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Conflict, Contract, Leadership and Innovation: An Interdisciplinary View

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The competitive market is able to regulate simple innovative processes. In those of a more complex nature whose principal players may belong to either the same or a different firm a different form of organization is required: one which coherently defines rules and resources designed to avoid, in conditions of uncertainty, tensions arising between the different players which prevent their coordination. In this essay, the hypothesis that such organizations require both contract and leadership will be presented and discussed. The contract is required to en-sure ex-post efficiency, avoiding wastage of resources, and ex-ante efficiency, i.e. mutual commitment between the different players in the innovative process. Leadership is required to progressively manage the conflicts that occur between contrasting visions of how best to proceed that emerge from different specializations, legitimized through a shared commitment. Notwithstanding such characterization, leadership may also not assume the same functions of contract. The contract may not be sufficient and require leadership, but strong leadership cannot replace contract. In such a case, there would be a risk of disengagement. An initial application of this simple model (leadership and contract) seems encouraging against competing theories conceiving contract or leadership as sufficient conditions for innovation.

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New solutions to existing activity-functionality are followed by application and dissemination within and outside the areas in which they were introduced; related activities change, as do their relationships. Such changes allow new features to come to light. As Abbot Payson Usher pointed out long ago, "Changes in function require new forms, new forms foster further changes in function" (Usher 1929/1988, p. 17). If this happens, the cycle can begin again, but success or failure, times and results are not predictable (Lane, Maxfield, Read and Van der Leeuw 2009, p. 38). The many who design, implement, operate, sell and buy a new product or new operational solution are today acting to close in and "tighten" their coordination. If they are unable to know timeframes and results, all these players struggle to align their different contributions. In fact, it is widely recognized that though each of the innovative processes presents a history and peculiar features that vary according to the contexts, there is a common aspect: the necessary contemporary contribution of various agents and the strong uncertainty. "Innovation processes [...] vary widely according to the firm's sector and size. Only two innovation processes remain generic: co-coordinating and integrating specialized knowledge, and learning in conditions of uncertainty." (Pavitt 2003, p. 1). "Let us distinguish between (a) the notion of uncertainty familiar to economic analysis defined in terms of imperfect information about the occurrence of a known list of events and (b) what we could call strong uncertainty whereby the list of possible events is unknown [...]. I suggest that, in general, innovative search is characterized by strong uncertainty." (Dosi, 1988, p. 1134).

Therefore, appropriate organizational measures are required and special consideration must be given to the spread of articulated organizational forms in order to coordinate the innovation processes. The increase in recent decades in the frequency and significance of changes in products, processes and organizations has not in fact encouraged the rise of vertical integration of firms (Langlois 2003, p. 352, 354), as transactional theory would suggest (Williamson 1991). Instead, the number of agreements for innovation among firms has increased (Hage-doorn 2002, p. 479-480, 490). Evidently, the division of labor has now advanced to such a point that players are often, though not all around (Tokumaru 2006), placed in different companies. These formal agreements demonstrate that coordination cannot be easy if it is unable to take place through

spontaneous and informal cooperative norms (De Jong and Klein Woolthuis 2008, Jennejohn 2008, Gilson, Sabel and Scott 2009).

To summarize, there may be some tension between the different players in the innovation process when, as is the case today, interaction between them is accelerated and there is a strong division of labor. The organizational forms of coordination are articulated and include agreements between independent enterprises. They give rise to several questions about the nature of such tensions and such forms of coordination, which this paper will try to answer by adopting an interdisciplinary view. In the next section, however, a preliminary question arises: if tensions in coordination cannot be excluded then how widespread are they? It will be found that there are cases where such difficulties may be considered absent, when the innovation process is confined within a consolidated knowledge. The competitive market is able to regulate these simple innovative processes.

Innovative Systems

In innovation, as in the invention, application, development and commercial exploitation of new products and production processes as well as organizations, the players contribute in different ways: strategically (resource allocation between current and new activities), technically (research, applications, prototypes, testing, production) and commercially (identification of the market segment, promotion, sales services). The innovation process requires coordinated interaction between all these functions, but they are not ordered in a linear fashion. Innovation does not come from resources devoted to research and development, followed by production, in turn followed by marketing and sales. The process is systemic, full of feedback loops and surprises (Nelson and Winter 1982, Kline and Rosenberg 1986, Freeman 1987). Once a plan has been established, the design of the prototype may take longer than expected, or may re-quire other skills and other facilities: the plan must then be revised. To move from prototype to mass production, engineers must modify the design over and over again and realign resources accordingly. Initial marketing may reveal unexpected difficulties, but also opportunities. Designers must return to the field, but this requires resources and so forth. It is a learning process in which one set of knowledge explores new applications; in the meantime

reality is changing due to the exploration of different knowledge at the same time.

Program and experience

Notwithstanding its complexity, this interactive system is not indecipherable. It can be assumed that its problematic central mechanism is essentially the same when applied in different fields and at different levels. This is the interactive program – experience mechanism (Lynn, Morone and Paulson 1996; Beckman and Barry 2007).

The technical area gives indications that can generally be applied to the various other functions in the innovation processes. It was here that an important contribution was made by Von Hippel and Tire (1995). In a factory producing electronic circuits, an innovation process took place which lasted two years. This consisted in the development and implementation of a Past Profiler and a Pitch and Place System. Several malfunctions were recorded. Five emerged immediately, during installation of the new machines, and were observed and resolved by the designers. Fifteen emerged during use. The designers knew that the machines should have been tested with a greater number of different conditions than was actually the case, and would have conducted these tests were it not for the high costs (Von Hippel and Tire 1995, p. 6, 9-10). In the remaining seven issues, the designers could not do anything in the lab despite having the time and the resources for countless tests. The problems arose because the new machines allowed changes in other parts of the production process which in turn demanded changes to the machines (Von Hippel and Tire 1995, p. 10-11). For example, after the intro-duction of the Past Profiler and Pitch and Place System, the engineers saw that the uniformity of the points of adhesive paste could be improved by reducing the thickness of the substrate of the plate. However, with a thinner support all the measures of the Past Profiler became unreliable. It was laboriously discovered that the laser beam passed through the plate and the reflective part was insufficient. This required rather significant changes to the machine.

In this example it can be seen that there are two specialized groups: the engineers developing the new machinery and the engineers overseeing the production of the printed circuit board as well as their thickness, holes

and printing. There is specific consolidated knowledge of the two groups capable of innovation such as: design, implementation and laboratory testing of the new machines on the one hand; design, implementation and testing of new plates on the other. Each of these is able to innovate and configure a "module" (consolidated knowledge and a dominant design) similar – at the level of components – to the technological paradigm (Peine 2008, p. 514). Within the confines of a module, there is a first form of learning which can be called application method[1] (AM), i.e. planning, implementation and testing based on that knowledge. This consolidated knowledge evolves also by learning in the process of interaction between the knowledge of the two groups on the field[2]. One reason is that the tests necessary to reveal the errors for all possible operating variations would be too numerous on the basis of a cost-benefit calculation. It is a form of learning that uses consolidated knowledge (method), field applications, and updates of the method (MAM). There is another type of learning in the process, namely self-guided experience (EA), where innovation by one party (the new machines) produces, after being practically applied, opportunities for innovation on the part of another (the new thinner plates) which, in turn, require changes in the machines (interaction). Finally, as will be shortly explained, it is useful to distinguish between structured (Clark 1985), and unstructured EA learning. The uncertainty varies according to the different forms of learning. In AM learning, uncertainty appears as

[1] The term method, as used here, indicates an explicit and tacit knowledge in the sense of Gurlay (2004) who, elaborating on Polanyi (1966) and Dewey and Bentley (1949), shows that tacit knowledge can be ascribed to a sign-process. In this way Gurlay resolves two problems which have long been disputed: whether the tacit know-ledge is only personal or also of groups and whether or not it is transmissible. A gestural process which is not verbalized is personal, but can be learned through observation, imitation, and experience. Therefore, knowledge, as resulting from interacting verbal and non-verbal processes could be expressed in an operating method, comprising explicit norms and gestural experiences. This will be personal but may be shared as it is not entirely transmissible in formal ways.

