
Inter-firm Networks: Antecedents, Mechanisms and Forms*

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Abstract

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This paper is an effort to review and organize the now vast literature on inter-firm networks, with the aim of assessing the important current forms of network, the organizational mechanisms supporting them, and the main variables that have been shown to influence network emergence and shape.

These results are achieved through a literature review encompassing a number of approaches across the social sciences. The paper can therefore be used as a typological state-of-art on inter-firm networks, and as a basis for developing hypotheses of relationship between network antecedents and forms.

Descriptors: inter-firm networks, network organization, coordination mechanisms, organization theory

Introduction

Inter-firm networking is increasingly important in economic life, because of its capacity for regulating complex transactional interdependence as well as cooperative interdependence among firms. In addition, the management of inter-firm cooperation is particularly relevant in contemporary Europe in the perspective of European integration. Inter-firm networks are also very interesting from a theoretical point of view because they can be, and indeed are, studied from different disciplinary approaches, thereby offering a precious ground of common interest and potential dialogue among various branches of the social sciences.

This review of inter-firm network studies tries to be as wide as possible in terms of types of approaches considered. It can be useful for defining a wide range of network forms and mechanisms, using a number of important social, economic and organizational dimensions, and showing different coordination properties. For example, research in industrial economics has highlighted the economic distinction between equity- and non-equity networks and — among the latter — it has paid more attention to the most institutionalized forms. Organizational research has contributed through a much finer classification, analyzing the specific traits and internal variation of network forms, such as franchising, joint ventures, sub-contracting, interlocking directorates, etc. Sociolo-

gical and social-psychological approaches have helped in identifying forms of socially controlled and informal cooperation. Moreover, by focusing on social and behavioural exchange rather than on transactions of goods or services, they have been very useful for analyzing horizontal coordination among similar firms.

As it is so widely used, the term 'network' has lost precision (Nohria and Eccles 1992). Let us then put forward some definitions on what meaning can be attached to this term for our purposes.

The term 'network', by itself, is an abstract notion referring to a set of nodes and relationships which connect them (Fombrun 1982), and it is used in a variety of sciences, including not only organization theory but also neuro-sciences, operational research, communication theory and small group theory. We are interested here in networks as modes of organizing economic activities through inter-firm coordination and cooperation. In this sense, networks lie at the very core of organization theory. They are modes of coordination among specialized organizational units; and striking the right balance between differentiation and integration is usually considered a central problem in the structuring of organization. In this paper, the focus is on firms as the differentiated units to be coordinated (in conditions of interdependence to be specified) and on networks as nexuses of integration mechanisms encompassing all the range of organizational coordination devices from lateral informal communication, to inter-firm information and planning systems, to complex integration structures (such as the much analyzed joint-ventures or franchising structures); in addition to or in substitution for market mechanisms.

These inter-firm organizational structures and processes are different from the integration of interdependent firms with one larger firm on one side, and tacit or price coordination through instant exchange and competition on the other (Thompson et al. 1991). This feature of inter-firm coordination has led to two adversarial characterizations of networks. On the one hand, there are those who define an inter-firm network as an 'intermediate' or 'hybrid' form of organization of economic activities with respect to markets and firms (Williamson 1991; Thorelli 1986; Balcer and Viesti 1986). On the other, there are those who contrast this view and maintain that a network is a 'third-type' organizational arrangement, with its own characteristics and properties, qualitatively different from those of both markets and firms (Powell 1990; Johansson 1987a). However, if left in these terms the question is somehow metaphysical. Both approaches stress, in an unnecessary way, some interesting properties of networks at the expenses of others. To be more precise, we wish to adopt a more operational and more balanced definition of inter-firm coordination modes with respect to the above-mentioned polar definition, which recognizes at least the two following properties of inter-firm organizational coordination.

1. An inter-firm network is a mode of regulating interdependence between firms which is different from the aggregation of these units

within a single firm and from coordination through market signals (prices, strategic moves, tacit collusion, etc.) and which is based on a *cooperative game with partner-specific communication*.

2. The *attributes* of a network — i.e. the coordination processes and structures an inter-firm coalition may employ — are not necessarily ‘intermediate’ with respect to those of firms and markets (a point under-rated by ‘markets and hierarchies’ approaches), but they need not be unique because they have different mixes and intensities both in firms and in markets (a point not taken very much into account by the third-type approach to networks).

The review of the literature on inter-firm networks proposed here aims to extract from available studies, and systematize in a typological framework, at least the following three elements of knowledge on networks: the main antecedent variables that have been shown to impact on network formation and form; the main organizational coordination mechanisms through which cooperation is achieved; and the main modes of inter-firm coordination — or network forms — that have been shown to be viable and important discrete organizational alternatives for governing inter-firm relationships.

