

# Knowledge Governance Mechanisms and the Theory of the Firm

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## **Knowledge governance mechanisms and the theory of the firm\***

### **Abstract**

*The paper builds on existing empirical research on knowledge transfer and sharing in inter-firm and intra-firm networks, for constructing a comparative framework. The first comparative question addressed is: what types of organizational network can govern what types of knowledge network? Both the cognitive difficulty of communication and the incentive to give information turn out to be fundamental in finding an answer. The variables influencing those two dimensions are discussed (divergence in knowledge and preference, computational and epistemic complexity). The second comparative question is what the differences are between intra-firm and interfirm knowledge flows and knowledge governance mechanisms. The results of our analysis downplay the exclusive properties of firms in knowledge transfer/sharing respects hypothesised by the ‘knowledge-based theory of the firm’, and call for a more ‘continuous’ (rather than ‘discrete’) and ‘combinatorial’ (rather than ‘idealtypical’) notion of governance mechanisms and forms.*

### **Introduction**

«As we continue to form a genuine theory of what happens inside the firm, we see that a key to explaining its construction is achieving a better understanding of the kinds of information exchange that take place, both within the firm and between firms. We must try to understand why it is sometimes easier to exchange information within firms than between them, while at other times it doesn't matter much whether or not the flows of information travel across firm boundaries. To achieve that understanding, we need lots of empirical studies of what actually happens in firms as people try to coordinate, to use common information, to construct common frames or references that allow them to think in some kind of co-operation with each other» (Simon, 1996).

In order to answer this question, which is of central importance to the subject dealt with here,

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says Simon, we need a large amount of empirical research on what really happens in firms when people try to communicate and share knowledge. Actually, one should add that there is an equal need for detailed, in-depth research into what really happens *among* firms at the level of exchange and sharing of knowledge. In what sense and in what respects are the mechanisms different from those inside the firm? What kinds of knowledge are effectively exchanged or shared under those different systems of governance? What implications can be derived from a knowledge-based analysis for a better understanding of both the firm and the relations among firms? The analysis given here offers some replies to these questions.

The ‘knowledge-based theory of the firm’, as it now stands, maintains that the firm enjoys special advantages in organizing the set of activities that can be effectively performed on the basis of a ‘sharing’ of knowledge: the advantage residing in a superior possibility of accessing each other’s knowledge that people and units in a firm would have. This property is supposed to hold thanks to the possibility of using, inside the firm, otherwise unavailable mechanisms, such as hierarchy, identification with a ‘community’, group decision, rules and programmes (Demsetz 1988; Grant 1996; Kogut, Zander 1996; Simon 1996). This conception stems from the mirror properties the market is supposed to have as a governance system alternative to the firm (Hayek 1945): the ability to avoid such an expensive mutual access among different knowledge nodes, specialized in different activities and specific to different contexts. For example, one can apply a medical prescription, a chemical formula, a patented production system, without understanding how these have been generated. This conceptualization is, however, admittedly, a very rough one. The idea that ‘outside’ the firm only market relations rule, obscures the fact that several mechanisms of knowledge sharing are actually sustainable even between firms. Hence, our understanding of the impact of knowledge on effective systems of governance can be greatly refined by in-depth study of the actual flows of knowledge and of the mechanisms that regulate them between firms and within firms. The conclusions of our analysis suggest a reappraisal of the role of firms in generating and applying knowledge, not only by means of their internal organization, but through the organization of their external relations as well.

### **Knowledge dimensions and coordination mechanisms**

Let us start from a set of ‘nodes’ of specialized knowledge: persons or sets of persons who begin a learning path starting from a speciality — whether functional specialization, specialization of product, of process, or others. Let us further suppose that specialization concurs with

complementarities (or interdependencies in organizational language) in generating coordination needs (Becker and Murphy 19xx; Thompson 1967). Which kinds of knowledge flows may link such nodes and which coordination mechanisms can regulate them? On what factors the answer depends?

This question has been core in organization theory since early contributions (especially in ‘structural contingency theory’); although it was not always phrased in knowledge terms (Lawrence and Lorsch 1967). In fact, some of the main tenets of that approach have been already fruitfully applied to a first systematization on knowledge governance mechanisms in firms (Grant 1996). The argument developed here generalizes those answers by a) considering both intra-firm and inter-firm relations, and b) explicitating and developing the analysis of objectives (and possible conflict between objectives) that was somehow limited and ‘buried’ in contingency theory and somehow lost in recent knowledge-based theorizing.

Two bundles of variables have been shown to influence significantly the possibility of knowledge exchange among organizational units and the effective mode of governing them in early contingency studies: the degree of differentiation and the degree of interdependence.

Here only those components in the concept of *differentiation* that can be referred to knowledge interchanges will be used, especially differences in technical specialties and in the cognitive orientations which often go along with them, both within and between firms (Grandori 2001)<sup>1</sup>. These differences include diversities in languages, in the perception of relevant information, in the theories and practices used, and in the categories of results pursued (content of objectives) – e.g. cost reduction, market share, innovation etc. Thus conceived, knowledge differentiation is expected to generate communication impasses and potential for conflict, *both among judgments and among preferences*.