[2] According to Kurt Lewin (1890-1947) a "field" is the space within which there are various agents, as well as material elements (agents-artifacts field), that affects the behavior and learning of the same agents and on which these have an influence. Therefore such behavior appears dynamically undetermined (Lewin 1951, p. 240).

calculable risk (Dosi 1988, p. 1130 and 1131; Peine 2008, p. 514); in MAM learning, uncertainty is epistemic (it would be too expensive and time consuming to collect and process all the information necessary to reduce the uncertainty to risk); EA learning is the extreme, where it is impossible to know ex-ante what information should even be collected, and uncertainty is ontological (Lane and Maxfield 2005, p. 10). With regard to tensions in the coordination of different specialized actors, these may be considered absent within a module (AM learning) where the engineers are linked by similar knowledge and experience. In MAM learning, there may be tensions stemming from semantic uncertainty: it may be unclear what exactly the results of applied experience mean. However, there is a guide that allows clarification: the comprehension requirements of the group that must incorporate those results into its method. It can be said, therefore, that the tensions in coordination will be absent or limited in AM and MAM learning, which are actually the modular systems described by Langlois, whose coordination may be left to the market. "Decentralization implies an ability to cut apart the stages of production cleanly enough that they can be placed into separate hands without high costs of coordination; that is to say, decentralization implies some degree of standardization of interfaces between stages. In an extreme – but far from rare – case, standardized interfaces can turn a product into a modular system." (Langlois 2003, p. 378). In EA learning, these tensions are to be considered present in a more significant way. Von Hippel and Tire do not provide information about this. They have one only sentence suggesting the presence of such tensions: "Neither game theorists' models of cooperative games nor psychologists' models of mutual adaptation offer us much help in predicting the path or the outcomes of this type of multi-party problem solving" (Von Hippel and Tyre 1995, p. 10). However, we may wonder why, if Past Profiler was working badly with a thinner plate, it was decided to intervene on Past Profiler, and not on other variables (on which the homogeneity of the points of solder paste depends) of competence of the engineers engaged in the printed circuits. There may have been a hierarchy shared between modules, such as to give precedence over the latter's opinion. But if this hierarchy was absent, there must have been a discussion, perhaps even an animated one, from which the laborious construction of a common vision from different views emerged. It can be assumed that, in the processes of EA learning, it is

necessary to distinguish between structured learning (with an established hierarchy) and unstructured. In the first case, there will be fewer tensions in coordination than in the second. Yet such tensions will not be absent as in AM and MAM learning. As stated above, even in structured EA learning, there is an ontological uncertainty. Engineers who need to modify the Past Profiler upon the request of the other group can always argue that no one is sure that this is the right decision. Eventually, the hierarchy established will resolve the issue. Nonetheless, debate and tension between the two parties cannot be excluded.

The following table presents a taxonomy of degrees of difficulty of the innovation process built on the basis of these considerations.

Table 1: Taxonomy of difficulties in the innovation process
(Intensity of tensions in x dimension scale; ontological uncertainty absent = white, where present = big x)

	AM and MAM learning	EA structured learning	EA non-structured learning
Ontological uncertainty		**X**	**X**
Tensions in coordination		**x**	**X**

Structured/non-structured learning

Tensions in coordination, uncertainty, and innovative value go hand in hand with the complexity of the production process. This can be seen in two examples. In 1984, Hyundai launched a project for a turbocharged engine with electronic control. According to Kim (1998, p. 518), this decision, which broke with the established knowhow, gave rise to an organizational crisis that was intentional. Managers insisted on moving rapidly from knowhow based on imitation-duplication to knowhow based on creative imitation. It was a move that only became successful in 1992

after hundreds of tests, but gave Hyundai the Alpha engine which was the basis for its success in the following years, allowing it to compete with the major American, European, and Japanese manufacturers. The engine is a more complex component than that in the previous case, there are six specialist groups rather than two (hydrodynamics, thermodynamics, fuel engineering, emission control, and lubrication; kinetics and dynamics related to engine and car design and CAD; vibration and noise; new ceramics; electronics and control systems; and manufacturing control and CAM) and the learning process was more difficult. "Hyundai engineers underwent 14 months of trial and error before the first prototype was made. However, the engine block broke into pieces in its first test. New proto-type engines were made almost every week, only to be broken again and again. [...] The team had to scrap 11 more broken prototypes before 1 survived the test. There were 288 engine de-sign changes, 156 changes in 1986 alone" (Kim 1998, p. 519). It can be inferred that learning was of the AM kind (the 97 first prototypes), MAM (the 53 prototypes to improve resistance and 26 for transmission) and EA (the 88 prototypes to adapt to the car and 60 for other tests). Kim does not provide information on the details of coordination tensions but one can imagine the problems that had to be addressed and resolved in the long trial months and most of all the errors encountered. Imagine the number of contrasting views (and attributions of blame) that must have arisen. What were the dynamics between the different groups and how were conflicts settled, caught between the goal to produce a competitive engine rapidly and collectively and continual failure? These problems must have been severe as the executives had almost given up, despite being prepared for the difficulties, having deliberately provoked the crisis: "[...] even the Hyundai managers began to doubt the company's capability to develop a competitive engine" (Kim 1998, p. 519).

Confirmation of the growing difficulty of structuring learning with the growing complexity of the production process is evident in a second example of the Smart Home, the house where facilities and services are all controlled by an electronic system. Here three real technological paradigms intersect: construction and plant engineering, electrical appliances, electronic transmission equipment and control. "The Smart Home field connects [different technological] trajectories, and, consequently, brings together different epistemic styles and paradigmatic mindsets that jointly

shape innovation in the field. The coordination problem can be reframed [...] as the challenge to coordinate different paradigm communities in innovation. [...] The existence of technological paradigms at the component level thus not only enables learning at the component level, but it also constitutes a challenge for learning at the system level." (Peine 2008, p. 522). The production system is not structured. There is no defined hierarchy between these paradigms that clarifies which of these dictates the terms to the others. Tensions in coordination are in this case documented. "[...] in the attempted mode of tight coordination, Smart Home systems were conceived of as integrated systems, and different proposals for a technological paradigm specifying such an integrated system competed in a battle for dominance. [...] However, [...] battle for dominance has remained inconclusive." (Peine 2008, p. 527). It is also important to highlight that in this lack of structuring and the resulting tensions there lies the greatest leverage innovation. "A most important result of this study has shown that technological paradigms might be an obstacle to innovation. [...] However, this obstacle may be overcome, and the case could demonstrate that technological paradigms, and particularly their persistence, triggered the emergence of loose coordination. It was only because paradigms had frustrated early attempts of standardization that the field moved away from tight forms of coordination in the first place. And this, in turn, bears an important potential. Loose coordination thrives on a more immediate concern for the applicability and the value added of technological solutions, and thus might indeed better suit the needs of end-users. The Smart Home field thus reveals a situation where paradigms pose a challenge in the first instance, but a challenge that, if overcome, bears great potential for innovation." (Peine 2008. p. 522, 527).

Complex productive systems

One notes signs of increasing difficulty in the structuring of EA learning, tensions in coordination and the value of innovation with growing complexity. It may be thought that this hap-pens because difficulties, tensions and innovation at one level reinforce others and strengthen each other reciprocally. With reference to the taxonomy introduced in the previous figure, two levels should be considered primarily. The common

strengthening of two levels in their difficulty with regard to coordination tensions could be represented in the next table by applying the rule: white on white = white (no difficulty), white on x = small x (moderate difficulty), x on x = bigger x (great difficulty).

Table 2a: Taxonomy of difficulties in the innovation process, components and production systems
TENSIONS IN COORDINATION

		In terms of technology modules		
		AM and MAM learning	EA structured learning	EA non-structured learning
In terms of technological paradigms	AM and MAM learning		**x**	**X**
	EA structured learning	**x**	**X**	**X**
	EA non-structured learning	**X**	**X**	**X**

One can thus identify a set of cases where problems of coordination are considered relevant in the lower right hand part of the matrix, and only in one case in where there are none, when innovation is confined within a module and in a technological paradigm (top left cell). Cases where innovation is more effective are also located in the lower right half of the matrix. The table for the uncertainty is simpler since the ontological uncertainty is of the yes-no type. Ap-plying the rule white-white = white, white on x = x, table 2b is obtained. Where there are no tensions in the coordination, there is not even ontological uncertainty but innovation is not very effective (cell top left).