Approaches and Antecedents

In our survey, we have identified several major lines of study characterized by the use of partially different hypotheses and by the development of a distinct body of empirical research.

Starting with economic approaches, *industrial economics* has long been concerned with the issue of ‘industry organization’ (Richardson 1971; Mariti and Smiley 1983). Building on the traditional research on vertical and horizontal integration, this discipline has increasingly considered incomplete or mixed forms of ‘quasi-integration’ (Blois 1972) and, in particular, to their use in internationalization processes (Dunning 1982; Mariotti 1984).

Core explanatory variables used for assessing the efficiency properties of firm networks are various classes of production costs stemming from technological regimes: economies of scale, scope, specialization and experience. For example, *economies of specialization and experience* have been indicated as important factors in explaining why, even in the presence of significant interdependence, a network of separate firms may be superior to an integrated enterprise — as in the case of sub-contracting (Eccles 1981). *Economies of scale* play an obvious role in the formation of resource pooling coalitions aimed at the provision of common services, as in horizontal franchising agreements, or in joint production agreements such as in the car producers’ joint-ventures (Turati 1990). *Economies of scope* can be the basis for the formation of agreements for the joint utilization of equipment or know-how, such as licensing agreements (Teece 1980).

Historical and *evolutionary* approaches have stressed the role of *technology*, related costs and learning problems in the formation of inter-firm networks. Both approaches have built extensively on Alfred Chandler's contributions, enriching them by adding the possibility of inter-firm organizational cooperation and coordination to that of the 'visible hand' of one integrated firm, especially in the processes of technological innovation (Nelson 1993).

However, economies in production costs alone are not sufficient to explain which organizational mechanisms will be necessary in order to coordinate the relationship. *Organizational economics* has added to the explanation of the relative success of networks the reduction of governance costs to that of production costs and, at present, it is one of the most widely used approaches in the analysis of networks. In fact — after some initial reluctance in admitting that networks could be something other than transitory or second-best arrangements with respect to the pure forms of market and hierarchy — organizational economics has helped us to gain an understanding of the nature of these forms of regulation of economic activities as optimal hybrid forms (in specified circumstances) which strike the right balance between the properties of markets and those of hierarchies (Williamson 1985; Powell 1987; Thorelli 1986; Bradach and Eccles 1989).

The most important and often used variables that have been hypothesized to be sources of increasing coordination costs under a market arrangement — thereby predicting the emergence of inter-firm coordination through organizational mechanisms — are asset *specificity*, context *uncertainty* and the *frequency* of transactions (Williamson 1981); the *measurability of performance* and the difficulties in detecting and *controlling* it (Barney and Ouchi 1984); and the presence of agents characterized by *risk aversion* (McGuire 1988; Davis 1991).

These are predictors of network formation as a consequence of market failure, but for the sake of completeness, the other side of the coin should also be relevant, although under-investigated, i.e. that of predictors of network formation as a consequence of bureaucratic failure. Important variables in this respect, however, have been investigated more in organizational studies than in economic perspectives.

On an intermediate, traditionally interdisciplinary ground between economic and sociological approaches, an *organizational perspective* on networks has married a prescriptive concern for what is effective with a descriptive concern for what actually happens. This attitude has focused attention on how to achieve some desirable results in networking such as reaching and stabilizing agreements (Schermerhorn 1975; Schmidt and Kochan 1977; Van de Ven and Walker 1984), how to design a fitted degree of structuring and formalization of a network (Van de Ven, Walker and Liston 1979), how to choose an effective power distribution within networks (Fox 1982; Gray 1987), and how to conduct research projects on networks from a methodological point of view (Fombrun 1982).

As far as inter-firm networks are concerned, these organizational studies are limited in that they have often predominantly addressed — when empirically based — the public administration sector. Another class of organizational studies, developed mostly in business schools and closely connected to strategy studies, have directly addressed the organization of inter-firm alliances, especially of formalized alliances such as joint-ventures (Harrigan 1985; Killing 1983; Turati 1990) and franchising (Pilotti and Pozzana 1990). Taken together, these organizational studies have shed light on a number of important explanations of inter-firm organizational coordination.

A first variable can be broadly defined as the degree of *differentiation* between the units to be coordinated. It includes the distance among the objectives and orientations of these units, the 'psychological distance' between their cognitive and emotional orientations, and the distance between their organizational profiles.