This however would not be a major problem if differentiated units could be isolated and decoupled. If there are no ways to increase value generation by exchange or pooling of those resource and activities, then there are no ‘*complementarities*’ (or no ‘*interdependence*’ in the organizational language), hence no need for coordination (Richardson 1972). Some types of ‘loose’ or ‘simple’ complementarities can be coordinated in ways that avoid communication rather than invest in it. Within firms, this is can be and has been achieved by creating ‘self-contained units’, as production islands or, at a higher level, autonomous divisions. Between firms, ‘market-like’ coordination is supposed to serve in allowing the exchange of goods and services without

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<sup>1</sup> In interfirm research, the more subjective and psychological dimensions of knowledge differentiation have been employed to predict increasing coordination difficulty and the need for high powered integration mechanisms: the construct has been labeled ‘*psychic distance*’ in spatial economics and the study of internationally differentiated alliances (Mariotti 1984) and ‘*cognitive distance*’ in the study of technologically differentiated interfirm alliances (Nooteboom 1998).

significant exchange of knowledge. This is possible and worthwhile if the nodes of assets and activities are complementary (or interdependent) – they generate more value if connected by exchange or pooling - but transfers or pooling of goods and services are sufficient, without the support of transaction-specific information. Many types of complementarity or interdependence among specialized units can not be regulated effectively without communication, though, both within and between firms (Richardson 1972; Grandori 1997)<sup>2</sup>. The type and bandwidth of communication is expected to depend on the degree of knowledge differentiation, on the tightness of complementarity (or intensity of interdependence) as well as on some core characteristics of the involved knowledge itself, broadly definable 'knowledge complexity', as illustrated below.

Some types of can be coordinated by communicating about actions but not about the knowledge on which they are based. This is a desirable feature especially if knowledge differentiation is high. Situations of that type include 'simple' interdependences as sequential and pooled ones (Thompson 1967) . Hierarchy, plans and programmes has been seen as a mode of coordination that avoid the costs of knowledge sharing: one-way communication on the 'correct' actions to be taken substitute for the transfer of the knowledge on which they rest (Demsetz 1991). This mechanism can obviously work between units in a firm, but is also applied in sub-contracting relations and in production joint ventures between firms. However, hierarchy only works if knowledge is not inherently distributed, i.e if one (central) node holds (or can pool) the relevant knowledge on which all specialized tasks draw upon; and programmes only work if the patterns of interactions are stable. 'Complex' interdependencies or 'tight' complementarities are such precisely because effective action requires a reciprocal understanding of the know-how and the know-why, a transfer or sharing of knowledge. The expected effect on effective coordination mechanisms is a failure of hierarchy and programmes as well as of 'market-like' coordination, both within and between firms (Grandori 1997, 2001).

Even where knowledge circulation or even integration is desirable, however, it should not be expected to occur automatically. Sophisticated systems of knowledge management are not sufficiently nourished. People jealously hoard their experiences. Functions do not talk to each other.

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<sup>2</sup> Asset specificity, and knowledge assets specificity in particular, the core concept in transaction cost economics also applicable and applied to knowledge governance issues, can be seen as a particular case of complementarity, for which a particular pairing of assets create *more* value than alternative pairings. As should follow from the analysis conducted in this paper, and I have more extensively argued elsewhere, assets specificity by itself set very weak, if any, constraint on feasible governance mechanisms, just determining an interest in long term association and surplus sharing among asset owners. Which mechanisms should govern that association depend on other factors, including both the degree of conflict among interests and the degree of information and knowledge complexity. These implications for transaction cost economics are discussed in the conclusions of the paper.

Divisions do not build on common ‘core competence’. Sub-contracting firms do not provide their suppliers with knowledge important for making the components of which they nevertheless have need.

Some impediments stem from the degree of differentiation of knowledge. As it increases, the possibility of mutual understanding, of succeeding in decoding the messages, of utilizing the knowledge of others, decreases; the ‘absorption capacity’ diminishes (Cohen and Levinthal 1990). Up to a certain level, the use of ‘integrators’, of figures with intermediate profiles, can enable a dialogue (as in the case of the integrating roles between functions inside the firm, or of brokers and intermediaries among firms). Beyond a certain level of diversity, access to different knowledge becomes prohibitively expensive and difficult. One can use the outputs of the applications of knowledge, but not have access to the source. Therefore, it seems that *there are limits to the possibility of coupling very high knowledge differentiation with very high levels of knowledge interdependence*. Furthermore, the more complex – difficult, intricated, profound – knowledge is, the stronger this trade-off between differentiation and integration is likely to be.

In fact, other complications derive from the characteristics of knowledge. Relevant characteristics of knowledge, with regard to whether and how it can be transferred and shared, and how should the process be regulated, are *tacitness, computational complexity and epistemic complexity*.