Table 2b: Taxonomy of difficulties in the innovation process, components and production systems
ONTOLOGICAL UNCERTAINTY

		In terms of technology modules		
		AM and MAM learning	EA structured learning	EA non-structured Learning
In terms of technological paradigms	AM and MAM learning		**X**	**X**
	EA structured learning	**X**	**X**	**X**
	EA non-structured learning	**X**	**X**	**X**

On increasing the number of levels to three, for example, the number of cells in each of the two matrices becomes 27, but this does not change their configuration: all the cells are black apart from one in the case of uncertainty, the lower right gray half tending towards black for tensions in coordination. It has the rule: N = 3L, where N = number of cells, L = number of levels, 3 = number of different forms of learning. This analysis conducted in the environment of technical functions suggests elements applicable in the general framework where different specialisms interact both within individual functions (strategic, technical, commercial) and the functions between them. One can imagine, therefore, that innovation is the result of a series of layered interactive learning processes where tensions in the coordination and value of innovation are correlated to complexity, i.e. to the number of levels and to the significantly different forms of learning. The significantly different forms of learning can be held to be more than three, comprising also semi-structured learning, intermediate forms between EA

learning and MAM learning, and intermediate forms between AM and MAM. It can therefore be written that: N = aL, where N = number of cells, L = number of levels, a = number of significantly different forms of learning. As the matrix becomes larger and the cells increase in number (i.e. the higher the number of levels related), the more the gray tends towards black in the lower right half of the matrix, indicating greater tensions in coordination, but also greater potential for innovation. We could then have:

Pt = F (Po, aLt, aLo); Tt = G (To, aLt, aLo), for example:
Pt = Po (aLt/aLo) = Po (aLt-Lo); Tt = To (aLt/aLo) = To (aLt-Lo)

where, in addition to a (number of forms of learning) and L (related levels) already intro-duced, we have: P = Productivity potential, T = degree of tension in the coordination. This formulation can be compared to that generally used for learning-by-doing dependent on production volumes: Pt = Po (Xt/Xo)ß, Pt/Po = π = nß where Xt/Xo= ratio of current and initial pro-duction volume, n = multiple of the volume of current production in relation to initial produc-tion, and π = nß proportional variation of productivity due to the multiplication by n of the vo-lume of production. The value of this π learning factor depends on the exponential coefficient ß, constant with the variation of n: the more an operation is repeated the more learning takes place. This has been called passive learning (Thompson 2010). As Lundvall (1992) has re-peatedly emphasized, as well as the vast literature on innovative systems, of the two learning mechanisms associated with the wide range of the division of labor, learning by doing neg-lects "learning by interacting". Such (active) learning has been referred to as interactions be-tween enterprises and society and institutions, between enterprises and other organizations, in particular research centers, between enterprises and customers, enterprises and suppliers, and units within enterprises. Most of these interactions are considered dependent on the degree of "complexification" (Arora, Landau and Rosemberg 1998, Foray 2004, Malerba 2007). A ma-nipulation to the formula proposed here can be written as: Pt = Po (aLt-Lo), Pt/Po = π* = aLo(n-1). Assuming Lo=1, it is π* = a(n-1). Increasing n times the complexity of the production process, π*=a(n-1) indicates the proportionate change in productivity that depends on the exponential factor (n-1) variable in the same direction of n.

Organization of Coordination

Simple innovative processes, with little tension between different players and uncertainty as calculable risk, can be ruled by the market. In those that are complex, where players may be-long to the same but also to different companies, a different organization is required: a coherent set of rules and resources designed to avoid tensions between the different players under conditions of uncertainty. The formal agreements between companies, being written, provide detailed information from which we can deduce the nature of the problems, which are intended to be solved. Examination of such agreements shows that they aim to ensure mutual commitment and avoid conflicts of interest on the goals. As such, the (first) meaning to be attributed to tensions between players is: mutual suspicion of disengagement.

Gilson, Sabel and Scott (2009) consider three agreements. In two of them there are parts that constitute normal supply contracts for defined goods and services and other parts that concern the development of new products in collaboration. The third is an agreement entirely for in-novation. The common denominator for all of these is that also in aspects relating to innova-tion, mutual obligations are defined. This was not obvious. Since the attainment of innovation goals is intrinsically uncertain, and this is confirmed in these contracts, we might expect simple statements of intent, designed at most to outline a route. Instead, they are real contracts de-signed to effectively regulate the set of actions that substantiate the process of mutual learning. In practice, therefore, the impossibility of negotiating on completely unknown results does not impede the establishing of common rules of behavior.

The contract between Deere (farm machinery) and Stanadyne (engine components)[3], with a duration of five years unless terminated earlier or explicitly renewed, is intended to establish a partnership to promote all the innovations that the two parties are able to achieve, notwithstanding any guarantee of a minimum number of purchases by

[3] Deere & Company and Stanadyne Corporation Long Term Agreement, Sec Rows 333-45823

Deere of parts supplied by Stanadyne. Stanadyne is obliged to: allow direct inspection of their establishments by Deere; participate in the Achieving Excellence program (which provides a detailed exchange of information on the basis of which, every six months, Deere classifies its suppliers in terms of increasing quality-reliability) in order to reach the top category, Partner; Stanadyne is obliged to accept that if this happens and until Stanadyne maintains that position, any reduction in production costs achieved is divided 50/50 between Deere and Stanadyne, and if not 100 percent to Deere; Stanadyne is obliged also to accept a route of collaborative and transparent planning and implementation; obliged also to accept termination clauses with respect to individual products and with regard to parts of the contract or the contract as a whole; it must accept an extra-judicial conciliation mechanism and accept rules for determining the price of supplies on the basis of costs and ex-post bargaining in good faith (see below). Other provisions relate to the confidentiality of information and the ability to use as agreed patents and new technical developments created under this agreement, in addition to force majeure and insurance clauses.

The theory of incomplete contracts could consider Stanadyne as the seller, called to decide a level of quality of its performance that is not verifiable. This service of the seller would be purchased by the buyer (Deere) at its discretion and "paid" through one of its own services. The process of interactive learning focuses on a continuous inversion of roles, so as to realize a new product in collaboration with whom to share the value. The duration of this process and the result cannot be anticipated. According to this theory, this sequence of exchange of ser-vices cannot be efficient in a very general sense (Bester and Krähmer 2008) due to asymmetry and information incompleteness (continuous uncertainty). Each would have no incentive to offer their best performance as there is no guarantee of receiving the same from the other party in exchange. In particular, each may fear that once having made specific investments in their own performance the other party may at some point claim a greater proportion of the result to contribute to their own performance to continue in the process, threatening to move to another supplier/buyer or use the outcomes from the learning achieved for their own benefit, thus abandoning the collective project. Gilson, Sabel and Scott (2009) argue that the contractual solution explored is considered capable of overcoming this difficulty in that it provides

mechanisms (such as the AE Program and the continuous exchange of information) that involve information investments (expensive) from both sides to know the technical and rela-tional capacity of the other: it does not just refer to inexpensive exchanges of information on individual performance. In practice, while Stanadyne invests resources to establish their ser-vices, Deere invests to know Stanadyne and vice versa. Specific investments are therefore bi-lateral and as such neither party can take advantage of the other. In this way, the parties enter a reciprocal relationship that involves high exit costs such as losses of specific investments of every kind. In view of this, the contract sets out strict conditions of exit that guarantee that both parties may abandon the project should it prove to be unproductive (as well as if one party breaches the contract). Consequently, the contract may include clauses such as the allocation of costs and of results where profit margins are negotiated ex post in good faith without this bringing ex-ante inefficiency.

This interpretation is also applicable in the second example, an agreement between Apple Computer Inc.[4] and SCI Systems Inc. for the section regarding the development of new prod-ucts. The same can be said for the third example[5] (Warner-Labert and Ligand) albeit in a context of more complex rules. The three cases provide a view that the purpose of collaborative arrangements between firms for innovation is in essence: to identify the players and the duration of their collaboration, predispose a detailed work plan in phases, each of which is in-tended to highlight and evaluate the other player's behavior, although the results remain uncertain until the last; ensure a thorough detailed continuous exchange of information; permit exit options in case the project turns out to be unproductive or for particular cases of breach of contract; and to adjust the allocation of costs and outcomes.

The letter of these agreements does not permit information surrounding actual operation. It is conceivable that they also entail implicit

[4] Fountain Manufacturing Agreement between APPLE COMPUTER, INC. and SCI SYSTEMS, INC. http:/contracts.onecle.com/apple/scis.mfg.1996.5.31.shtml

[5] Research, Development And License Agreement by and between WARNER-LAMBERT COMPANY and LIGAND PHARMACEUTICALS INCORPORATED dated September 1, 1999; http://contracts.onecle.com/ligand/warner.rd.1999.09.01.shtml

acceptance of some form of authority on the part of one party to the other. In effect, there are signs that could indicate that Deere, Apple and Warner-Lambert exercise authority over the companies they collaborate with, particularly be-cause they control the sales network of the products to be realized. However, this authority is limited by safeguard clauses: it is circumscribed by the contract. This contract and authority framework is confirmed in a study that examined the letters of agreement between independent enterprises and their actual performance in the case of development of a new commercial airplane by a network of companies (O'Sullivan 2005).

The cooperation agreements in question could be seen as working protocols for projects in analogy with the "project planning model" (Van de Ven 1980; Hobday 2000) which is considered very suitable for innovation within companies. The project plan could be considered a contract that focuses on the common goal rather than the development of distinct specializations, which would then require integration to realize interactive learning processes. Connecting structures are established, in this case explicitly, with authority with regard to advancement of the process, with the task of facilitating information collection and processing and the experience of the various players, and monitoring their work. Also in this case the contract will define the boundaries of the authority, establishing rules to align the actors' behavior.