It is well known that inter-unit differentiation is a major source of coordination costs within firms, and it seems plausible that it plays a similar role between firms. In the literature on mergers, acquisitions and multinational companies an excessive degree of differentiation has often been recognized as a cause of bureaucratic failure and disintegration of firms (Porter 1987; Franck 1990; Olie 1990). The most tightly coupled forms of network, such as those of joint ventures, have been shown to be failure prone with respect to inter-firm differentiation (Harrigan 1985; Miles and Snow 1992).

On the other hand, networks seem to be better able to tolerate and profit from differentiation than hierarchies. It must be noted that the *complementarity* (and hence diversity) of the resources controlled by different firms is considered a predictor of network formation, especially for purposes of innovation (Teece 1986; Richardson 1971; Camagni 1991).

A second variable highlighted in organizational studies on networks is the *intensity of inter-firm interdependence* (Van de Ven, Walker and Liston 1979; Oliver 1990). It is known that inter-unit interdependence is a particularly good predictor of the integration mechanisms effectively adopted by organizational units. In inter-firm relationships, interdependence may well arise due to a number of factors already analyzed in other perspectives mentioned here, such as asset specificity, uncertainty or the amount of resource exchanged. Actually, all approaches to inter-firm coordination are interested in the governance of interdependence. Therefore this variable may be considered an intermediate variable on which many network antecedents have an impact, and which might then be able to explain a particularly high part of variance in the emerging network forms.

Another important organizational variable is the *number of units* to be coordinated. An increasing number of sub-units to be coordinated poses limits on the size of hierarchies (Williamson 1970) but, through networks, firms can expand their activities beyond those limits (Vaccà

1986). The number of separate but interdependent firms requiring coordination has been shown to be a predictor of the relative presence and consistency of central staff in networks (Phillips 1960) and of the degree of network formalization (Van de Ven, Walker and Liston 1979).

The *complexity* of interdependent *activities* has long been considered a predictor of organizational arrangements, and it has also been shown to be positively related to the complexity of inter-firm organizational arrangements (Turati 1990; Osborn and Baughn 1990; Killing 1988; Van de Ven, Walker and Liston 1979). *Asymmetry in the resources controlled* by the different firms, including information and know-how, have been added to this type of organizational analysis of networks as a predictor of their degree of centralization or asymmetry (Mariotti 1984; Balcer and Viesti 1986; Gray 1987).

Finally, many organizational studies have indicated flexibility as a major property of networks. Flexibility in this context does not only mean capacity to change firms' output according to contingencies but also capacity to change the organizational arrangement itself. In this sense, networks are hypothesized to entail lower *transition costs* with respect to internal organization — and some forms of network of being more conducive to *self-change* than others (Pfeffer and Salancik 1978; Gadde and Mattsson 1987).

A *negotiation analysis* of network has been fruitful not only for understanding the exchanges of resources and behaviours but also for refining our understanding of how these exchanges are regulated, i.e. the form of network adopted. In fact, if only context variables of the type considered so far were used, one could achieve at best the explanation and prediction of the emergence of a network and of its generic form (e.g. a joint venture or a licensing agreement). However, in order to understand the fine structure of an inter-firm coordination agreement, the specific utilities of the partner firms should also be considered, as well as the type of negotiation process that is likely to emerge. In this way, one may be able to predict, for example, when a symmetrically or asymmetrically owned joint venture is likely to be formed, or what solution among two or more Pareto-efficient organizational agreements will be chosen because of particular properties.

More basically, any network arrangement, as in any form of cooperation, must be sustainable by the underlying game structure (Jarillo 1988; Axelrod 1984; Scharpf 1993). Different inter-firm coordination mechanisms can be meaningfully compared if a coordination problem is given that can be formulated as a game. For example, transaction-cost economics has mainly addressed a particular problem and game, that of effectively regulating buyer–seller exchanges in varying conditions of specificity and uncertainty. In this case, the negotiation game among the firms involved has strong distributive components, and the parties' interests are opposed, to a large extent. For this reason, the

coordination of this type of interdependence often requires complex contracts and explicit safeguards.

However, this distributive negotiation structure is a particular case. A number of studies on networks, such as joint ventures and consortia, have analyzed the negotiation structures of alliances aimed at pooling complementary resources as integrative negotiations (Contractor 1984, 1985; Grandori 1989, 1991). In an ideal situation, if firms' resources were perfectly complementary and the game were totally cooperative, even a very high specificity of resources should not lead to opportunism problems and to a need for coordinating structures (Hill 1990).

