributions, this view actually turns into a more rigorous system conceptualization. In fact, the definition of an aim oriented system¹³ as an aim oriented set of elements, properties and interrelationships could be as well an adequate definition of the firm following one of the system accounts we have reviewed in the previous section¹⁴.

In this section we would like to explore the firm-system correspondence identified by the fathers of the firm more into depth, and possibly to push it beyond their suggestions. In order to do that we will just try to argue that some basic constituent features and properties of the modern firm are in fact system properties: in other words, what we intend to do is to show how some general system properties naturally apply to the firm, which can be thus explicitly retained as a system and investigated with a system methodology.

First of all, whatever lens we use to observe the firm¹⁵, what we see satisfies the three basic constituent properties of a system, as stated, for example, by Ackoff and Emery (1972). A first property emerges clearly when we use, for example, a lens which focuses on the 'operative units' into which the firm gets structured according to its coordination needs, along with the interactions which connect them: in a U-firm, for example, the former are its functional departments (R&D, production, marketing, etc.), while the latter are instead mainly, but not exclusively, relationships of hierarchical control. It is evident that the 'properties' of each operative unit - for example, the intrinsic degree of autonomy of each functional departments - crucially affects the properties of the entailing configuration - for example, the degree of effectiveness of the firm control, or its overall coordination capacity. Such a system property, i.e. of the relationship existing between the system 'elements' and the system as a 'whole', is quite general, as it can be detected also by looking at the firm through other lenses. Accordingly, the same property can be transferred straightforwardly from the system to the firm.

A second system property can be seen at work by resorting to a lens which discloses the interactions that the 'legal actors' participating to the economic activity of the firm establish simply by exerting their individual rights, either of property or of obligation. For example, the effect that a certain legal participant - such as a creditor bank - has on the properties of the whole legal configuration of the firm - for example its exposition to bankrupt and to the relative legislation - depends on the properties of at least another legal participant - for example, that of the shareholders. Also such a property, i.e. the conditional influence that a system element exerts on the whole system depending on (at least) another element, emerges also by approaching the firm with another lens. Once more, therefore, the same system property becomes a firm property.

Finally, a third system property refers to the possibility to extend the previous two to those sub-systems into which the firm observed through a certain lens could be articulated.

The previous properties, which as we said can be legitimately considered firm properties, makes of it an 'entity' with respect to which an holistic principle turns out to be crucial. That

¹³ The aim orientation of a system will be discussed in the following.

¹⁴ This definition has been taken and adapted by Emery and Trist (1960), and reflects their account of what we will call 'socio-technical' systems.

¹⁵ The lenses to which we will refer here might appear arbitrarily identified. In the next section we will argue that their identification corresponds to a precise criterion.

this is actually the case can be shown by analyzing the firm with a lens which visualizes its 'resources and competences', along with the routines through which they are connected. Indeed, although it might be in principle possible to identify the resources and the competence which refer to a specific kind of activity (i.e. R&D), and distinguish them from those which refer to another one (i.e. marketing), on the other hand, the interchange of the former with another set of specific resources will change the competences of the firm as a whole (or even make them cease). Similarly, the economic activity of the firm does not simply result from the addition of the activity of the units of which is made up. Once again, this emerges clearly from the lens we have adhered to before: what a firm is capable to do it is much more than the sum of its individual capabilities.

In addition to the previous ones, further system features of the firm emerges by considering, using again a different lens, that any firm exchanges with other 'institutions' different kinds of flows (both material and immaterial), being connected to them by specific forms of 'strategic' relationships¹⁶. This makes of the firm an 'open system', with a series of 'dynamic' implications with respect to which the resort to system theory becomes even more necessary.

First of all, as for any other open system, the actual evolution of the firm over time is marked by a sequence of changes of status through which the structure of the firm has progressively moved to a higher degree of complexity. The transformation of the family firm into the middle-large firm, and that of the functional firm into the divisional one are two transformations in which such a hierarchical change of status has appeared more evidently, and on which the literature has accordingly concentrated the most (von Bertalanffy, 1968). However, the development of the firm through a progressive series of, as we will call them, configurations, is a quite general fact, directly connected to the intrinsic openness which characterizes the firm. Indeed, the evolution towards higher degrees of structural complexity can be seen as the typical firm response to the progressive increase of the environmental turbulence surrounding the firm itself¹⁷. As in any other open system, it is this turbulence increase, along with the related increase in what the firm imports from its outer environment (both material and immaterial flows), which counteracts the inner tendency of the firm to increase its entropy and to fade up and dissolve. In other words, while we are used to think that the increasing complexity of the economic system within which the firms operate puts on them a greater competitive pressure and makes it more difficult for them to survive, the system view shows us the reverse side of the coin: the higher complexity of the firm environment in fact also results from the increasing local disorder, or destructuring process, the firm needs to transfer externally (i.e. in the environment) in order to survive¹⁸.

Thinking of the firm as a 'negentropic' or 'antientropic' system (i.e. as a system which diminishes and hampers its inner entropy) also provides us with a way to look at the firm dynamics which is definitively more convincing and adequate than that of the traditional equilibrium analysis: again, a system property which candidates to become a firm property.

¹⁶ A point that, as for the other lenses, we will expand in the next section.

¹⁷ The globalisation of production and the volatility of the consumer preferences are usually considered the most important sources of such a turbulent environment. Evidently, the advent of the so-called 'New Economy' adds to them other elements of turmoil for the firm.

¹⁸ Such an argument is quite well known in system theory, where it has been developed under the agenda of 'emergent properties of systems'. Indeed, the seminal idea that order emerges from chaos (Prigogine and Stengers, 1984) has been recently made operational in various ways. The behaviour of a process which evolves in the form of an open-ended spiral, "encompassing recursive events of any process, predictable in repeated patterns" (Bergson, 1995), for example, can be seen at work in the growth of organizational structures. Following this intuition, also Kay examines the role of linkages in defining corporate strategies and addresses their "double-edged" nature, as possible sources of both vulnerability to environment factors and of internal economies (Kay, 1997).