Conflict On How to Proceed

In this section, we will see that when the contract ensures mutual commitment, a second aspect of the coordination tensions becomes apparent: the conflict of how to proceed when the same players are mutually committed.

In companies

In work on projects within companies, it is often assumed that there would be no disagreements on how to proceed due to technical reasons, like in a classical model of artificial intelligence. The "program" dictates the instructions to be executed at different operational terminals (staff

resources, technical operations, marketing). As the work progresses, terminals transmit the numerous data of their individual experience to the center where it is processed and selected for the purposes of updating the program. The new program, specified in terms of additional adjustments, is transmitted to operational terminals. This appears to be the Arrow (1974) organizational model. There would be no conflict on how to proceed; simply be-cause there would be no direct relation between the players. Nevertheless, in the same paper Arrow warns that in the uncertainty of innovation processes the gathering, processing and re-laying of information cannot be considered mere technical functions, guaranteed by the plan and the link facilities provided with the authority. Information judged initially or from a certain point of view irrelevant may later or from other points of view be important (Arrow 1974, p. 54). It is precisely this fact that makes it impossible to avoid direct contacts between players that must be mediated, but not through purely technical intervention. We should thus make the analogy with the model of distributed artificial intelligence, whose mode of operation is not sequential (as in the classic model) but parallel. A large number of operating units are simultaneously active in interaction with each other. Program, experience and modifications of the program are found to be connected in every unit. A central agency is needed to organize the flow of information among all players and to monitor time, cost and connections. Besides this technical function, there is also the requirement for a "political" function. Each player is legitimated, in the sense of Suchman (1995, p 574), to insist on his/her own point of view, which is for the common good. Conflict is inevitable. And the political function is called to handle it.

De Clercq, Menguc and Auh (2008) interviewed CEOs and Marketing Directors of 260 indus-trial companies in Australia to explore the links between innovative capacity, conflicts on how to realize this and conflicts regarding the allocation of company resources. The result is that in the most innovative companies, the highest levels of both of these two conflicts were recorded (De Clercq, Menguc, Auh 2008, p. 1051-1052). The explanation is that while the conflict over the allocation of resources is generally negative for innovative capacity, it becomes positive when it is justified by disagreement on how to proceed. In this case, the disagreement on resources is seen, and effectively constitutes a contribution to the joint

venture. The term that the authors use in this regard is significant: political activity. Moreover, the issue of conflicts within companies engaged in project work is not new. In one contribution often regarded as pertaining to the technical approach (Galbraith 1974), it is taken for granted that there will be conflicts of this nature. Seven years earlier, Lawrence and Lorsch (1967) showed six company case studies in which there is such a technical dimension, but accompanied by a second equally important dimension regarding conflict. After defining differentiation and integration, the authors hypothesize that in the most innovative organizations one should find out the maximum differentiation and maximum integration, but - as these are in opposition - the greatest efficiency of integrative structures must be found (Lawrence and Lorsch 1967, p. 12). The hypothesis is confirmed. However, it is evident in the data from table 12 p. 45 of the essay by Lawrence and Lorsch that the link officials not only had the greater authority technique, but also the ability to manage conflicts. Going further back in time, conflicts within organizations that change in conditions of uncertainty are found in March and Simon (1958). Conflicts then constitute the main issue at the center of the different course latterly taken by Cyert and March (1963), compared to that of Simon who thought more important to study the formation of decisions of agents with bounded rationality in organizations that are well coordinated and in the absence of conflict (Augier and March 2001, p. 224). Finally, Hoegl, Weinkauf and Gemuenden (2004) present a longitudinal study (duration 36 months) of the case of the European automotive industry, examining collaboration both within and between working groups. The project was complex on several levels. Each working group consisted of nine members on average; there were eight subprojects, while the overall project comprised 39 working groups. The link structures consisted of eight project leaders and an overall project director responsible for providing the infrastructure for integration, while the working groups were independent although acting within programs (times and costs) that were defined step-by-step and continuously monitored. The technical complexity would inevitably suggest a model of central planning. The best results were expected as a result of good collaboration within the groups promoted by good collaboration between the groups. In effect, it emerges that collaboration between groups yields good results due to the control of defined working time (a condition for each group interacting with

the others). Collaboration between the groups has no actual effect on the collaboration within the groups. Instead there seems to be quite a strong effect in the opposite direction (Hoegl, Weinkauf, Gemuenden 2004, p. 48).
The interdependence between the actors is not so much a technical constraint. It is a goal which can be achieved to varying degrees, giving rise to different results. It cannot therefore be assumed that by itself this interdependence prevents conflict between the players or allows it to be solved easily and automatically. Rather, the opposite seems true: the decisive leverage to obtain good coordination of interdependent actions seems to lie precisely in appropriate conflict management (Marshall 2007).
In all these cases, the conflict in how to take forward the innovative joint project arises because each specialization emphasizes its point of view that reflects the best contribution it can and intends to give. There is an inversion of logic with respect to that held in the technical approach: it is not the shared commitment that allows the avoidance of conflicts, but on the contrary, it is this very commitment that causes them to arise. This is therefore a conflict between different identities (specializations) and visions (ways of proceeding), while there are also motives for conflict concerning interests. In fact, even if the conflict of interest on goals is avoided by the contract, different interests are still present in the different ways of achieving the common goal. In this regard we can consider a result obtained by the same Hobday (2000) who also argued the superiority of organization for projects. In the examination of two innovative processes within a company, one organized by the matrix formula and the other in accordance with a project formula, it appears that in the former case, human resources are placed in defined career paths. The functional lines constitute a community of practice in which those who have more experience share it with young people for the purposes of career development. This does not happen in the project organization. Each project member is responsible for his/her own career and will have a strong drive to outshine the others (Hobday 2000, p. 885, 892).

Between companies

Concrete cooperation agreements between firms are aimed at preventing disengagement. If these organizational measures are effective, the different

players of innovation are linked by a bond of active participation. These agreements typically contain arbitration clauses that may be interpreted as a means to enforce contracts against disengagement. On the other hand, there could be a different interpretation: the internal arbitration procedure could be seen as a support to the management of conflicts that arise when the common commitment is guaranteed. The spread of these clauses would therefore be a significant sign in favor of the hypothesis that conflicts on how to proceed would be fueled by mutual commitment, even between firms.

Such agreements between companies often provide for extra-judicial arbitration in the form of "escalation procedures" (Jennejohn 2009). In the case of conflict and following all possibilities of composition between the players, the matter will be taken to the highest level for ex-amination by a peer group of managers. If agreement is not found at this level, the issue will be presented to CEOs. Only if this fails will the matter be resolved by outside arbitration and/or the courts. Eisemberg and Miller (2006) examine a sample of 2554 commercial con-tracts of all types and find that the arbitration clauses that avoid immediate recourse to courts are quite rare. This holds only in 10.6 percent of cases. By contrast, Jennejohn (2009) finds that similar clauses are found in 49.7 percent of agreements of collaboration between companies for innovation, in a sample of 8705 agreements of this type found between 1.1.1991 and 31.12.2005. The use of these contractual clauses specifically in innovation agreements, which are necessarily incomplete, is difficult to interpret. The traditional point of view would entrust implementation of incomplete contracts to the courts, called to fill the gaps by recourse to the "legal system". In Jennejohn's (2009) interpretation, there is no recourse to the courts because the criteria on which to base the assessment cannot be established outside the specific organization and cannot be defined when a third party is called upon to enforce them (Jennejohn 2009 p. 28, 36, 51). Such reasons could be held consistent with the causes of disputes general-ly due to accusations of doing little or badly. According to this explanation, arbitrations would be established to enforce the contract against disengagement, being unable to resort to the assistance of the courts. But there could be another explanation. The same reasons, with greater relevance, might explain the non-recourse to the courts because it is known that lawsuits do not

normally arise from allegations of doing little or badly, but as a result of different ways of looking at what must be done. The same conclusion of Jennejohn seems to go in this latter direction (Jennejohn 2009 p. 51). It must be added that even in agreements between companies a profile of conflict of interest is evident not on the goals but on different interests regarding the ways of acting. The agreements in question determine pricing for the supply of new products or components on the basis of detailed information on standard costs and margins which are negotiated in good faith. This may be an incentive for the supplier to propose a maximum use of its competencies and insist on its points of view on how to proceed in order to contain actual costs.