In sum, the negotiation approach has highlighted the *structure of games* as a predictor of both network foundation and shape. In addition, it has shown that further criteria for the prediction and explanation of networks, besides production and transaction cost-efficiency, are the *Pareto-efficiency* and *fairness* of devised arrangements. Finally, a negotiation approach has helped in appraising the effects of *processes* in enhancing the likelihood of an agreement and in shaping its form (Schmidt and Kochan 1977; O'Toole and O'Toole 1981; Weiss 1987).

Resource dependence views are very important in sociological studies on networks (Evan 1966; Pfeffer and Salancik 1978; Aldrich 1979; Benson 1975; Jacobs 1974). A distinctive contribution of resource dependence studies has been to envisage a particularly broad range of network forms. In this respect, Pfeffer and Salancik's (1978) book on the external control of organizations has been one of the few contributions to provide a review of some important alternative forms of inter-firm networks and of the empirical research relevant for their prediction. The forms considered were joint ventures, interlocking directorates, associations and cartels, social and personal networks.

It has been shown that part of the network antecedents highlighted in this contribution are very close to those studied by organizational economists and organization theorists (Grandori 1987b). This is particularly the case with core explanatory variables such as 'critical uncertainty and interdependence' and 'asymmetry in the resources and information controlled' by the various actors. On the other hand, a different dimension in network explanation offered by the resource dependence perspective, in addition to what has already been achieved by the economic and organizational approaches mentioned above, is the *strategic manipulation of transactions and games* aimed at changing the relationship of interdependence to one's own advantage. This can contribute to gaining an understanding of the direction in which new transactions relations might go. For example, it helps to understand how networks for avoiding a small number of unfavourable, asymmetric situations are formed. 'Countervailing power' networks and associational structures formed by disadvantaged and highly substitutable parties in order to deal with a concentrated or unsubstitutable counterpart are a case in point, e.g. associations of firms in a rela-

tively fragmented industry for dealing with more concentrated supply or distribution sectors (Reve 1992; Stern and Reve 1980).

In fact, resource dependence theory distinguishes among *types of dependence* as a possible predictor of networks, both in quantitative and qualitative terms. That dependence can vary quantitatively as a function of the *breadth relationships*, has been pinpointed as an important predictor of the complexity of a network form (Alter and Hage 1993). On how many activities are the firms interdependent? How important are these activities for each firm involved? Are these activities limited to information processing and exchange or do they involve the coordinated processing or exchange of goods and services? Does the relationship involve joint transformation processes?

A second related distinction is more qualitative in nature. It has been hypothesized that 'horizontal' interdependence — i.e. interdependence stemming from *resource-pooling*, based on symbiosis, complementarity or commensality — may require different coordination mechanisms than 'vertical' interdependence between firms — i.e. interdependence stemming from *resource-transferring* from one firm to another (Pfeffer and Salancik 1978). More specifically, besides simple situations of totally cooperative interdependence among a few firms in which informal networking and inter-organizational 'small grouping' may suffice (Evan 1966; Aldrich and Whetten 1981), studies have revealed that complex resource-pooling alliances are mostly regulated by associational agreements (e.g. trade associations, cartels and consortia); while complex resource-transferring alliances have been shown to be mostly regulated by agreements based on various forms of relational and obligational contracting. It has also been shown, empirically, that there may be a trade-off between tightly structured horizontal and vertical alliances used by the same firm (Reve 1992).

The *neo-institutional approach* also treats dependence as a central concept, but dependence does not just refer here to the material resources or transactions but includes the core resource of *legitimation*. Networking, social linkages and, in general, the avoidance of isolation — in all the forms it can assume, from personal friendship to a formal relationship (Di Maggio 1986) — is expected to be an important predictor of firm survival within this perspective (Baum and Oliver 1991). Firms legitimate reciprocally by belonging to particular networks.

Another very important factor that has been shown to affect inter-firm network formation and shape in an institutional perspective may be defined as '*institutional embeddedness*'. The relative effectiveness and ease of formation of various inter-firm cooperative structures is contingent to the larger social institutions in which these relationships are embedded. These social institutions include the legal system, the banking system, the structure of labour markets and the political system (Whitley 1990, 1991; Grabher 1993; Dore 1983; Aoki 1988).

In the more general field of *organizational sociology* at least two other

types of 'embeddedness' have been argued to affect the likelihood of emergence of different types of inter-firm network. Using the definition coined by Mark Granovetter (1983, 1985) they may be called '*social embeddedness*' and '*cultural embeddedness*'.