The *tacit* or explicit nature of knowledge (Polanyi 1958): expressible or declarative knowledge, by definition, can be expressed and communicated — to itself or to others — through languages and communication supports (documents, electronic systems), whereas tacit knowledge reveals itself in action and cannot be deciphered in its components even by one who employs its (like competence in sport). Hence, the flow of tacit knowledge between different subjects is possible solely through the mutual observation of the subjects in action, a ‘community of practice’ (Wenger 1998). The corollary of this possibility theorem is the failure of alternative mechanisms, including hierarchy, procedures and mere community of discourse.

*Computational complexity*. The number of elements and symbols, and of the possible connections between them, makes the storage and transfer or sharing of such knowledge difficult without supports to the limited computational ability of the mind (documents, programmes) (Simon 1962; Hyllingen ). Conversely, informal communication, as well as hierarchy (in the sense of centralized decision making), are expected to fail in managing computational complexity (Galbraith 1974)

*‘Epistemic’ complexity* stems from the fallibility of judgments and the difficulty in constructing valid and reliable knowledge, and can be operationalized as the difficulty of observing phenomena and diagnosing cause-effect relations. Perhaps we should not even talk of a ‘transfer’ of

epistemically complex knowledge (as part of scientific and artistic knowledge) — it would be more appropriate to speak of a decoding and reconstruction of such knowledge. The most important mechanisms that can effectively convey those interchanges are knowledge certifications, formalization of languages and joint problem solving, as in scientific or ‘epistemic’ communities; while both hierarchy and price-based exchange are expected to fail (Cowan, David and Foray 1999; Grandori 2001).

Finally, knowledge exchange and sharing, even if possible and appropriately supported by communication channels and occasions, will not occur if there is no interest in doing so in the eyes of the ‘nodes’ possessing it. *Difference in the content of objectives may sum up with competitive game structures in differentiating objectives*, thereby weakening the incentives to communicate and generating conflict potential. Why should a piece of knowledge, or even just an output based on it, fly from one node to another? It may do so on the basis of intrinsic motives: actors may share objectives, or agree on actions because of complementary interests, or sustain exchange by reciprocity. Alternatively, in case of disaligned objectives, it may occur for extrinsic reward. However, if complex knowledge is involved, it may be difficult to size rewards and enforce contracts, and extensive interaction and reciprocal access to knowledge bases may be required for understanding whether or not any valuable output can be generated. Actors are asked to invest knowledge assets – rather than just to sell information - and would demand to retain their property rights over them (Ouchi and Bolton 1988; Boisot 1988).

Therefore, in sum, effective coordination mechanisms in case of disaligned objectives (objectives that determines conflict on what actions should be chosen) should be expected to vary from some kind of ‘knowledge market’ — if knowledge is sufficiently structured so as to be tradeable — to the sharing of formally defined property rights over knowledge and knowledge outputs, in the case of complex, specific knowledge. Between those extremes, more or less intense forms of ‘trilateral governance’, ranging from mediated and arbitrated negotiations to the use of pledges and hostages have been shown to be viable to support exchange in general (Bazermann and Lewicki 1983; Williamson 1983) and knowledge exchange in particular (DeLaat 1999; Grandori and Neri 1999).

The elements are there now for outlining a general framework on the expected effective coordination mechanisms (as a blueprint of coordination mechanism failures) as a function of some explanatory variables. If we consider the partial effects of these variables, that the received theory and research described above suggests (summarized in Table I), we realize that they cluster in two