Conflict from voice opportunism

Contract guarantees mutual commitment, but not the absence of conflicts. These arise from conflicting views on the best course of action from different specializations and are legitimized by their mutual commitment. This is an added coordination problem that may be referred to as voice-opportunism, the temptation of players of a shared project to prevail individually. The definition of voice-opportunism conflict must therefore take into account the fact that it is not a disagreement about objectives, but on how to reach them. It is not simple disagreement but a tension to prevail, the conflict pushing for ways out. Applying the definition of Hartwick and Barki (2002), conflict requires the simultaneous presence of three dimensions: cognitive (disagreement on how to proceed), behavioral (active promotion of individual points of view against those of others), emotional (anxiety over the outcome of the common project).

A first route out of the conflict, which seems to be the fastest and easiest, is that of compromise. One must question, however, whether this is best in terms of innovation. It will now be seen that it is not.

The literature on the links between conflict and innovation is substantial. It should also be considered, as frequently emerges, that explicit conflict is viewed with fear within organizations and thus is often hidden. These analyses have therefore had to go deep in order to document the emergence of conflict situations that appeared far from clear. The large number of these studies may thus give evidence that conflicts in innovation

processes are also frequent among players that share the same goals. Underlying this extensive research is the question of whether the conflict in question is for or against innovation. Up until 1980, the dominant idea was that conflict was against (Brett 1984) and that it was necessarily to solve it quickly. Sub-sequent studies showed a frequent positive correlation between conflict and innovation (Van de Vliert and De Dreu 1994). Finally, in recent works the position is more complex. Conflicts are seen as positive when they are neither too mild nor too acute (Anderson, De Dreu and Nijstad 2004). On the other hand, it is not particularly easy to distinguish between task con-flicts (positive) and relational conflicts (negative): one often entails the other (Mooney, Holahan, 2007). Conflict management thus seems very demanding: how does one determine the right amount of conflict? And even if it could be determined case by case, how can it be obtained? It would therefore be better to seek compromises through negotiation (De Dreu 2008). Kesting and Smolinski (2007) however, show that this practice cannot be effective if the uncertainty is of the continuous type. In this regard, the case of large Open Source software virtual communities seems to be instructive. They do not bow to pressure with regard to timing and the cost of the innovation process not pursuing profit. The practice of negotiation should therefore be easier. In effect it is widely used. Despite this, conflicts are not avoided (Jensen and Scacchi, 2005) and have to be managed by leadership. Compromise would, on the other hand, be a logically untenable response. If the actors' bond of committed participation is effective and comparison between the positions that seek to prevail is legitimate, then the com-promise that requires mutual (although partial) sacrifices cannot be legitimate. Under conditions of uncertainty, no one would be able to justify these sacrifices for the sake of uncertain results. There are additional reasons, to be discussed shortly, which discourage notions that innovation may be efficiently achieved through compromise. There is a way out of this impasse but it is necessary to reverse the current logic of the relationship between conflict and innovation. The most widely used scheme envisages an innovation process resulting from a series of inputs, which may include conflict (Hülsheger, Salgado and Anderson 2009, table 3 p. 1138). On the other hand, one should think of innovation itself as the positive (although not guaranteed) exit from conflicts. Conflict cannot be resolved by claiming everyone is right to a slight extent. It is to be

resolved by arriving at a new interpretation that does not deny different, conflicting points of view, but that is produced by them (Cameron 1986).

Conflict and innovation

Conflict, or disagreement on how to proceed, among contrasting standpoints, with anxiety for the fate of the common plan, offers a possible way out towards innovation, but only by ruling out compromise even if it entails the risk of destructive results. In this section, we will see that innovation requires insightful solutions that entail changes in interpretative codes. Such changes lead to a redefinition of the very destiny shared by the actors in the innovation process. Hence, innovation can be interpreted as the result of a particular kind of conflict, "im-perfect not negotiable". Leadership, the focus of next section, will have to be able to promote and manage this kind of conflict.

The Berliner Georg Simmel (1858-1918) is to be credited for one of the first modern contributions on conflict (Simmel 1903), anticipating analyses widely found today (Song, Dyer, Thieme 2006). The ways out of conflict are characterized by Simmel in terms of inclusion and cohesion. Inclusion refers to the amount of advises taken, cohesion is the force of the links obtained among them. The possible outcomes of the conflict can be ordered in increasing inclusion and decreasing cohesion. The first is annihilation (or even escape), which most strengthens cohesion but excludes the losers (Simmel 1903, p 499). The second is submission, in which there is slightly greater inclusion and slightly less cohesion since the losers are not annihilated but silenced (Simmel 1903, p 499-500). The third is war or clash, an irreducible op-position among parts in which the degree of cohesion is even lower and the degree of inclusion is greater (Simmel 1903, p 500, 508). The fourth outcome is a compromise that obtains the maximum inclusion and the minimum cohesion (Simmel 1903, p 509-510). However, in Simmel's opinion compromise does not conclude the list of the outcomes of the conflict, which includes another: creativity or innovation. Innovation will be able to give rise, at the same time, to greater cohesion and also to greater inclusion (Simmel 1903, p. 491-492, 516-517).

It can be considered that war or clash is not a stable solution to the conflict between mutually committed actors. It is a case of a "double bind"

(Bateson, Jackson, Haley, Weakland 1956, p. 254): the situation in which, among subjects joined by an emotionally relevant relationship (anxiety for the collective plan), the communication of one towards the other presents an in-consistency between the level of explicit speech (that which is stated) and a further communication level (such as gestures, attitudes, tone of voice); the receiver of the message cannot decide which of the two levels to accept as valid, nor notice the inconsistency. In fact, the two communication levels will be contradictory. On the one hand, mutual commitment encourages everyone to genuinely express their different points of view. On the other, in the hypothesis of war, their antagonism will be able to transmit messages of mutual blame, disdain and hostility. During confrontation then, there will be a drive towards "more". The more a position feels threatened, the more it will express itself strongly, the more conflict there will be, the more - in order to exit the conflict - the positions considered weak will be threatened, the more the latter will want to express themselves strongly and so on. Hence the outcome of this spiral cannot be an endless conflict. It will have to end either with the breach of the agreement, or with one of the other two results: compromise or innovation.

Secondly, it can be noted that there will be no procedural continuity between compromise and innovation. In short, we can pass from conflict to a compromise and from conflict to innovation, but not from conflict to compromise to innovation.

Compromise and innovation seem to be incompatible as both exhaust the conflictual drive. We are dealing, respectively, with the change 1 of Watzlawick, Weakland and Fisch (1974) and change 2. In change 1 (compromise) there is a change in what is being said: a change in the language. Through colloquial comparison between different positions, the propositions used to express the latter are processed through algorithms typical of these same positions. Each position agrees upon the others. By contrast, in change 2 (innovation) the solution requires liberation from rules and bonds typical of the language practiced through the introduction of a new code. This second type of change, in reality innovative, demands insight: every interpretative principle persists strongly because it has internal consistency and because it corresponds to real experiences that confirm its good sense. Therefore, a different code seems to be ex ante "senseless". This is also the viewpoint of Kurt Zadek Lewin, whose

contribution – criticized or forgotten in the 1970s – has now been rediscovered in the sphere of complex approach systems of social dynamics. "Lewin was primarily interested in resolving social conflict through behavioral change, whether this be within organizations or in the wider society. [...] The primary methods he developed for achieving this were Action Research and the 3-Step model of change. [...] – 'unfreezing,' 'moving,' and 'refreezing' [...]." (Burnes 2004, p. 987, 998). Unfreezing takes on a similar meaning to doubting about the previous code, moving is similar to a change in this code, and refreezing is similar to establishing a new code.

Insightful solutions

The solution of problems through a change in the interpretative canon seems to be obvious once it is found. Often, however, before arriving at this point, the actors have reached an impasse. The solution ultimately depends on particular skills, such as seeing images that are out of range or hidden, that are useless when it comes to "normal" problems (Bowden, Jung-Beeman, Fleck, Kounios 2005, p. 322-323). The search for insightful solutions has tended in two directions. In the Special Process approach, the idea is that cognitive resources not activated spontaneously are required. On the contrary, in the Business-as-Usual approach the interpretative canons are practiced, only extended with a broader vision that allows a solution to be attained. However, there is also an intermediate position (Bowden, Jung-Beeman, Fleck, Kounios 2005). Difficult problems enable strong cognitive resources, which are partially use-ful, as well as weak resources that explore in other directions. The solution entails a cumulative strengthening of these weak resources[6] to make them dominant (Bowden, Jung-Beeman, Fleck, Kounios 2005, p. 324). In any event, a broader vision or cognitive resources exploring in unusual directions are also activated on the basis of external drives. But where can the strengthening of these forces come from? The answer that is suggested by the two case studies that follow is that such strengthening comes precisely from conflict not concluded by compromise managed by an effective leadership. The typical traits of

[6] Such resources can be those of apparently weak knowledge or even those of weak actors, as emphasized in various studies on the role of minorities (Nemeth, Wachtler 1983; De Dreu 2002)

insightful solutions emerge in a case of success (Echelon) studied by Lane and Maxfield (2005): conflict between different points of view, possible compromise, innovation due to conflict without compromise, that drive toward the change in the interpretative code managed by a strong leadership. The Olivetti – Programs 101 case confirms that compromise threatens innovation even when the conflict has already produced initial yet important innovative results.