Granovetter has forcefully argued that all economic relations between firms take place within a web of pre-existing social relationships. These webs constrain the direction and forms in which economic relationship can develop. This argument is particularly relevant in considering inter-firm networks. In fact, it shows that some elementary form of social coordination, such as acquaintance and communication, is the basis on which more elaborate inter-firm coordination structures may emerge. Some network forms have also been shown to be more sensitive than others to the existence of prior interpersonal networks between firms. For example, in a large sample of Italian industrial firms, consortia between firms that had previous interpersonal relationships were formed in 90 percent of the cases, while for joint venture agreements this was true in only 50 percent of the cases (Soda 1992).

Finally, the institutionalized social norms and the values internalized by economic actors are likely to have a bearing on the emergence of inter-firm networks (Boisot 1986; Hamilton, Zeile and Kim 1990). 'Atmosphere' was also a contextual variable acknowledged to be important in organizational economics approaches, but left as a residual category. In contrast, the analysts of organizational culture have seen it as a central phenomenon to be studied and as an important predictor of inter-firm cooperative behaviour (Ring 1993).

A final perspective, with roots in both the sociology and economics of organization is the tradition of *radical and Marxian studies*. They have looked especially at those networking strategies and behaviours which *cannot* be justified by any notion of efficiency or effectiveness and have explained them as pure power mechanisms for reproducing élites and class *dominance* (Whitt 1980). The largest part of empirical research on networks in this perspective has been conducted in sociology and has focused on clubs, interlocking directorates, participation in non-business institutions and other informal power networks (Moore 1979; Perucci and Potter 1989).

Turning now to the field of *social psychology*, an important tradition of study on networks, is that of *Social Network Theory*. This kind of analysis used to be applied to small-group research. As far as inter-firm coordination is concerned, social network analysis has been successfully applied in particular to the study of the emergence and change of informal structures (Burt 1990; Lomi 1991), network boundaries (Burt and Minor 1983; Laumann, Marsden and Prensky 1980), the process of corporate cooptation (Burt 1983); interlocking directorates (Burt 1979, 1980), and patterns of relations among small firms (Lomi and Grandi 1993).

A distinctive contribution and focus of attention of social network analysis has been the study of the *positions of individual firms* within net-

works. Interesting results have been achieved by applying to inter-firm networks the classical abstract categories of network analysis such as *centrality* (Lomi 1991), *structural equivalence* (Burt 1978; Lomi and Grandi 1993; Gerlach 1992), and *clique analysis* (Benassi 1993). As to the antecedents of these features of the networks, social network analysis has focused attention on endogenous dynamics and on *the particular network structure at a certain time* as a predictor of the future evolution of the system.

The perspectives from strategy and *general management* on inter-firm coordination have used many arguments drawn from the already mentioned approaches from economics, sociology, social psychology and organization theory. Business policy has perhaps been the area of business administration most involved in the study of inter-firm networks under the heading of 'strategic alliances' (Porter and Fuller 1986; Ohmae 1989; Contractor and Lorange 1988). A distinctive focus of this research has been to use all the available tools of analysis eclectically, often in the perspective of one focal *firm* trying to enhance its *position*. In particular, in many business-policy contributions, the variable of *specificity/unsubstitutability* of a firm's *distinctive competencies* — characterizing the whole network or single firms within it — is a goal variable to be manipulated. Therefore, in terms of the principal variable used as a network antecedent, managerial approaches have been particularly close to resource dependence views.

Among managerial perspectives, a stream of *industrial marketing* contributions are beginning to assume the character of a 'school' or 'approach', thanks to the persistent work of a group of Swedish scholars on long-term buyer-seller exchange relationships of industrial goods (Hakansson 1982; Ford 1980; Ford, Hakansson and Johanson 1986; Forsgren and Johanson 1992). Inclined to a socially oriented analysis, the Swedish 'network approach' has principally analyzed the social-exchange aspects of inter-firm networks (Johanisson 1987b) and the dynamics of networks, rather than their structural form (Gadde and Mattson 1987). Among the antecedents of networks that these studies have particularly and distinctively emphasized are the role of individual skills (Grieco and Hosking 1987) and of *entrepreneurship* (Johanisson 1987c).