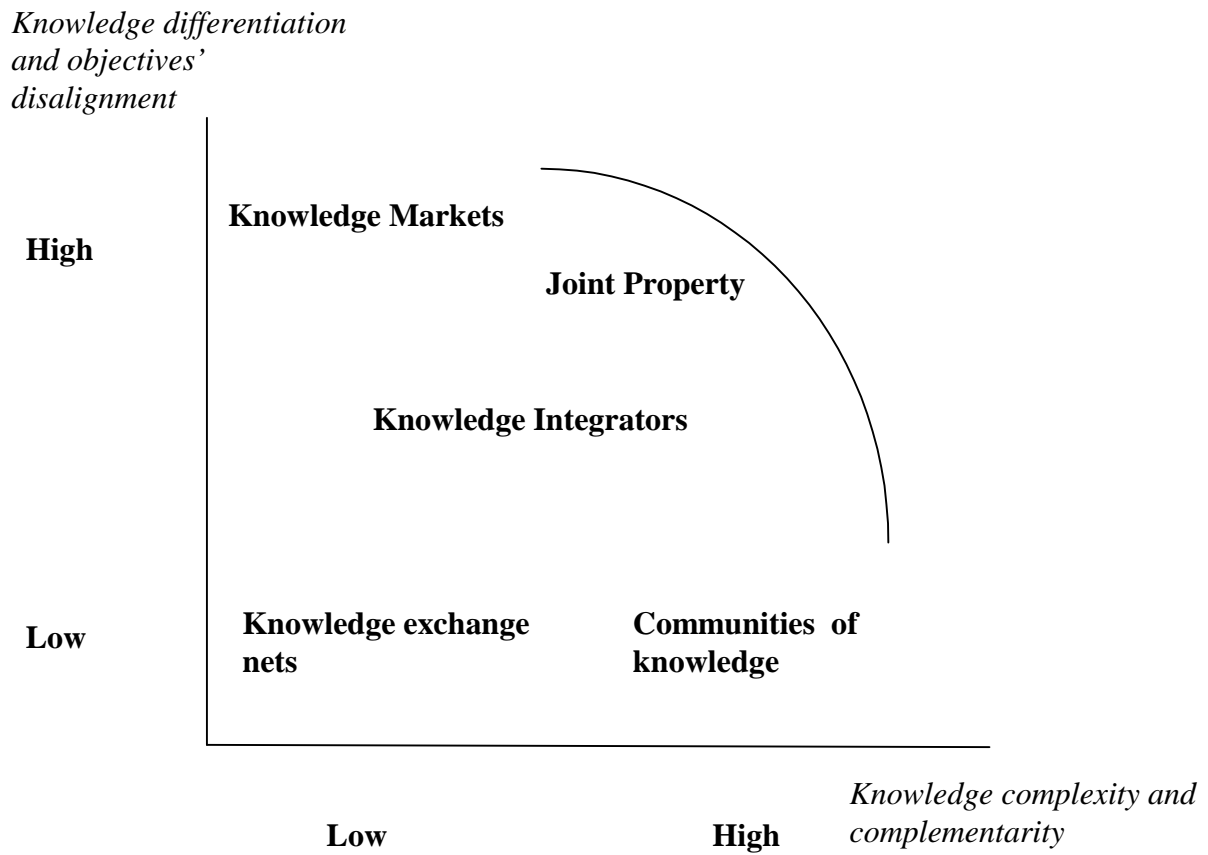
factors, whose components have similar effects on feasible coordination mechanisms. A first factor mainly represents the potential for conflict - of opinion or of interest - among nodes, and mainly contributes to the failure of direct and communitarian knowledge exchange. Intermediaries and incentives are necessary to support exchange or sharing. A second factor mainly represents the level of knowledge complexity and complementarity, and mainly contributes to the failure of prices and hierarchy, as well as of programmes and routines.

Therefore, the whole interpretative model can be represented in its general terms by the two-dimensional scheme of Figure 1. The existence of a frontier of knowledge governance mechanisms descends from the hypothesis that no combination of mechanisms seems to be able to govern extreme complexity of knowledge and complementarity *coupled with* extreme conflict potential. In order to answer the initial questions, our analysis proceeds in the next two sections by placing empirical results on the effective application of different coordination mechanisms in the space defined by the two dimensions, with reference to intra-firm and inter-firm two relationships respectively.

**TABLE 1.- PARTIAL EFFECTS OF EXPLANATORY VARIABLES ON KNOWLEDGE GOVERNANCE MECHANISMS**

EXPLANATORY VARIABLES	COORDINATION MECHANISMS
Tacitness	Direct interactions, routine sharing, communities of practice
Computational complexity	Information backups, procedures, catalogues
Epistemic complexity	Certifications, codes of conduct, communities of knowledge
Interdependence complexity	Direct communitarian interaction
Knowledge differentiation	Brokers, intermediaries and arbiters
Disalignment of objectives	Brokers, intermediaries and arbiters, incentives and property rights