In 1990, Echelon, a Silicon Valley company, created a new technology of universal control, LonWorks®. At that time in the United States, control systems were present in several fields (air conditioning, lighting, lifts, security, mechanical, electrical and electronic plants, handling of liquids and granular solids, home automation) and each of them responded to the classic cybernetic paradigm: sensors and peripheral activation units connected to a central computer that processed incoming data and sent back operative commands to periphery units. Echelon's idea was conceived by the realization that, with the appropriate technology, it was possible to shift to distributed control. Echelon's LonWorks® technology is based on a low-cost integrated circuit that processes information peripherally so that a network of intelligent nodes is created. Given the potentially very wide fields of application, Echelon initially took the idea of its engineers seriously according to which LonWorks® would perform a similar function to personal computers, supplanting expensive large computer systems connected to "stupid" terminals. Of course, this great change would call for the creation of a completely new industry, with new products and new professional figures and organizational forms. The problem was how to favor this difficult transition by a small firm facing a system with many firms, some of them large, dominated by the traditional paradigm. Up to 1996 a certain success was achieved, though very slowly. With regard to the expectations formulated five years earlier, an impasse had clearly been reached (Lane and Maxfield 2005, p. 18). The problem was that there were no firms that could serve as an interface between Echelon and the installer companies. It was necessary, therefore, to promote this network of integrators of LonWorks® systems. At this point in Echelon two lines of action entered into conflict, supported by two different views but by a single interpretative code. One of them was suggested by the results already achieved by targeting large companies, such as Olivetti and

Ameritech, that provided systems in vast office complexes, in the first case, and in buildings, in the second case, offering technology able to improve their functionality appreciably. The other, supported by those with other experience in their own professional careers, sought to involve "independent control contractors" who competed with large companies in the sector of medium systems, using devices that they adapted to customers' specifications (Lane and Maxfield 2005, p. 18, 20, 21). The second line would require rapid development of the new product LonPoint® created by having engineers add to LonWorks® a programmable algorithm of control. Conflict between these two lines, that called into question the very identity of Echelon, broke out mid-way through December 1996. The argument adduced to support the first line was that it was not possible for Echelon to turn their back on large firms, or else the latter would develop alternative products. The argument in favor of the second line was that large firms would not easily accept changing their technologies for new ones that would demand radical changes to the entire design of their large systems. On the contrary, small firms had to buy control technologies in any event and hence it was easier to use those that were more efficient. However, the interpretative code was the same in both cases: everything depended on the degree of technical superiority of the Echelon product; it was therefore a question of electronic engineering. On the basis of this common interpretative code, it was possible to come to a com-promise: to implement both lines and continue on the course already undertaken and slow down the development of products on the LonPoint® track in order to await the results of further experiments. However, the top management did not opt for this compromise. It decided, instead, to go ahead with the decision to explore the second way, even if serious doubts remained (Lane and Maxfield 2005, p. 33). The decisive impetus came from an unexpected external direction and in the space of a year it proved decisive. In the autumn of 1996, the Echelon technicians went to visit the control system of the 50-floor IBM building at 590 Madison Avenue, New York City, upon the invitation of TEC that had installed it. They came back from this visit with the awareness that they did not know very much, about what the TEC technicians had allowed them to see, especially in two respects. On the one hand, the control systems actually applied to large plants were much more complex than that envisaged (the IBM building required 40,000 lines of commands

in order to function) and hence the programmability of distributed control had to be much simpler. On the other hand, the installation and the new system had to be carried out "like a heart transplant. Overnight you have to cut-over from one system to the other, so there's heat in the building in the morning – pipes hissing, compressors banging, a lot of ad hoc adjustments to do, very different from an intellectual appreciation of the problem." (Lane and Maxfield 2005, p. 34). Based on these considerations, starting from early 1997, the engineers began to modify the apparatus to make it become more user-friendly. And it was at this point that an important event occurred[7]. In September 1997, a three-day meeting was organized with five companies of systems integrators, including TEC, conceived as a training course for testers. The Echelon officers presented a number of prototypes and described plans for their completion. They also asked for comments and suggestions or proposals. The small system integrators used that occasion with enthusiasm and flooded Echelon with advice. The full understanding of the apparatus by the installers had provided its results. Thanks to the visit to NYC, the Echelon technicians had been encouraged to change their interpretative canon. They had understood that the problems with the small system integrators, who did not have high electronic engineering skills, lay not so much in the technical superiority of the product as in its ease and transparency of use. Many of the modifications requested would probably have been thought of sooner or later by the Echelon engineers, but they would have been a small subset of a long list without any priority. Hence, the benefit that came to Echelon was decisive. The products ready to be delivered in the spring of 1998 contained the majority of modifications recommended. During the second visit to the IBM building when, after the new system had been installed in an area of the plants, lightning cut off the current and, once restored, everything had been automatically reset, while the operators ran everywhere to restore the controls of the old system. Already by 2003, only fifteen years after the creation of Echelon, 4000 companies had purchased its technology, and the total commercial figure that surrounded it was estimated US$1.5 billion.

[7] It is mentioned in a previous manuscript (on page 31 of D. Lane and R. Maxfield: Incertezza ontologica e innovazione, Università di Modena), then strangely omitted in the version of the essay of 2005

In the Olivetti case, the conflict is between the electromechanical paradigm and electronic paradigm (Perotto 1995). However, it is not a question of a conflict between preservation and innovation, as it might nowadays appear. The parties in conflict were all truly committed to innovation. The supporters of the electromechanical paradigm were not conservative opponents of change. Their positions of power in the company were based on the myth of "designers-inventors". Nonetheless, the conflict turned into a real war in which the engineer Pier Giorgio Perotto and his team of electronic designers risked being annihilated. They managed to emerge from the corner in which they had been confined thanks to the creation of an absolutely new product, the result of a change of interpretative code promoted by the very danger of annihilation, the machine "Programs 101", the first personal computer in the world. Between 1963 and 1965 the engineer Perotto was obliged to accomplish the leap forward by himself and with a few collaborators, from the code that privileged machines to that which gave importance to users, which in Echelon's case was carried out by the whole company between 1996 and 1998 in the field of control systems. This realization re-opened the stakes in Olivetti, but the result was a compromise that did not allow the rapid allocation of necessary resources to Programs 101. Hence five crucial years were lost during which the new idea of the personal computer was maximized in the United States and the Italian firm missed a historic opportunity. Later when asked whether things could have gone differently, Perotto replied that if Adriano Olivetti had not died before his time, his leadership would not have al-lowed this great opportunity to be wasted.

Imperfect and non-negotiable conflict

According to Perotto, Adriano's leadership would have known how to re-interpret the role of Olivetti, in the world they were entering, away from the dominant paradigm. Also in the Echelon case, interpretation of the company's role lies at the center of the innovation process that succeeds only after the role itself has been reviewed. The interpretative code that agents use in their relationships is thus closely related to the interpretation that they give of their "common fate" (Berkhout 2006). Therefore, it seems to emerge that the conflict between agents engaged in the innovation

process is an "imperfect antagonism" (Schelling 1980), be-cause they feel they share a common fate that they themselves are building. The conflict is imperfect because, while destructive outcomes are not excluded, it can be considered that the prevailing force is toward non-destructive results, since agents are linked by an interdependence now and in the future (common fate[8]). In default of leadership, the cohesive force of the common fate may well push toward the compromise result of maintaining long-term interpretative codes. Indeed, innovation comes only from new interpretations of the common fate. The conflict that turns into innovation can thus be defined as imperfect non-negotiable conflict. Thus, the function of leadership appears to be to sustain and manage this sort of conflict, and favor external relationships, building on internal weak cognitive resources (thus accepting an apparent strong risk of error), enhancing and not repressing differences, and nonetheless nurturing the sense of common fate (Hülsheger, Anderson and Salgado 2009, p. 1139).

Leadership

If company managers were asked what the first tool for innovation was, they would probably reply: leadership[9]. On the other hand, this subject

[8] Common fate is something more than interdependence. It is the narrative that attributes meaning to the presence and activity of all during the course of time. Interdependence and common fate define according to Lewin a "group" whose members assume collective responsibility. "It is not similarity or dissimilarity of individuals that constitutes a group, but rather interdependence of fate. [...] What is more, a person who has learned to see how much his own fate depends upon the fate of his entire group will ready and even eager to take over a fair share of responsibility for its welfare." (Lewin 1948, p. 165-166).