At the outset, let us observe that a certain legal configuration of the firm, such as that of the public limited company, or a certain configuration of its operative units, such as that of the multi-divisional firm, as any other system configuration we can think of through a certain lens, it is not an equilibrium configuration where system elements, properties and interactions remain unchanged. On the contrary, in a public limited company, the relative weight of the shareholders in the decisional process with respect to that of the creditors changes with the firm size and with its capitalization degree; and the same holds for the relationships occurring among the divisions of an M firm, which become closer or looser depending on the focusing strategies of the firm. Accordingly, the idea of a system configuration with respect to the firm dynamics appears closer to that of a ‘steady state’, in which the configuration itself is kept constant (and not unchanged) through continuous flows of exchanges, both within the firm and between the firm and its outer environment. Indeed, also with respect to the firm, it is when such flows make the parameters and the variables of the system to overcome the thresholds of consistency with respect to a certain configuration that the system switches to a further, hierarchically more complex, configuration. Again, just to make an example, it is when the relative weight of the institutional investors in the decisional process increases over a certain threshold that the legal configuration of the firm switches from a public limited to a public company as such. Similarly, it is when the coordination relationships among the operative units overcomes a certain threshold of heterogeneity (due to product diversification) that the firm switches from a purely functional to a multidivisional configuration.

This ‘steady state’ view of the firm dynamics makes it relevant for the firm also the idea of system fluctuations and of chaos. In fact, given that the characteristic configurations of the firm are far from being stable equilibrium positions, they are subject to non-linear processes which continuously place them in front of bifurcations. Although, *ex-post*, the sequence of phases undertaken by the different system configurations of the firm appears quite predictable – the M firm, for example, is usually treated as an obliged evolution for the U firm – in *ex-ante* terms, the presence of more than two degrees of freedom, or of ‘strange attractors’, which might lead the firm to chaos, rather than to an ordered evolution process, can’t be excluded a priori. In order to exclude this case we need to admit that the firm also, as any other open system, benefits from proper auto-regulation mechanisms which keep it equifinalistic, that is independent from time and from initial conditions. In fact, whatever the lens we use, any system configuration is protected from chaos by a suitable homeostatic mechanism. Let us think, for example, of the configuration the firm reveals in terms of resources, capabilities and competence. Sticking to its core or distinctive competences, indeed the strongest *credo* of modern strategic analysis, allows the firm to maintain its steady state competence configuration also in the presence of diversification policies which are in principle chaotic.

Auto-regulation and homeostasis properties are, as system theory shows, based on the functioning of feed-back processes. And feed-back processes are central to the firm evolution too. The idea here is that not only are the relationships among the elements of whatever system configuration mutual and reciprocal: when we think of the coordination relationships among the operative units of firm that appears nothing but a common sense¹⁹. The crucial issue is rather that feedback allows the firm, as to any other system, to be homeostatic with respect to its objective and to its characteristic configuration. Far from entailing a deterministic view of the firm, according to which the firm would promptly behave following a well defined objective function (i.e. profit), and rather drawing on a behavioural approach (à la Cyert and March), the orientation towards an objective is another property that the firm

¹⁹ For example, the way the engineering department communicate with the production department feed-backs on the way the former communicate with the R&D one. More in general, the idea that the firm organization structure is a chain rather than a linear process can be envisaged at any other level.

shares with any other open system. The idea is simply that, while the different behaviours of the firm components (e.g. shareholders vs. managers) prevents the adoption of a purely teleological view, on the other hand, the firm is moved by forces which act “here and right now”, according to intentions and aspiration levels: the system configuration which appears through the lens of the operative units, for example, is oriented towards the control of the firm. Although this orientation to the scope works along with the emergent properties of the firm we have discussed above, its functioning contributes to the ordered evolution of the firm. And feedbacks are in this last respect essential, whenever the firm-system is pushed away from its scope: indeed, when this happens, such deviations are leveraged by reducing (negative feedback) or augmenting (positive feedback) the distance of the system elements from their threshold values.

The systemic conceptualisation of the firm, already arguable by extending the previous system properties, can be further enriched by a final important consideration. Not only does the firm exchange material and immaterial flows with outer institutions, thus being ‘open’, but it also interacts with other institutions which are socially embedded, thus identifying a ‘socio-technical’ kind of system. Accordingly, the properties of such kinds of systems becomes relevant for the firm too. That this is the case can be shown by referring to the most important of these properties, that of their ‘organized complexity’. The starting point in this last respect is that the firm, being aim oriented, i.e. moved by specific missions and goals, naturally develops system configurations which are hierarchical, i.e. configurations which can be broken down in further configurations, in turn made up of further configurations, and so and so forth. Looking at the operational units of the firm from an organizational lens, this feature appears quite evident: let us just think, for example, of the plants which constitutes each of the functions (a higher level configuration) into which the divisions (a further configuration) of an M firm can be broken down. What is more, as in any other socio-technical system, also the firm configurations are so interrelated that their behavior and structure change once they have been insulated from the others: for example, the degree of ‘power’ the shareholders exert on the basis of their shares only turns into a different degree of participation when they are set at work within the legal framework of the firm along with the creditors and along other legal subjects.

All these features make of the firm an organized kind of complexity, which crucially affects the negantropic properties we have recognized before. More precisely, the hierarchical structure which organizes the firm complexity makes the firm evolution somehow bounded by those sub-systems which are characterized by limited information or by certain critical values: in system theory, business missions are often quoted as examples of such bounding sub-systems (Tomasi and Consiglieri, 2001). Furthermore, because of the same hierarchical structure of the firm configurations, their evolution is inevitably irreversible or, when it is reversible, this is extremely costly. When we will specify the actual characteristics of the firm configurations we have identified in this paper we will have the chance to argue this point at great length. For the time being, a quick thought to the path-dependence which has characterized the development of the firm organizational structures in different capitalistic systems, as argued by the seminal work of Alfred Chandler Jr., can be an illustrative example.