**FIGURE 1 – Knowledge dimensions and knowledge governance mechanisms:  
a framework**

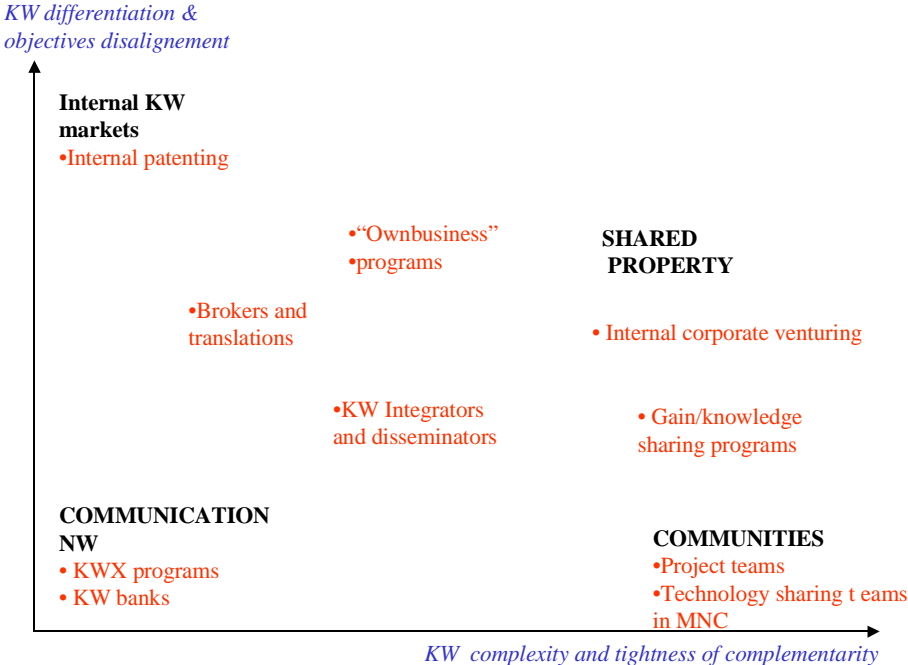


### **Internal knowledge governance mechanisms**

Machiavelli thought that ‘one makes war with one’s neighbours, and makes alliances with those who live far away’. Without going so far, studies on the management of knowledge within the firm nevertheless soon found that the ‘commonness’ of knowledge inside the firm is certainly not to be taken for granted (Chakravarthy, Zaheer, Zaheer1999). There are some kinds of knowledge that do indeed circulate freely and easily — for example, the expressive languages and codes specific to the activities performed; knowledge that has been consolidated and become a corporate ‘public good’; the know-how that has entered organizational routines. These types of common knowledge are formed thanks to continuity of association — an attribute that may also obtain in the relations between firms that collaborate steadily over long periods. Firms whose critical productive factor is embodied in knowledge not incorporated in machines but in people have constructed sophisticated systems to support the exchange of knowledge which should favour mutual learning and the generation of new knowledge. After some years’ experience, however, the hypothesis according to which the best ideas and experiences are in any case exchanged, when the appropriate channels have been established, has revealed its limitations. In the first place, some experiences, best practices and knowledge are too complicated and/or tacit to be effectively transmitted at distance and/or in a short interaction. Secondly, the truer it is that relevant knowledge is a human, ‘personal’ resource — acquired and embodied by people — and the more people compete with others inside the firm (and, more indirectly, with other people outside), the more are the individual incentives not to diffuse one’s own base of personal competitive advantage (especially in the internal labour market). Internal employment contracts, on their side, are, typically, performance contracts, on services rendered (Simon 1955) on the basis of competencies that remain the property of the actors rendering the work services (Penrose 1959). Thus inside the firm, too, only some work relationships imply investment in co-specialized knowledge with respect to other resources conferred in the firm. And even in these cases cooperation is not automatic: the work contracts are enriched with ‘relational’ components (e.g. reciprocated knowledge transfers) and with ‘high powered incentives’ (e.g. gain sharing and other forms of decisional and economic participation).

Owing to these problems, knowledge management systems within firms, which started out as mere communication infrastructures, have been enriched with explicit mechanisms of knowledge integration. The case of 3M provides examples of application within a firm of tools that embrace almost the entire range of possible coordination mechanisms (see Figure 2): from internal patent systems to internal competition for project financing, to data banks and catalogues of knowledge managed by brokers ('Record of Inventions' and 'Technical Coordinator'), to incentives for 'purchase' and re-use of patents and inventions from other units and divisions ('Pathfinder program') or to the formation of internal joint ventures ('Technology sharing awards'), to virtual groups (Forums), to the granting of property rights on the business lines to those who have provided the knowledge assets ('Own Business Program') (Turati 1998).

**FIGURE 2 – Internal Mechanisms of Knowledge Governance**



The experiences of other large firms (some also appear in Figure 2) show that the variety of mechanisms is not a feature peculiar to the specific case. Davenport and Prusak (1998) illustrate for instance the following cases. British Petroleum employs 'translators' who literally translate the findings of technicians on the North Sea rigs into a language the financial headquarters in London can understand. At Texas Instruments, roles of 'knowledge brokers' have been formalized, with 50% of their time devoted to mapping the knowledge and facilitating encounters at high utility potential — also on the basis of Card Catalogues of best practices. Instances can also be found of elaborate but structured communication mechanisms – such as 'knowledge exchange' computerized networks, suited to computationally complex but not ambiguous knowledge - failing when more complex situations are addressed, and being backed up by roles

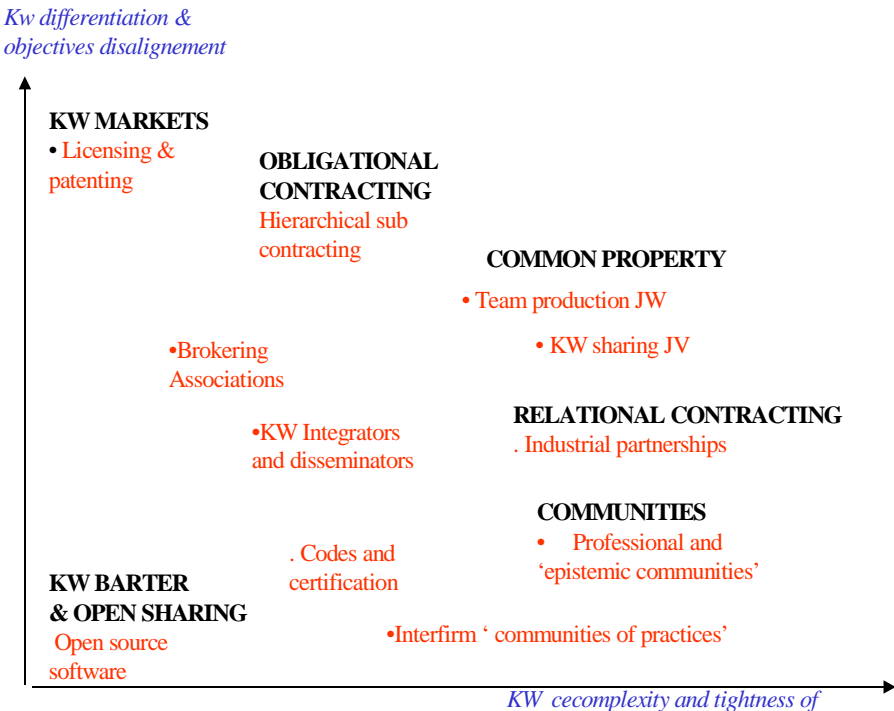
dedicated to the memorization and diffusion of knowledge acquired in significant projects or by face-to-face teaming (Mobil Oil).