The perspectives on inter-firm coordination considered so far differ in the 'locus of effectiveness' that they assume. Most approaches reason from the point of view of the overall result for the coalition of firms, of all the firms involved as a whole, i.e. of the network itself. Some approaches are interested in the relative position of different firms, or of one firm, in a network. The widest level of analysis encountered thus far is that of industrial economics, because it is interested in the effectiveness and efficiency of the organization of industry. However, inter-firm organization has traditionally also been a concern at the more general level of *economic policy* and *economic law*, i.e. at the level of

the competitiveness, effectiveness and fairness of national or international economic systems. The prevailing attitude toward inter-firm networks at that level used to be rather negative (especially in the Anglo-Saxon countries), while in the other approaches reviewed so far, it was generally positive. The central variable of concern in economic policy and law is that of the *negative externalities* that inter-firm networks may generate. Only very recently the results of inter-firm network analyses, produced from a number of the previously-mentioned perspectives, have been brought to the attention of the legislator with a demand for developing norms to balance the advantages of both cooperation and competition, rather than simply defending competition (Jorde and Teece 1989).

Finally, we complete this review by considering *population ecology* models. In fact, a natural-selection perspective is, in a sense, 'final' in that it concerns the verdict on the survival of organizational arrangements — of networks in this case — whatever the reason, justification, contingency or factor responsible for their emergence. *Economic effectiveness and efficiency* will play a role in the selection of inter-firm arrangements as long as they are modes for regulating economic activities in market economies. However, other forces also enter into the selection of organization forms in modern society, and this is especially true of inter-firm organization. *Legitimation* has been indicated as the major additional force shaping the processes of selection, with public support and legislation being a critical factor for network development (Carrol, Delacroix and Goodstein 1988).

Organizational ecology studies of inter-firm networks have been mostly concerned with establishing the survival rates of networked firms with respect to those of isolated firms (Barley, Freeman and Hybels 1991; Lomi and Grandi 1993) and have generally obtained positive evidence that networking, whatever its form, does have an impact on firms' survival chances.

Network Mechanisms

Many studies on inter-firm networks have analyzed a number of specific forms and mechanisms of networking. In the next two sections we are going to offer a systematization of these contributions with two aims in mind: first, to understand the nature and variety of the mechanisms of coordination employed to sustain inter-firm cooperation; second, to understand the specificity of each 'discrete form' of networking in terms of the peculiar mix of coordination mechanisms employed. In this section, we shall address the first task, i.e. to draw, from the various approaches used in the literature on networks, an overview of the full range of organizational coordination mechanisms that are employed in inter-firm relations, in addition to or in substitution for market-like relationships (or no relationship).

Communication, Decision and Negotiation Mechanisms

These are the less costly and more ubiquitous mechanisms on which networks are founded. They are always present, to a greater or lesser intensity, both ex-ante and ex-post in all kinds of network. In order to form alliances, partners have to be searched for, and network forms have to be devised and agreed upon. In order to maintain long-term cooperation, repeated sequential communications, decisions and negotiations must take place. In fact, some inter-firm relationships are sustained solely by this mechanism. Examples are cross-firm inter-personal networks aimed at information exchange and at cultivating potentially useful contacts (Aldrich and Glinov 1990; Granovetter 1985).

Social Coordination and Control

All kinds of stable systems of cooperation, have a 'social side' (Griesinger 1990). This is hardly new. It is worth stressing how the mechanisms of social coordination and control may work in inter-firm relationships, both because they take on some peculiar traits and because sometimes they have been neglected (Granovetter 1985).

We are going to consider here social coordination and control in the sense of deep and stable relationships based on group norms, reputation and peer control (Ouchi 1979, 1980).

Integration and Linking-pin Roles and Units

Horizontal responsibilities and roles are key mechanisms for creating a network organization design (both internal and external to firms). For example, the classical internal integration figure, the Product Manager, can also be employed in inter-firm networks: for example, in the Italian textile-fashion network built by Versace, qualified relationships with a few reliable products have recently taken precedence over the earlier constellation of small-size subcontractors where product managers from the fashion house responsible for the various product lines took care of the producer firms. Inter-firm project management structures are applied in engineering consortia for the realization of complex plants.¹ Finally, a much studied inter-firm coordination mechanism chiefly based on linking-pin roles is that of interlocking directorates (Burt 1979, 1980).

Common Staff

Where the scope of inter-firm cooperation is wide and/or the number of cooperating firms is high, coordination activities become quite significant and dedicated staff may be necessary. In fact, network forms regulating the cooperation between many firms, such as franchising and associations, set up consistent central coordination structures, and a pos-

itive relation has been found between the number of affiliated firms and the size of central staff (Phillips 1960). For example, joint ventures and consortia, that usually regulate joint-action cooperation, or franchising agreements, that usually aim at co-aligning a wide range of firm behaviours, are characterized by the presence of central coordination structures. By contrast, more limited-purpose cooperative relationships, such as bank-insurance commercial agreements for the distribution of complementary products, or the circulation and discussion of ideas and technical developments among engineers in high-tech industries, can be regulated effectively and directly by the parties involved.