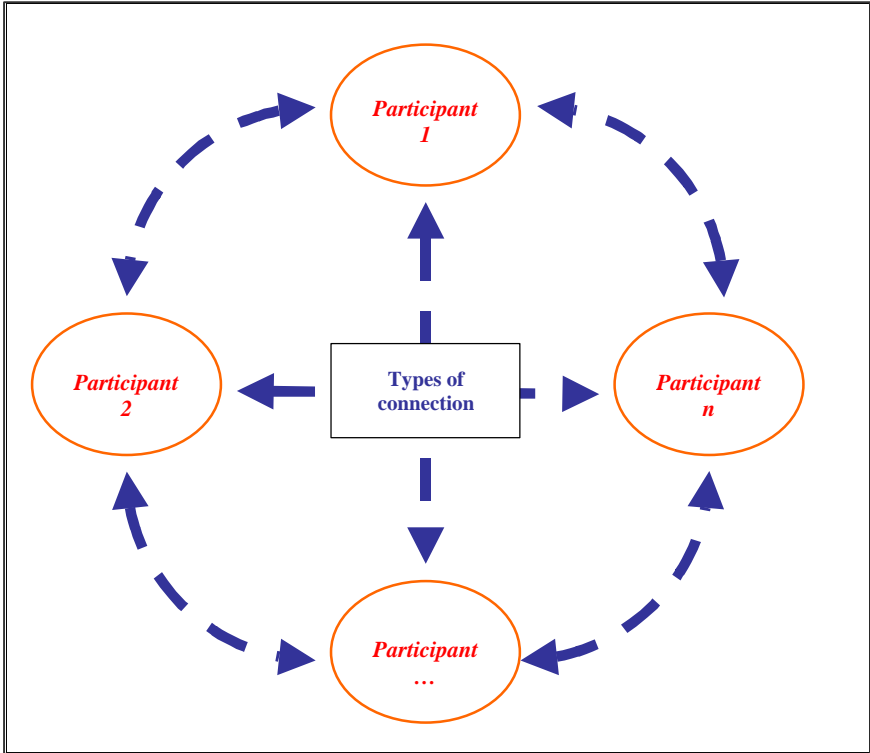
In conclusion, on the basis of the previous factual arguments, we feel quite confident in admitting that the main system properties identified by system theory can actually be retained firm properties too. On the basis of this extension we feel accordingly entitled, if not even obliged, to support the system view put forward by some fathers of the firm with an actual system methodology, a task we will devote to in the next section.

3. Four lenses for a system view of the firm

Having argued that the firm is in fact nothing but a system, although with very special features, we are left with the problem of finding a consistent methodology, i.e. a system one, to investigate it. In searching for such a methodology we have been struck by the fact that our object of investigation (i.e. the firm) is, first and above all, a *manifold* and a *dynamic* system. Indeed, like an iceberg, the firm has unfolded and unfolds over time along paths which refer to different levels of analysis: accordingly, as the biologist needs to wear different lenses to monitor the internal and the external evolution of the iceberg, rather than that of the tip or of the base, ourselves too need more than one lens to observe the firm system configurations and their dynamics.

At the outset, the lenses we are looking for should be, as we have already said, of systemic nature: in other words, they should allow us to see the firm as a set of firm ‘participants’ (not necessarily individual agents, but also different material or immaterial entities) interrelated by a certain kind of ‘connections’ (i.e. relationships which, again, can consist of both material or immaterial flows among the firm participants). Of course, the specific nature of both the constituent elements and the connecting relationships of the firm depends on the specific firm ‘dimension’ on which we focus: looking at its organizational dimension, for example, the firm as a system will appear to us differently from what we would get by looking at its legal dimension. In generic terms, however, the lenses we are going to use will have to work in a way which discloses us a firm dimension made up of interacting firm participants as suggested by Figure 1.

Figure 1 – A generic firm dimension observed through a system lens



The next questions thus become: how many and which lenses of such a kind should we actually use in approaching the firm as a system? And again, which kind of relationships does occur among the resulting firm dimensions?

As far as the first question is concerned, the answer is quite crucial, as it will amount to deciding what of the firm as a system we are going to retain. In this last respect, although we are aware of the manifold nature of the firm, looking at the main system views of the ‘fathers’ of the firm (analyzed in Section 1), and integrating them with those contributions which have been more effective in documenting its historical evolution²⁰, we feel that our lenses should focus on four crucial dimensions of the firm: (i) the capabilities dimension, (i) the legal dimension, (ii) the organizational dimension, and (iv) the institutional dimension.

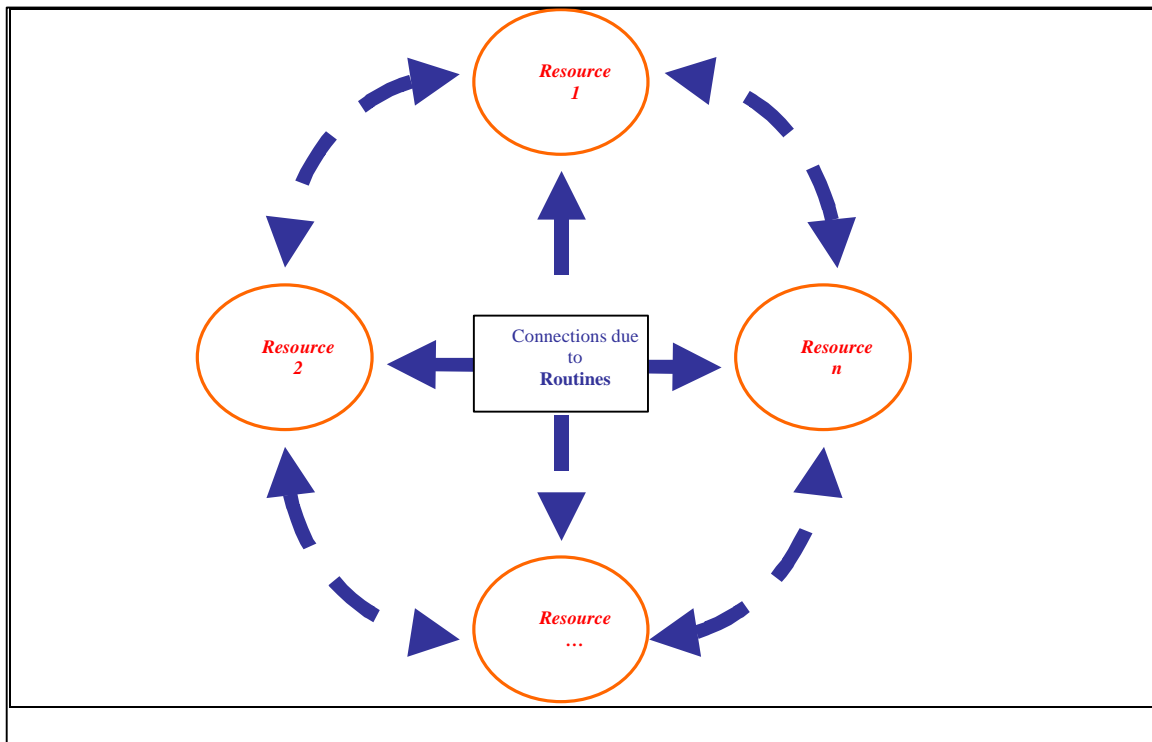
Although this selection might appear, *prima facie*, arbitrary and partial, it is in fact the result of an accurate evaluation of the firm nature and on the nature of its dynamics. First of all, it embodies the idea, recently ‘rediscovered’ in the debate on the economic theory of the firm, that the firm is, first and above all, a set of resources, capabilities and competence which allow it to exist and to accomplish idiosyncratic production activities (Montresor, 2002). Second, it retains a legal dimension of the firm which extends beyond the exclusive consideration of property rights and principal-agent relationships, and which does not considered contractual relationships as the unique channels of legal interaction among the firm participants. Third, it clearly distinguishes the previous forms of agglomeration and interaction from those which emerge, in the third organizational dimension, from the coordination needs of the firm and from other organizational kinds of issues. Fourth, it sets the firm at work in an institutional dimension, considering it as an institution which interacts, strategically, with other institutions, both formal and informal.