Where complexity of knowledge and high conflict potential are simultaneously present, one should expect a sharing of property rights on the knowledge assets by the persons or groups who confer them for a common activity. This is frequently observed in the formation of partnerships for conducting a firm’s professional activities. Islands of shared property rights on knowledge assets by people who confer relevant knowledge, can also be found inside firms where most technical and financial assets belong to other actors. This is the case of internal corporate venturing in which those who confer complementary knowledge retain the property rights over it are recongized as residual claimants over the generated profits (e.g. in farmaceutical firms).

It may be wondered, however, whether the mechanisms of knowledge governance are different and to what extent out of the aegis of corporate governance.

**External knowledge governance**

**FIGURE 1 – Inter-firm knowledge governance mechanisms**



- The exchange and free and mutual sharing of knowledge is entirely sustainable between firms, if the knowledge bases are not too distant and the relationships are not directly competitive; and if the knowledge is not too tacit and complex. Examples of this are the networks of *open source software*, through which software designers exchange program-generating codes without patent or royalty systems (De Laat 1999). The system works thanks to a mechanism that can be likened to that of scientific publications. The recompense is the acknowledgement of the competence of the source (individual and/or firm) and the awareness that the reciprocity game is the only one able to sustain the development and evolution of the software. In addition, the change of rapid obsolescence of software products means that the protective logic underpinning the defence and privatization of competencies as ‘basis of sustainable competitive advantage’ loses out. Important, rather, is the ability to ‘keep pace’ and change continually, leaving acquired knowledge to become rapidly a public, common good (Gavetti 1998).
  
- A system of exchange and cooperative sharing of knowledge can and must take the form of a *community*, if the knowledge is complex and hard to transfer. A first step in this direction is the formation of elements of common identity (such as specific languages) and systems for certifying and guaranteeing the knowledge that is to be transferred: suffice it to recall the studies on the importance of ‘networks’ of reputation and certification in sectors like the legal (Karpik 1989) and the cultural/cinema (Salvemini, Delmestri 1999). Further examples of inter-firm ‘community of practice’ — more or less connected — are the associations of firm professionals (such as ‘controllers’ clubs’). Face-to-face interaction, discussion or even common activity are distinguishing features of more integrated inter-firm communities. For example:
  - the relations of collaboration and circulation of competencies in the industrial districts, underpinned by mechanisms of identification with the district (rather than with individual firms), and by mechanisms of lateral communication, joint training of staff, association between firms (Brusco 1999; Lipparini, Lomi 1999; Corno and Nonaka 1999);
  - relations of informal but stable collaboration in research and development, established by specific firms with complementary knowledge, as happened, and still does, in knowledge-intensive sectors like semiconductors (Saxenian 1990), telecommunications (Schrader 1991) and biotechnologies (Powell 1996).

- The mechanisms of patenting and pricing knowledge are those that are traditionally supposed to regulate the relationships between firms in this field. It can be remarked that these ‘knowledge markets’ typically transfer solutions, not cognitive assets — resources, matrices, capital. The interest and efficiency of the mechanism lies precisely in restricting the pooling of knowledge, while maximizing its possibilities of application. However, knowledge markets would hardly function well without the support of brokers and arbiters as soon as certain elements of complexity appeared. The number of patents or of possible exchange partners is sufficient to create unsustainable search costs and to jeopardize a ‘spontaneous’ mechanism of encounter between supply and demand. And the elements of ambiguity and imperfection in the explicit definition of property rights (very likely for intellectual products) are enough to require forms of arbitration and rules for resolving conflicts (Soda 1997).
- When a high conflict potential and knowledge differentiation combines with a high complexity of knowledge and interdependence, two restrictions for the coordination mechanisms are generated. Firstly, a trade-off looms. For, tight complementarity and complex knowledge would demand interaction rich integration mechanisms, while diversity hinders the possibilities of reciprocal access and communication between nodes. As hypothesized in general, also in interfirm relations *the governable combinations between the values of these two variables are bounded at the north-east of the complexity-diversity square*. Forms of inter-firm organization able to govern combinations of simultaneously high values must, at the same time, encourage the formation of a community and protect the different interests of the parties. Certain salient points on the frontier of intermediate forms in Figure 3 can be identified. In privileging the demands for exchange of complex knowledge, it is necessary that interests and competencies be somewhat realigned. If, instead, the output of different knowledge can be transferred without high knowledge integration, contractual relations can be kept more competitive. The differentiation between these two forms is evident and is pursued in many sectors. It is often expressed in the two distinct legal-organizational forms of obligational and relational contracts between firms. More concretely, in studying certain categories of relations, like those of supply and outsourcing, two ‘rings’ of relations are repeatedly encountered: the ring of suppliers, closer to and more integrated with the firm, basing themselves on a logic of partnership, open book contracting, suspension of opportunistic thinking and mutual access to production structures; and a ring of suppliers who