[9] The McKinsey survey (September 2007) posed this question to 1458 company directors belonging to different sectors in different countries. The interviewees could choose from seven alternatives. 47 percent of the highest level directors and 58 percent of the other directors indicated leadership. Other answers all had lower results: promoting behaviors of risk assumption (43, 52), improving the decision-making processes (35, 41), making the directors aware of the real importance of innovations (35, 38), spreading the meaning of urgency of innovation (33, 33), presetting accounting instruments on innovative processes (22, 26),

is covered widely in the literature. Reviewing the contributions from 1990 to 2005 that dealt with leadership in companies, Porter and McLaughlin (2006) found 373 in 21 journals, classifying them into 60 percent empirical and 40 percent theoretical. A recent review focused more on complex change and leadership (Uhl-Bien, Marion 2009), including a bibliography of 146 entries. This great quantity of works is justified by the importance that organizations give to the subject and by a thorny question that they keep on asking: what are the distinctive skills of good leaders (Bolden, Gosling, Marturano and Dennison 2003).

Leadership for innovation

The features of effective leadership in innovation processes, also known as transformational leadership, have been pointed out through repeated observations (Avolio and Bass 1991, Mumford, Scott, Gaddis and Strange 2002, Antonakis, Avolio and Sivasubramaniam 2003). They are consistent with the functions that emerged in the previous analysis: favoring external relationships, building also on internal weak cognitive resources, enhancing differences, nourishing the sense of common fate. Among these traits, the "idealized influence" deserves particular attention. It emerges that the leadership for innovation must be perceived and be effectively bearer of "higher-order ideals and ethics, [...] charismatic actions [...] centered on values, beliefs, and sense of mission." (Antonakis, Avolio and Sivasubramaniam 2003, p. 264). Only in this way can it actually carry out those functions (Burke, Sims, Lazzara and Salas 2007). Moreover, leadership, consistently with this profile, takes responsibility for any failures as far as presenting itself as a "servant leadership" that considers the needs, expectations and interests of others the most important (Greenleaf 1977; Barbuto and Wheeler 2006; Liden, Wayne, Zhao and Henderson 2008; Sosik, Jung and Dinger 2009). The consequences are decisive. Innovative leadership cannot also assume at the same time the functions typical of the contract (Jansen, Vera and Crossan 2009). The reason for this is that the innovative leader could seem to betray his/her idealized role whenever

creating working groups devoted to innovation different from those who deal with routines (19, 24). (TMQ 2007).

obliged to decide without rules, for example, the substitution of certain agents, to impose aggressive deadlines in contrast, to skimp on resources, even to abandon courses undertaken that seem rather unproductive, in general to take decisions that can seem in contrast with the valuing of differences, weak resources and common fate (Cha and Edmondson 2006). These behaviors, even if they can be objectively justified (Krantz 2006), would be interpreted as a betrayal of those values and ideals that are held to be typical of the leader. Suspicion toward the leader is, however, a useful attitude be-cause it allows the avoidance of a very dangerous syndrome pointed out by Gemmill and Oakley (1992, p.273): "the leadership myth functions as a social defense whose central aim is to repress uncomfortable needs, emotions, and wishes that emerge when people attempt to work together". This does not mean that the leader has to be deprived of his/her power. It implies rather the necessity for a precise distinction of roles and functions. The function of the contract is to establish impersonal rules that circumscribe and "defend" the function of leader-ship.

Disengagement

Leaders who undertake the functions of the contract will sooner or later be accused of working for their own interests or their own views or to promote their own identity, rather than serve the common innovative mission. There will then follow a misalignment of goals among agents. The conflict on how to proceed will then turn into conflict on the very goals and mutual commitment will vanish. It will then be evident that leadership, essential because of a voice-opportunism conflict (lever of innovation) due to contract for mutual commitment, must be seen as complementary to this. If, on the one hand, the contract is not enough and leader-ship is necessary, on the other, strong leadership cannot replace the contract. In this latter case, the danger of exit opportunism will return. We will have to expect, therefore, that innovation is interrelated to leadership and contract at the same time; that the moves towards compromise will be important if the leadership is weak, or towards the lack of commitment if the contract is weak. In this framework, strong leadership coupled with weak contract means that the leader's authority is not clearly circumscribed by the contract that poorly defines the commitment rules. Strong contract and

weak leadership means that well-defined, articulated rules provided by the contract are intended formally or informally also as a means of substantially avoiding authority and leadership, or a lack of leadership due to management's personal inability to carry on the role of "transformational" leadership.

Competing theories and discussion

According to the theory outlined here, once the innovation process is defined as interacting non-structured learning by various specialized actors in the context of ontological continuous uncertainty, tensions in the coordination among actors are seen as conflicts both on goals (due to exit opportunism), and on how to reach the common goal (due to voice opportunism) which has been contractually agreed upon. The achievement of truly innovative solutions requires transformational leadership so as to avoid a compromise solution. This idea is part of the dialectical interpretation of Action Theory in which the "pattern-maintenance function is counter-instrumental with regard to the function of goal-attainment, and their adaptation is counter-instrumental with regard to the function of integration." (Ajzner 2000, p. 169). Contract (alone) may be seen as counter-instrumental to innovation attainment (due to compromise), and leadership (alone) is counter-instrumental with regard to mutual commitment. As Ajzer points out (Ajzner 2000, p. 169-170), this means that the systemic problems would be eliminated if the pattern-maintenance function (contract) could fulfill goal attainment, and adaptation (leadership) could fulfill pattern maintenance. This switch of functions seems to be the main message of two theories that, starting from the same premises about interactive learning, provide tools to avoid conflict. One, the "separate venture" solution, argues that a particular kind of contract is supportive of the innovation process without authority and leadership. In the second, "dynamic routines" are capable of supporting the process without the contract. Both are likely to outweigh the conflict.

Macher and Richman (2004) in a three-case study (Motorola, Kodak, IBM) note that "managers within each organization concluded that the current structures and routines in place could not succeed in the new technological paradigm [cellular phone, digital imaging, personal computer]

and their firms consequently would not sustain industry leadership if they remained burdened with the existing structures and routines designed for stable and incremental innovation." (Macher and Richman 2004, p. 6-7). They went on to develop new organizational structures targeting the demands of the emerging technological paradigm: the separate venture solution. This solution may be achieved by acquiring a different firm that has started to develop products under the new technological paradigm, by creating a joint venture or by establishing a division that is organizationally separate from the rest of the firm. In any case, this separate venture "is unique in that it has objectives that are largely independent and in some senses counter to the rest of the firm. As new technologies develop within the separate venture, distinct routines often emerge [...] These routines are usually distinct from the current routines within the existing organization in that they are specifically targeted toward developing and commercializing the new technology." (Macher and Richman 2004, p. 7). The separate venture can be thought of as a contract that creates a commitment to an innovation goal by establishing a separation between insiders and outsiders of the separate venture, and by guaranteeing independence from (even opposition to) the rest of the organization (Christensen 1997). Revisiting Simmel's view and partially Coser's (1956) interpretation of that view we may see that this solution prevents conflict between actors in the innovation process. Within the separate venture established to reach the innovation goal, the contract will avoid conflict on goals and means because the insiders have an incentive to act as a team in order to support opposition to the rest of the organization. From this point of view, no authority or leadership is needed.

In this separate venture solution, routines are seen as counter-instrumental to change. However, Feldman and Pentland (2003) argue that this "conventional wisdom [...] is only part of the story. While it is true that routines facilitate cognitive efficiency, they also embody a selective retention of history, filtered by subjectivity and power. [...] By directing attention to the per-formative [...] aspect of routines [not only to the "ostensive" aspect] our theory emphasizes the contingent [...] nature of routines as source of their variability." (Feldman and Pentland 2003, p. 115). Accordingly, the ostensive aspect of the routines (as repetitive recognizable patterns of interdependent actions carried out by multiple actors) has the

function of guiding, accounting and referring, like a musical score. However, this ostensive aspect substantially needs the per formative aspect in order to constitute a routine, in the same way in which a musical score requires actual musical performance (Feldman and Pentland 2003, p. 102). Thus, as in the musical metaphor, the performative aspect involves introducing variations. Furthermore, while routines, "as an agreement about how to do the work, reduce conflict" (Feldman and Pentland 2003, p. 98), in the move from the per formative to the ostensive as-pects of routines, variations may or may not get incorporated into the ostensive aspect and this "depends on the power of particular individuals or groups [...that] have the power [...] to turn exceptions into rules and, thus, enact organization in ways they think appropriate." (Feldman and Pentland 2003, p. 110). In sum, this theory of "dynamic routines" entails authority and leadership as the means for innovation without conflict.