The previous argument implicitly assumes a relationships among the four lenses which is worthwhile making explicit. First of all, the four lenses *do not* observe four different parts, or four different sub-systems of the firm, but the firm as a whole. On the contrary, each of them catches the firm as a whole, but from a different perspective. Second, the four lenses are complementary rather than substitutive in observing the firm as a system: in other words, each of them provide us with a view which integrates the views emerging from the other, but still for the system as a whole. Accordingly, the system is fully described just when all the relevant dimensions are retained. However, and this is the third point, the four lenses are mutually exclusive, in the sense that the view one allows us to catch is not affected by those emerging from the other lenses.

Having clarified these important ‘instructions’, we are finally ready to use our four lenses to observe the dimensions of the firm as a system. The first thing that we observe is that, by focusing on a certain dimension, the ‘participants’ and the ‘connections’ we have somehow stylized in Figure 1 now takes on a more specific identity and thus defines the firm-system. More precisely, focusing on the firm capabilities, the first lens shows us the firm as a system of individual *resources*, both tangible and intangible, such as, for example, physical assets but also human capital. These resources are connected among them through the implementation of organizational *routines* the firm follows to carry out its economic activities (e.g. R&D, production, marketing, etc.) (Figure 2). Indeed, individual resources, and the competences which result from their further integration through suitable behavioral procedures (for example, at the level of functional department), are at the basis of the explanation of how the system-firm organizes to be ‘capable’ to do something: both in terms of effectiveness and of efficiency.

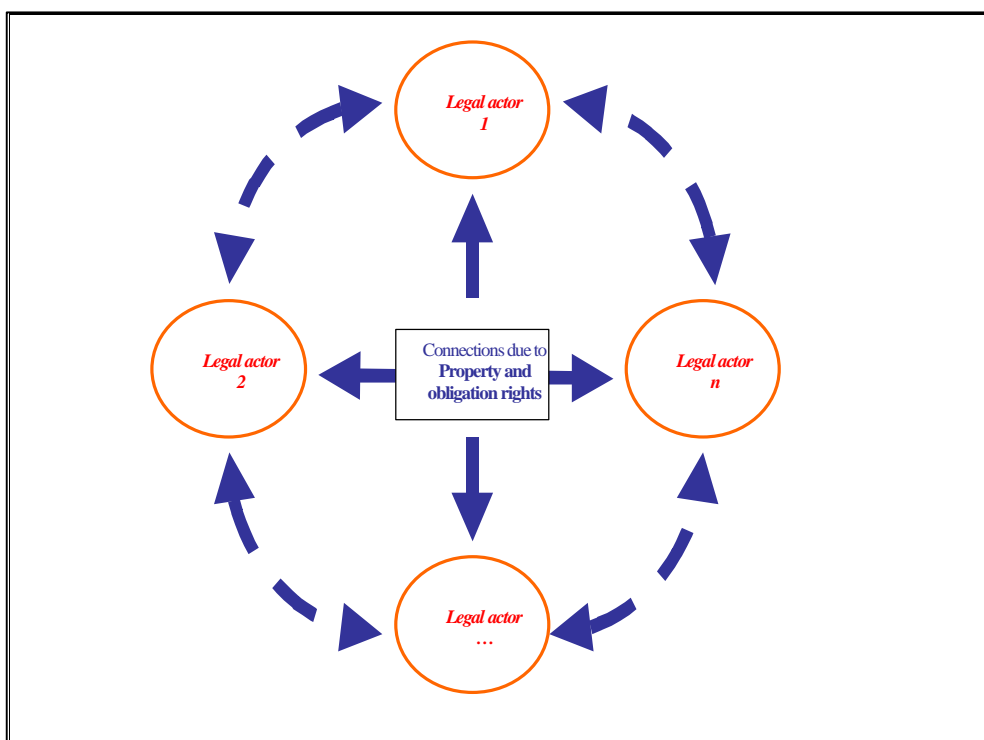
²⁰ As we have already said, the important historical work carried out by Alfred Chandler (1972) is just one of them, but other can be traced by looking at, for example, the evolution of the legal set-ups of the firm which can be found in Berle and Means (1932), or the history of technological capabilities contained in Freeman and Soete (1997, Part I).