stand further away as regards competences and interests, based on a logic of distributive negotiation, fairly closed regarding information, with the possibility of replacing each other, and having guarantees specified in the contract. This configuration has been clearly identified in various sectors: telecommunications (Suarez-Villa, Rama 1996); construction <sup>3</sup>; automobiles (Dyer 1999); household appliances (Lipparini 1998); packaging industry (Golzio, Fiorani 1999). If, on the other hand, the attempt is to maximize diversity and complexity jointly, mechanisms are needed to realign interests, to move competences closer together, and to create team production. Part-sharing of property rights, maintenance of fairly differentiated knowledge bases (also because these are connected with other knowledge not pooled) and the joint application of resources to common activities are distinguishing aspects of joint ventures and other forms of consortium. Data exist that support the hypothesis that the formation of joint ventures is especially frequent in conditions where some competences are differentiated in a framework of close common basic knowledge (Cantwell, Colombo 1997). Even in the case of these property networks, one can distinguish between forms having team production but not integration of the respective competences (as in many joint production ventures in mature sectors like that of automobiles; or in large-scale industrial construction); and forms whose aim is precisely the integration between knowledge bases in order to produce new knowledge (as in joint ventures in research and development) (Grandori 1997; Grandori, Neri 1999).

From the empirical findings on the exchanges and sharing of knowledge in interfirm networks, it emerges that ‘islands of shared knowledge’ or even ‘islands of shared (formal) property on knowledge’ are found not only within but also between firms.

### **Implications for the theory of the firm**

Certain conclusions can be made from, and some directions for future research are suggested by, the above comparative analysis of the mechanisms governing knowledge transfer, sharing and integration between and within firms.

1. The coordination mechanisms that can be successfully applied to link nodes of differentiated knowledge do not quantitatively differ according to whether the ‘nodes’ (firms, units or single actors) are internal to the same firm or not.

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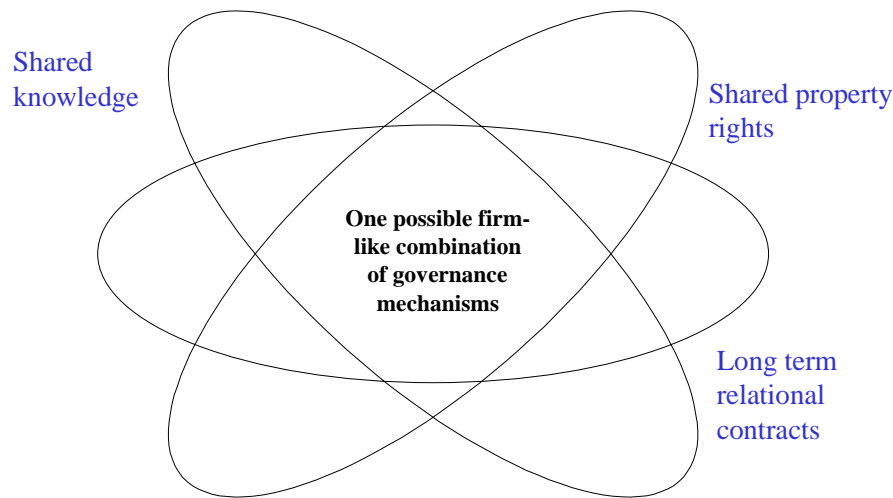
<sup>3</sup> Conference on Alliances in the Construction Industry, Delft, March 1998.



2. The ‘boundaries’ of the ‘clusters of shared property rights’ on knowledge do not coincide a) with the boundaries of the clusters of unified property rights over other assets (technical and financial capital), and b) with the boundaries of the ‘communities of shared knowledge’ (actual possession of common knowledge).
3. The formation of ‘islands’ of shared formal property rights is sensitive to the coupling of high knowledge complexity, tight interdependence and conflict potential.
4. More generally, knowledge and interest factors are to be considered together for explaining when particular governance mechanisms are necessary, sufficient or rather fail.