The two theories - separate venture and dynamic routines - taken separately succeed in avoiding conflict and supporting innovation by means of either contract or leadership. This is contrary to our hypothesis on conflict-contract-leadership. However, these theories are not necessarily incompatible with one another. Dynamic routines may open up several opportunities for change; one of them is chosen; a separate venture is established in order to develop its innovation potential. This in fact happened in the cases studied by Macher and Richman (2004). The same holds in the case of IBM System 360 (Pugh, Johnson and Palmer 1991). In this way, however, contract and leadership are both necessary and conflict is not avoided. The continuous ontological uncertainty could play a crucial role here. If there were only one option for change (as in the separate venture hypothesis), conflict could be avoided. The same would hold if several options existed but they were clearly defined (as in dynamic routines). In reality, different options for change exist and the result is uncertain. In this case, conflict may be unavoidable, as emerges in case studies.

A preliminary application

The previous discussion should be accompanied by carefully designed empirical research in order to verify one of the three hypotheses.

An initial application can be presented in relation to Territorial Pacts (TPs) in Italy. TPs are public-private agreements on the coordinated implementation of private and public investments aimed at developing a given area. While in the rest of the paper we discussed innovation in the private sphere, TPs refer to organizational and institutional innovation in the public and social spheres. However, some results seem of general interest.

Between 1997 and 2009, 220 TPs were started, 153 in southern Italy, and 67 in central and northern Italy. In all, they were allocated 5 billion euro, five percent of total public investment in that period. TPs aroused particular attention and became the opportunity for detailed analyses of local development in Italy (Barca 2006a, 2006b, 2006c). The experience of TPs offers the possibility to assess the contract-leadership model by exploiting the high diversification in the contracts among agents through which implementation took place: strong contracts, weak contracts, very undemanding formal declarations of intent. Leadership also played a major role in TPs, again of different kinds and strength. Finally, the results of TPs are also very different, from success to failure.

Qualitative field research was carried in 2001 by Cersosimo and Wolleb (2001). "The paper identifies some of the causes explaining the different performance of the TPs: [...] leadership, the accumulated experience of collective action and the capacity for institutional building by local actors." (p. 369). Building on this preliminary work, in 2002-2003 quantitative research was carried out by several scholars (DPS 2003)[10]. Finally, Piselli and Ramella (2008) widened the analysis with new case studies. A data set of 30 TPs (established between 1997 and 1999) is now available. By standardizing the data and building an index of economic results (risec[11]), we can now appreciate that the economic and socio-

[10] Piera Magnatti of Nomisma, Gianfranco Viesti of the University of Bari and Carlo Trigilia of the University of Florence, scientific research director Francesco Ramella of the University of Urbino. The processing of data and the construction of indicators was edited by Francesco Ramella with the collaboration of Luigi Burroni of the University of Florence. Magnatti, Ramella, Trigilia and Viesti (2005) published the results of the research in a volume.

[11] Weighted average of the normalized values of the indicators: 1) impact on the local economy; for every single TP this element was found through the data gathered in the case study,

institutional features of areas account for a very modest share of the variance of this index. The same holds for the endowment of social capital. On the contrary, as Cersosimo and Wolleb (2001) outlined, indexes of leadership[12] and contracts[13] are both significant, but in a complex way.
These complex relationships between economic results and explicative variables can be made sense of by grouping TPs into four sets by using the leadership-contract type suggested by the theory. The first set (weak contract and weak leadership) consists of four Pacts: Pisa, Cosentino, Basso

assessed comparatively (comparing it with other cases analyzed) and translated into a graduated scale: weak, medium, strong impact. 2) Improvement of the local economic structure according to assessments expressed by qualified interviewees; average percentage of interviewees that indicated a positive influence of the agreement: a) on the innovative skill of companies, b) on product quality, c) on the cooperation between firms or companies, d) on trust relationships between companies); 3) Improvement in the endowment of public goods and in the attractiveness of the area according to qualified observers with reference to the average percentage of interviewees who indicated a positive influence of the agreement: a) on the formation of the labor force, b) on the endowment of public services and company infrastructures, c) on the attractiveness of the area for external investments, d) on the endowment of social infrastructures. (DPS 2003, p. 44).

[12] An appropriate index was constructed from factor analysis. The scores are given by averages of normalized values of indicators drawn from case studies: 1) presence or absence of a personal leadership that carries out a recognized function of guide in the coalition that supports the agreement; 2) strength of leadership (these data were assessed comparatively in the TP and translated into a graduated scale: high, medium, low) (DPS 2003 p. 27).

[13] The index refers to the sum of scores of indexes of partnership intensity calculated from factor analysis. The scores are given by the averages of normalized values of three indicators drawn from case studies: 1) commitment (these data were assessed comparatively in the TPs and translated into a graduated scale: high , medium, low); 2) presence or absence of a limited group of agents that carries out the incentivizing and coordination role for the coalition of local agents supporting the agreement; 3) number of protocols signed (DPS 2003 p. 27).

Veronese del Colognese, Lecce. The second group (weak contract, strong leadership) consists of 13 TPs: Conca Barese, Benevento, Palermo, Piombino Val di Cornia, Avellino, Miglio d'oro, Maremma grossetana, Livorno, Sud Basilicata, Nord Barese Ofantino, Cuneese, Simeto Etna, Foggia. The third group (strong contract, weak leadership) consists of 5 TPs: Taranto, Vibo Valentia, Sistema Murgiano, Ferrara, Valdichiana. The fourth group (strong contract, strong leadership) consists of 8 TPs: Napoli Nord-Est, Rovigo, Caltanissetta, Teramo, Canavese, Sangro Aventino, Locride, Alto Belice Corleonese.

Table 3: *Results (risec) of TP according to leadership and contract*

	WEAK LEADERSHIP	STRONG LEADERSHIP
WEAK CONTRACT	No. of cases 4 Average *risec* -0.50 Variance 0.49	No. of cases 13 Average *risec* -0.53 Variance 0.87
STRONG CONTRACT	No. of cases 5 Average *risec* +0.37 Variance 0.18	No. of cases 8 Average *risec* +0.88 Variance 0.67

TPs with strong leadership and strong contract perform significantly better than TPs with weak leadership and weak contract. Moreover, the coupling of strong contract and weak leadership is associated with lower results than those in which leadership is also strong. Finally, with strong leadership and weak contract we have the worst results, although it must be taken into account that in this case the variance is particularly high.

The analysis can be refined by using some proxies for "compromise" and "disengagement". A good proxy for compromise is an index of rapidity of spending (v_erog). As emerges from monographs on cases (Cersosimo

and Wolleb 2006), this index was high when all agents converged on undemanding projects. For disengagement, the proxy is revocation and renunciation of plans as a percentage of public funds allocated (renunciations).

Table 4: Results (risec), leadership and contract, disengagement and compromise

	WEAK LEADERSHIP	*STRONG LEADERSHIP*
WEAK CONTRACT	*No. of cases 4* *Average risec -0.50* *Average v_erog (compromise) 1.51* *Average renunciations (disengagement) 36.3*	*No. of cases 13* *Average risec -0.53* *Average v_erog (compromise) -2.02* *Average renunciations (disengagement) 34.5*
STRONG CONTRACT	*No. of cases 5* *Average risec +0.37* *Average v_erog (compromise) 2.22* *Average renunciations (disengagement) 27.6*	*No. of cases 8* *Average risec +0.88* *Average v_erog (compromise) 1.15* *Average renunciations (disengagement) 20.0*

The index of delivery speed is significantly higher on average in the five cases with strong contract and weak leadership, as expected. The index of disengagement is greater when leadership is strong and contract is weak, as suggested by the theory.

To sum up, while performance of TPs cannot be interpreted on the basis of a linear hypothesis of leadership or contract influence, or of a simple cumulative interaction between these two variables, the theory outlined in this essay helps us to move forward. The hypothesis that leadership and

contract are complementary (and not substitutable) elements seems to be con-firmed by empirical evidence.

Conclusion

The preliminary empirical application seems to encourage the theory advanced in this paper. This evidence will have to be much more carefully assessed through future empirical research. Should the results be confirmed, some general lessons could be drawn on how to build an efficient organization for producing innovation. In particular, there would be a strong argument to resist the natural tendency of leaders to avoid "obstacles" to their action, namely the use of contracts. Similarly, a strong argument could be made to resist the natural tendency of the actors in the innovation process to escape authority and leadership that could be seen as threats to their "democratic" dialogue.

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