Figure 2 – (i) The capabilities dimension



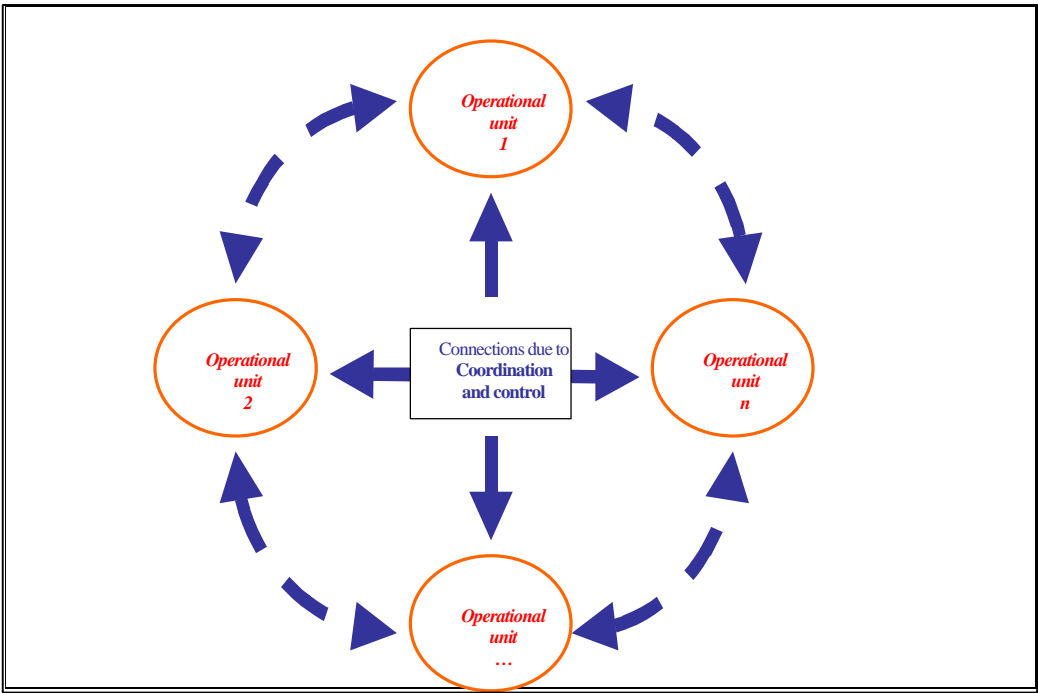
The view that we get by using the second lens, that is by focusing on the legal dimension, shows a different set of firm participants, identified by the *legal actors* which participate, both directly and indirectly, to the economic activity of the firm: not only shareholders and managers, therefore, but also creditors and other actors which hold with respect to the firm a property or an obligation right. Indeed, it is the application of these *rights* which identifies the relevant channel of connection among the participants of this lens and, accordingly, the legal organization of the firm as a system (Figure 3).

Figure 3 – (ii) The legal dimension



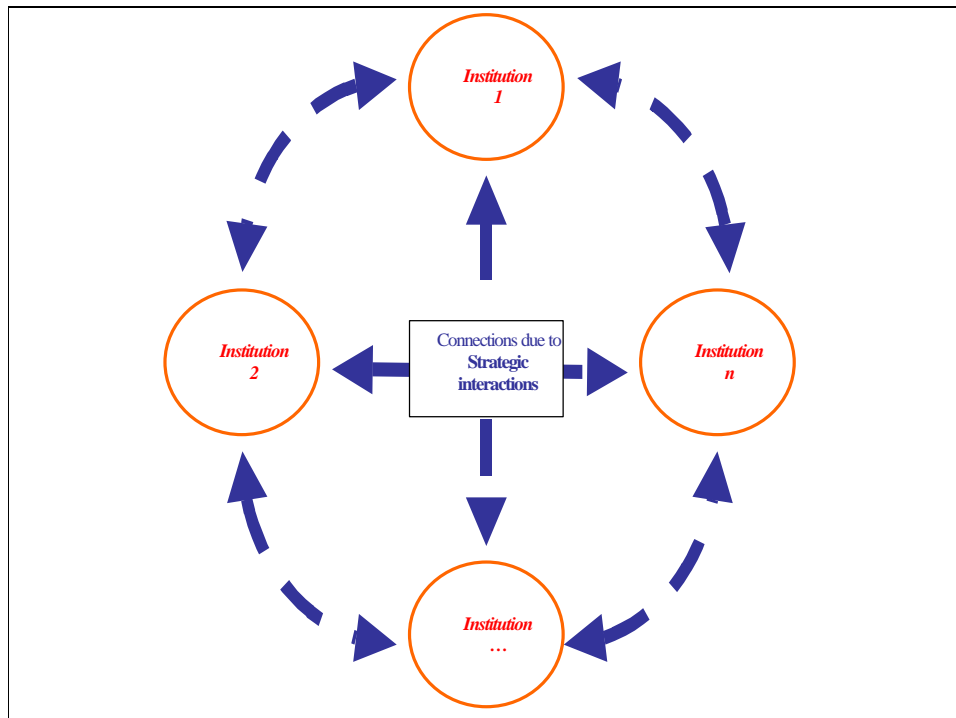
Also the third lens that we use gives us back the imagine of a system of elements and relationships, but from an organizational point of view (Figure 4). The constituent elements of the firm are in fact this time the minimum units of aggregation - generically indicated *operational units* - into which the firm organizes to solve the problems of *coordination and control* of the agents which operate within it: the different functional departments of the firm, and its divisions, are the typical examples of these operational units. Furthermore, coordination and control are also at the basis of the relationships which establish among the operational units on the basis of their relative authority. Once again, their interplay identifies the organization of the system-firm from a truly organizational point of view.