The first two points suggest a direction in which the notion of firm and firm boundary can be reconceptualized, as has often been called for (Demsetz 1993; Buckley, Mickie 1996). The idea, supported by those authors, that the firm can be defined as a set of rights, contracts and mechanisms that may be present in ‘different degrees’ rather than all or nothing, turns out to be sustained by our comparative analysis. Moreover, and partly diverging from the above-mentioned authors, our analysis suggests that it is not the type, in the qualitative sense, of the governance mechanisms by which a ‘firm-like’ organization (à la Demsetz) can be distinguished from one that is not so. If the possibility of applying the individual mechanisms inside or outside the firm boundaries does not supply a valid criterion of demarcation, the probability or relative frequency of certain mechanisms with respect to others — and with respect to the possible combinations among mechanisms — in a form of governance might be a less deterministic criterion, and one more consonant with the empirical findings. For instance, it could be said that a combination of shared property rights on resources, of community of knowledge and relational contracts is more ‘firm-like’ than a combination of exchanges governed by patents and prices, obligational contracts and sharing of rights on residual rewards (Figure 4). But this is not the only possible combination: other combinations may employ more mechanistic mechanisms, and configuring other types of enterprise (for example, unified property rights, hierarchy and planning, obligational contracts). On the other side, this probabilistic definition of a firm does not rule out the possibility that single relations between nodes within a firm (say among divisions in different countries) are much more loosely coupled and ‘market-like’ than a relation between one of those divisions and its suppliers: even though ‘outside’ firm boundaries it can be much more tightly coordinated through hierarchy, programmes and teaming.

**FIGURE 4 – Firm-like governance configurations**



The analysis performed, therefore, suggests that the firm be also conceived as an entity with multiple boundaries, as Figure 4 seeks to represent visually. The boundaries of common and co-specialized knowledge actually possessed by a collective actor only partly encroach on the legal boundaries of ownership of technical and financial resources, which are, in turn, not the same thing as the boundaries of the ‘internal contracts’ that govern the provision of human resources (including tacit and personal knowledge).

Point 3 and 4 have implications for the discussion that has recently arisen regarding the possibility of a knowledge-based theory of the firm, independent of ‘assumptions’ about the ‘opportunistic’ motivation of the economic actors (Foss 1996; Conner, Prahalad 1996; Kogut, Zander 1996). The conclusions of our analysis suggest that the two factors of knowledge and interests indeed interact and have to be considered simultaneously (Foss 1993) and it specifies a way for doing so. More specifically that only *the coupling of* high conflict potential and high knowledge complexity and complementarity seems to be necessary and sufficient cause of formal property rights unification. This conclusion weakens the argument that there may be a theory of economic organization based exclusively on the nature of the knowledge and on the exclusive properties of the firm in the governance of that knowledge. On the other hand, it also shows how it is not necessary, and is actually misleading, to employ extreme assumptions — like that of opportunism (Williamson 1975) or, symmetrically, like the opposite ones of trust and altruism (Bardach, Eccles 1989; Simon 1996) – for explaining variation in the forms of governance or for

defining them. The configuration of interests is an antecedent vis-à-vis the potential of competition and opportunism inherent in an economic relationship. The goals pursued by firms and persons, in turn, are a variable that may assume different 'values' (of intensity, content of the goals pursued and degree of congruence of the preferences); they are not, nor should be, treated as general 'assumptions' on economic action (Grandori 2000). The 'competitive dynamic' presents situations in which it is entirely convenient to cooperate and there is no incentive not to contribute to the utmost of one's capabilities, independently of the specific nature of the relationships and of the uncertainty as regards the future: for example, simply because without cooperation, there is no learning; and if one does not learn one is unable to compete — in other times, places or relationships. In the terms given by our scheme, transaction costs economics neglects the possibility of relationships of mutual, non-competitive learning between firms; while the knowledge-based theory neglects the possibility of competitive use of knowledge; and both (in their orthodox formulations) underrate the importance and effectiveness of inter-firm relations, with respect to intrafirm relations, in the development and application of new knowledge. A possible task for future research may be that of specifying further combinations among the variables here studied as two broad factors. Even though, for the general argument developed in this paper, we have not distinguished the specific contributions to conflict potential deriving from knowledge differentiation and from objective disalignment, as well as the specific incidence of knowledge complexity and tightness of complementarity in raising the demand for high powered integration mechanisms, this could be done, and even more varied coordination configurations could eventually be found.

Lastly, in an organization design perspective, effective firm boundaries can not be the result of least cost choices between external and internal organization, based on the idea that, under the two regimes, governance mechanisms are distinctively different and mutually exclusive. If the mechanisms that make up the networks inside and outside firms do not indeed differ by radical qualitative discontinuities, the internal management of knowledge can usefully learn and emulate the external one, and vice versa; according to the context in which useful solutions for the problems encountered were first developed. It can be argued, for instance, that within large firms the possibilities to motivate sharing and internal exchange of knowledge by using 'fair rewards' and 'high powered incentives' (recognition, prestige and status, or monetary) are underestimated and underutilized. There are in fact examples of successful coupling, within firms, of knowledge community building and teamwork with individual monetary incentives as pay for performance schemes (Zenger, Hesterley 1996; Manke and Laursen 2000). Specularly, it is likely that many

organs and mechanisms of knowledge integration that were developed in order to facilitate the relationships between functions and firm divisions (such as project, product and process managers) may be more extensively used to sustain inter-firm collaboration. Achieved examples of this include the employment of programming, hierarchy and product managers in the coordination of the relationships between commissioning firm and subcontracting firms (Dioguardi 1987); or the employment of project managers and task forces in the coordination of multifirm projects (Lutz 1997).

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