Hierarchy and Authority Relations

A long-standing idea of organization science is that a firm can employ coordination mechanisms other than hierarchy among its units: for example, lateral communication and negotiation, group work and decision making, objectives and incentives, matrix structural designs, etc.

As much as firms are complex institutions which make an extensive, but not exclusive, use of hierarchy, networks as complex institutions can make use of hierarchical and authoritarian relations between firms, in addition to other more parity-based coordination mechanisms. A case in point is that of the franchising form. Although a franchised chain is not a firm but a network of firms which cooperate on the basis of a complex contractual arrangement, the coordination mechanisms that make franchising work successful include hierarchical supervision, formal planning and programming systems, information systems, training systems and accounting systems that are quite similar to those we find in firms (Pilotti and Pozzana 1990). Another example is that of the creation of authority relations in a consortia: a cluster of firms with different competencies cooperating for the realization of a large plant, for example, may, and often do, concede to one firm the right to determine the behaviours of the other firms within a given 'zone of acceptance', to coordinate their actions, to speak on everybody's behalf and to exert technical leadership (Bertolini and Grandori 1990); i.e. to use (rational-legal) authority.

Planning and Control Systems

Cooperation brings with it the problem of controlling the delivery of cooperative behaviours. It is known that control systems based on results are more effective than the hierarchical supervision of behaviours in a wide range of circumstances involving unobservability of input behaviours and uncertainty as to the correctness of the various possible behaviours. Various forms of inter-firm networks employ planning and control-by-results systems similar to those found in firms. The franchising form is among those exhibiting the highest planning and control

intensity. Examples can be found in fast-food chains where production timing and sequences are programmed and gap monitored, in hotel chains where personnel are uniformly trained and customer satisfaction is monitored, and at the franchised sales points of textile producers where layout is designed and look is inspected.

Incentive Systems

Objectives realigning mechanisms become a core mode of coordination in informationally complex activity-contexts, in which performance is difficult to measure. Agency contracts often are, for example, a form of obligational contracting, widely used in producer–distributor relations, that are largely based on the use of incentive schemes as a coordination mechanism. Profit-sharing or income-sharing mechanisms found in consortia, franchising and some associational forms are other examples (Daems 1983).

A coordination mechanism which can provide particularly strong incentives to initiate and maintain cooperative relations among firms is that of *property rights*. In fact, whereas the prospected mutually beneficial cooperative endeavour entails joint action with relevant ‘team production’ effects and uncertainty about results, the incentives to act opportunistically may be high and the negative consequences potentially disruptive if important activity areas are involved (such as core productions or R&D). Proprietary commitments and an *a priori* specification of property rights over the results of the collective action can provide a particularly effective mechanism for the ‘fair division’ of benefits, by ‘hostage’ effects and legal safeguards (Williamson 1983, 1985).

Very important forms of inter-firm cooperation make central use of property rights, such as joint ventures and other ‘equity alliances’ as well as all those consoriated-company forms where the joint ownership of assets on the part of two or more partner firms is involved.

Selection Systems

A meaningful distinction that may be drawn among network forms has to do with the ‘specificity of access’ to the network (Grandori 1989). In fact, a powerful means of enhancing the likelihood of achieving a co-ordinated action among firms is the selection of partners on the basis of some good predictors of relevant behaviours for the cooperation. Even on the basis of casual observation of networking behaviour among firms, we can formulate the testable hypothesis that the broader the scope of cooperation, the stricter the rules of access will be. In order to enter a trade association only anagraphical characteristics and general conformity to laws are required, while in order to enter a franchised chain the whole economic, social and organizational characteristics of a candidate affiliate are important. It may be worth noting that a high

specificity of access does not mean highly formal access rules. In fact, specificity of access may be all the more relevant in informal socio-cultural networks that have to rely heavily on socialization as a mechanism for building up operating norms and values (Ouchi 1980).

Information Systems

Information systems have long been considered important vertical integration mechanisms within firms. More recently they have come to be seen as powerful horizontal integrators for managing interdependence both within and between firms (Ciborra 1990; Ebers 1993). Information-technology networks deserve a place among inter-firm coordination mechanisms, firstly because of the spectacular cost reduction in communication they bring about, thereby supporting many forms of wide-spread network otherwise hardly feasible (Child 1987; Malone, Yates and Benjamin 1987) and, secondly, because information-technology networks may be employed as a stand-alone coordination mechanism — based on machines rather than on human or organizational means — in an inter-firm relationship. Examples are inter-firm CAD/CAM systems, computerized order-entry systems or computerized reservation systems (Porter and Millar 1985; Cash and Konsynski 1985).