Figure 4 – (iii) The organizational dimension



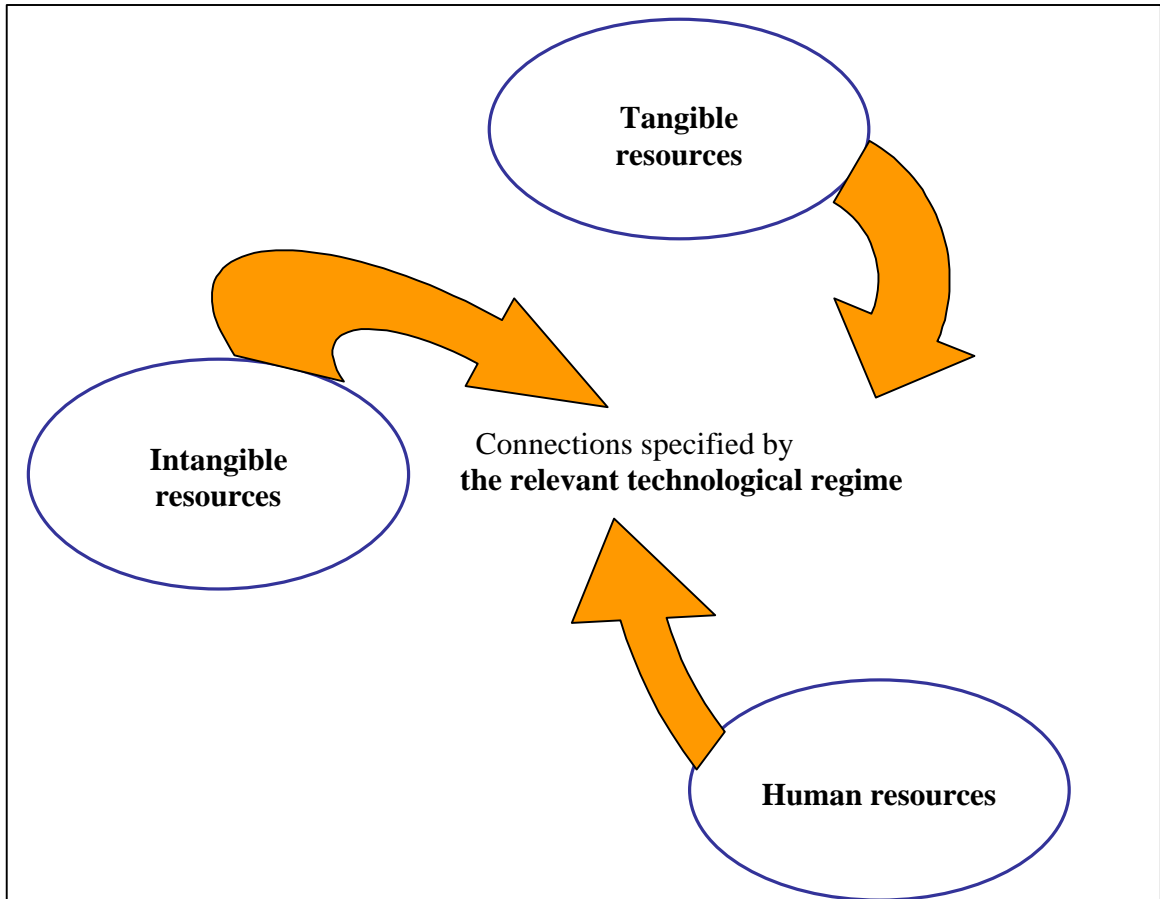
The fourth and last lens depicts the firm as a system of interacting *institutions* (Figure 5). In other words, it focuses on the network of actors which provides the firm with those material and immaterial ‘inputs’ the firm needs, in addition to its capabilities, to perform a certain economic activity: suppliers and customers are two of the numerous actors with which the firm interacts. The relationships which constitutes the system in this case are of course of different nature but they are all driven by strategic kinds of considerations. Indeed, it is from the implementation of these *strategic relationships* that the institutional organization, or institutional set-up, of the firm actually emerges.

Figure 5 – (iv) The institutional dimension



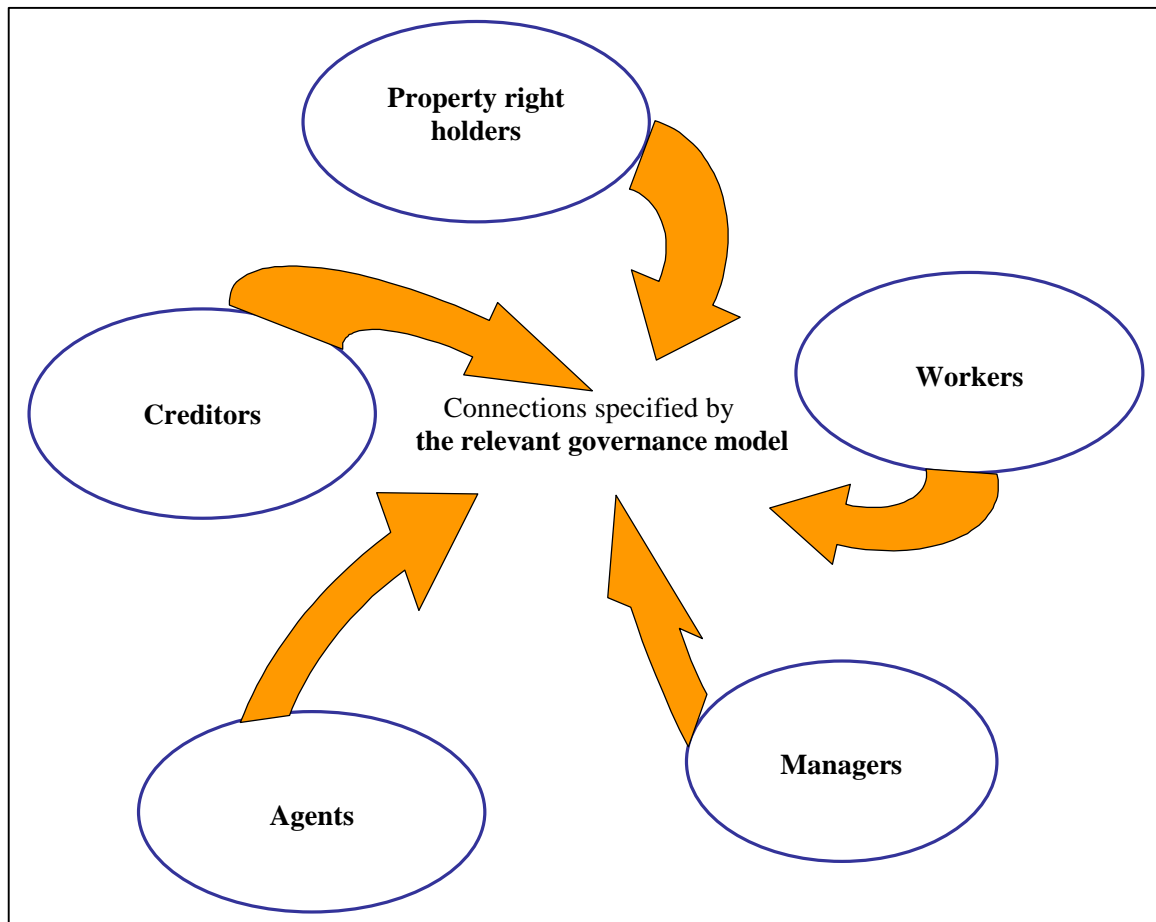
The ‘pictures’ of the firm that we have taken up to now are of course still quite generic. However, a further specification level of the firm-system will become possible if we are just able to identify the determinant of the relevant connections for each of the four dimensions. This is actually possible and allows us to move from the generic *definitions* we have identified above on the basis of an inclusion principle, to more specific system *configurations*. As far as the first lens is concerned, for example, the specific nature of the connections which establish among the firm resources crucially depends on the ‘technological regime’ which is relevant for the firm (Breschi et al., 2000). Indeed, depending on the features that the relevant firm technology reveals in terms of opportunity conditions, appropriability conditions, knowledge nature and cumulativeness, the firm will connect its resources according to different kinds of routines: more or less tacit, complex, independent, etc. The resulting configuration will thus appear as that of Figure 6, where the three typical firm resources have been specified: tangible, intangible and human.

Figure 6 – (i) The capabilities dimension: a configuration



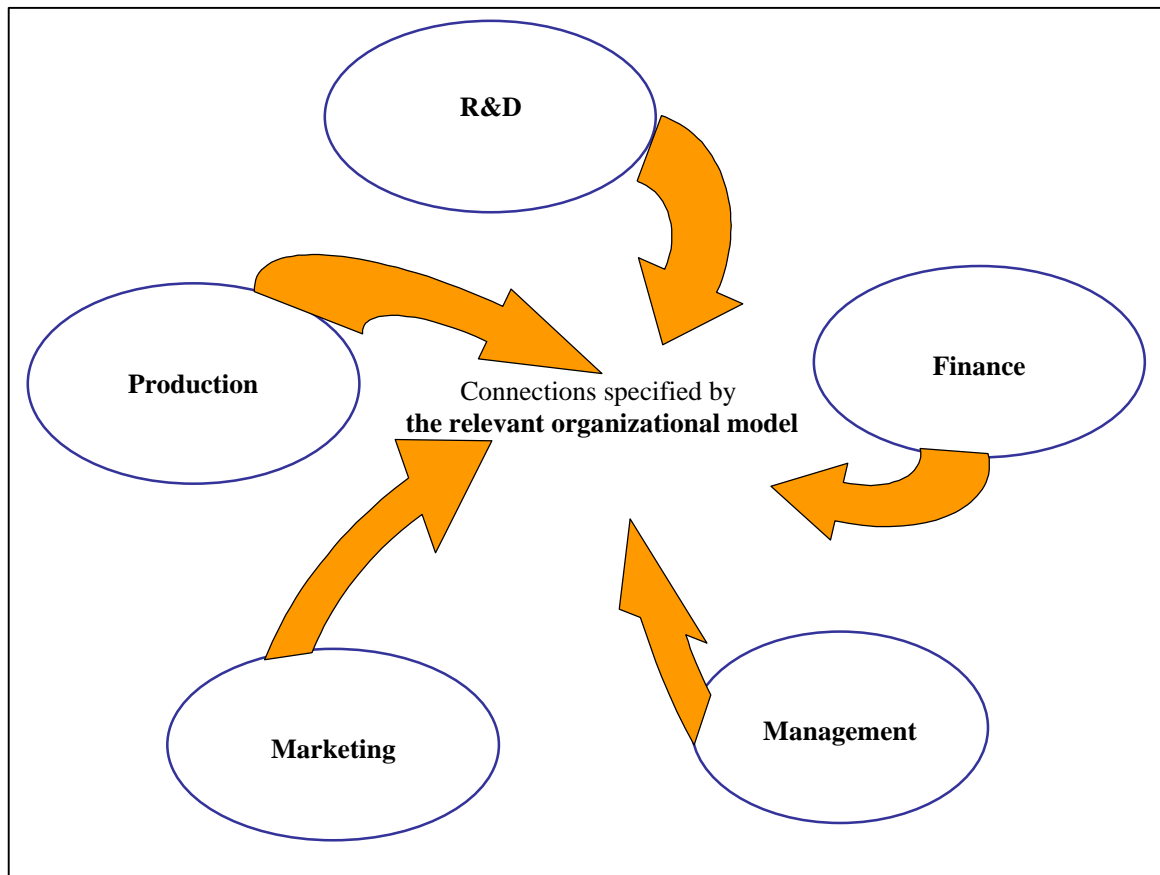
A certain system configuration can be identified also with respect to the legal dimension of the firm. The qualifying factor in this case is the model of governance that the firm selects as a result of such diverse circumstances as the dominant set of corporate laws, industrial relations, contractual weight of the parties and so on. Indeed, the typical (this is not to say necessary) legal actors of a modern corporation, i.e. property rights holders, managers, creditors, agents and workers, exert their rights differently depending of the peculiarities of the relevant governance model, as suggested by Figure 7.

Figure 7 – (ii) The legal dimension: a configuration



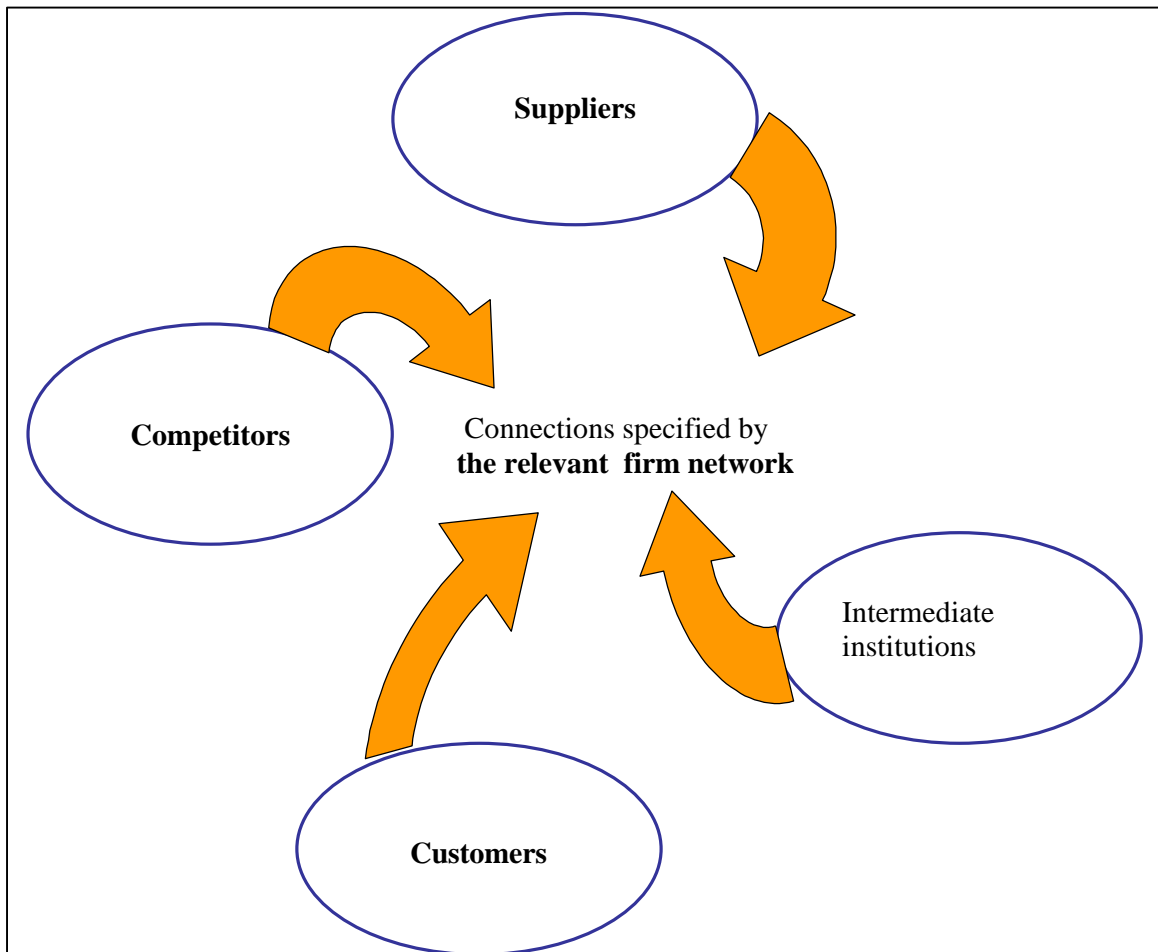
The configuration of what we observe through the organizational lens evidently depends on the specific organizational model the firm implements. The choice between a model by function (e.g. R&D, production, marketing, etc.) and a model by division (e.g. on a product rather than on a geographical base) is just one of the several alternatives which affect the actual nature of the relationships occurring among the firm operational units. In this last respect, Figure 8 describes, for example, the configuration of a firm whose organizational model has a typical functional base and whose operational units are allocated around the following typical functions: R&D, production, marketing, management and finance.

Figure 8 – (iii) The organizational dimension: a configuration



Finally, Figure 9 reports a typical configuration of the institutional dimension of the firm, crucially affected, as it is, by the nature of the network within which the firm itself operates. Indeed, depending on the spatial and organizational extension and features of such a network, the relationships the firm establishes with such different ‘institutions’ as suppliers, customers, competitors and ‘intermediate institutions’ (banks, universities, chambers of commerce, etc.) will be of a different nature. In other words, it will be the network itself that will make some relationships more or less strategic than others.

Figure 9 – (iii) The institutional dimension: a configuration



The analysis of the specific configurations the firm reveals with respect to its four basic dimensions is of course an extremely important instrument to investigate the firm systemically. For each of the four dimensions we are in fact able to detect a level of organization of the system-firm in which the relationships among the relevant firm participants are configured by a connecting principle, i.e., respectively: the relevant technological regime, the selected model of governance, the specific organizational model, and the inherent firm network. Depending on this connecting principle, each of the four possible configuration might turns into an actual *structure*, i.e. the structure the firm takes on when considered as a system.

Of course, the actual structure of each firm dimension is the result of one of the several possible ways in which a certain configuration can be, so to say, modularized. In turn, the actual structure of each dimension can be differently modularizes with the actual structure of the other dimensions in order to identify the actual structure of the firm as a whole. However, in order to accomplish this last piece of our system methodology we need to move from the methodological level of analysis we have followed up to now to a more applied level of analysis, which goes beyond the objectives of the paper. For this reason, to this exercise we will rather devote in the natural follow-up of the present research program.

4. Conclusions

Dealing with the firm as a system means something more than ‘simply’ retaining all its constituent elements and relationships. As some influential contributions in the history of the theory of the firm clearly reveals, there is something more. First of all, some fundamental system properties hold with respect to the firm too, and thus can be thought, *mutatis mutandis*, as firm properties: holism and nega-entropy are the most relevant of them, but not the only ones. Second, the system methodology becomes an essential tool of analysis in investigating the firm and its evolution over time. In particular, in order to catch its inner complexity it turns out useful to look at its relevant dimensions with a proper set of lenses, through which the firm can be: (i) defined in the elements and connections of each dimension, on the basis of an inclusive principle; (ii) organized in the configurations its relevant dimensions show once their determinant has been identified; (iii) specified in the structures which result from the modulation of the same configurations.

In this paper we have argued that four lenses can be used at this purpose, in order to consider the system-firm with respect to four relevant dimensions: (i) the capabilities dimension; (ii) the legal dimension; (iii) the organizational dimension; (iv) the institutional dimension. For each of them we have then identified the system elements and connections of the firm, we have shown how some crucial classifier elements might, on principle, yield different configurations, and just hinted that a proper modularization of the firm dimensions and of their relationships defines the actual structure of the firm.

Following the previous rational we actually arrive at an implicit definition of the firm as an evolving kind of ‘organized complexity’, resulting from the dynamic combination (or better to say, modularization) of the actual structures of its configurations. Such a definition is evidently quite abstract, but on purpose. Indeed, we deem that this is the only firm definition that is convenient (if not possible) to provide at a general level, while more ‘concrete’ definitions are just definitions of its actual structures.

Of course, this is not to say that actual firm structures are unimportant, but just that it turns out methodological convenient to derive them from a common starting point, i.e. a system one. How to move from this point on, that is how to identify the firm in its actual structures, is the next point on the agenda. With respect to it at least two further research lines can be envisaged, complementary rather substitute between them. The former consists of setting our system methodology at work by building up a model which is able to embody the definition-configuration-structure chain for each of the four dimensions, and to combine them. The latter intends to provide a taxonomy of firm structures by looking at, and combining, the actual historical evolution of our for firm configurations. For example, it will be possible to isolate a, let us say, ‘new-economy’ firm structure as the outcome of the interplay of four dimensional structures, i.e.: (i) a capabilities dimension shaped by the technological regime of the Information and Communication Technologies (ICT); (ii) a legal dimension affected by the diffusion of the so called e-governance models; (iii) an organizational dimension pervaded by ‘virtual’, or quasi virtual, organizational linkages; (iv) an institutional dimension in which the firm sets up by solving strategically the outsourcing or the internalization of its material and immaterial assets. But also more ‘familiar’ firm structures could be revisited using the same framework and possibly enriched by adding new system elements to their analysis.

In this last respect, it seems to us that such a taxonomy might encompass also the so called Small and Medium Enterprises (SMEs) model: a model that more ‘traditional’ approaches in economics have mainly considered from an organizational (e.g. characterized by informal channels of coordination) and an institutional (e.g. set in homogeneous socio-cultural networks) dimension, while getting some difficulties in combining it with a capabilities dimension (i.e. the crucial role of knowledge intensive resources and of the knowledge

access). It seems to us that by combining our four firm dimensions, also the SMEs model could be analyzed in its inner complexity, and possibly organized around more specific SMEs firm structures.

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