Public Support and Infrastructure

It is well known that there are cases in which cooperation would be highly beneficial but very difficult to achieve and maintain: these situations have often been stylized and analyzed as 'tragedy of the commons' or 'prisoner's dilemmas' situations (Jarillo 1988). In these cases, some form of direct support by public agencies may be critical. Cooperation with innovative activities is a typical example in all those situations in which the costs of innovation are high and the degree of appropriability of benefits is low (Ouchi and Bolton 1988; Teece 1986). The high degree of involvement of local-government agencies in the creation of infrastructures for fostering scientific 'poles' and 'parks' can be a case in point (Dioguardi 1990).

These ten different coordination mechanisms are used in inter-firm networking in various combinations and degrees. In the next section, the most important *organization forms* that can regulate inter-firm cooperation will be reviewed as particular combinations of these mechanisms. However, a further element should be introduced in order to characterize the forms of inter-firm network. The substance of an inter-firm cooperative agreement, in terms of the mix of coordination mechanisms that the partner firms employ, can vary substantially in its *degree of formalization*. In most Western law systems, contracts are the main means of formalization of inter-firm relationships. Although some scholars have seen inter-firm networks mainly as webs of informal

cooperative relationships (Hakansson and Snehota 1992), and others have concentrated more on formalized alliances as networks (Contractor and Lorange 1988), the whole body of the literature on networks shows that the extent to which inter-firm relationships are formalized, or explicitly regulated and safeguarded by contractual provisions, is an important *dimension* of inter-firm organizing — as it is of any sort of organizing (see also, Aldrich 1979; Reve 1992; Stinchcombe 1985; Imai and Itami 1984).

In the next section, therefore, the main forms of inter-firm networking will be analyzed in terms of the mix of coordination mechanisms employed and the extent to which they are formalized into contractual agreements. The use of associational contracts in addition, or as an alternative, to exchange contracts may be an interesting comparative issue. For example, it can be noted that associational agreements have been studied in connection with problems in regulating cooperation among large numbers of similar firms (Staber 1985, 1987; Staber and Aldrich 1983) while exchange contracts have been seen mainly as mechanisms for regulating transactional interdependence (Williamson 1985).

To conclude this section, we address *the issue of trust*. Trust is one of the most frequently mentioned concepts in connection with inter-firm cooperative relations. We have not included trust among the basic coordination mechanisms, not because we consider trust to be unimportant, but because it is not a mechanism in the sense in which the other mentioned coordination devices are. Agents may be confident that other agents will act in the interest of the system of cooperation to which they belong because they perceive that they have converging interests. Even where there is a conflict of interests, they may trust each other, without control or safeguard, on the basis of some other integrative mechanism, such as social norms and identification in the case of non-calculative trust, or reputation and social control in the case of calculative trust. In any event, trust is more an outcome that needs to be explained; it is a characteristic of the emerging relationship, rather than a mechanism.

Network Forms

Many forms of inter-firm network have been considered in the reviewed literature: joint-ventures, franchising, consortia, commercial agreements, sub-contracting, interlocking directorates, personal networks. What precisely are the differences between these forms? Can we develop a classification of network forms that might be conducive to a comparison among them? Can we bring back these different practical organizational solutions to some common theoretical language? As much as we are used to do with this internal organization, we are interested in distinguishing among forms of external organization in terms

of the distinctive mix of coordination mechanism employed and the degree of centralization and formalization.

Network forms will be distinguished here along the following dimensions: whether they are *formalized* or not (due to the support of exchange or associational formal contracts); whether they are *centralized* (there is a central coordinating firm) or parity-based; their characteristic *mix of coordination mechanisms*.

Social Networks

Firms entertain purely social relations in the sense that these are not coupled with formal agreements of any kind. Such social relationships need not be dedicated just to the exchange of 'social goods' such as prestige and status, friendship and sense of belonging, power and career opportunities. Neither do they need to be based on parity. Social influence can be reciprocal, in the sense that it can include elements of leadership and authority in both inter-firm and interpersonal relations. We shall discuss the distinctive properties of social networks as inter-firm coordination modes, distinguishing between *symmetric* or *parity-based networks*, and *asymmetric* or *centralized networks*.

Among symmetric social networks, *personal networks* linking firms through contacts among their entrepreneurs and managers, are a first form of social networking. As inter-firm links they are often 'exploratory' networks for the exchange of confidential information which has potential but unknown economic value (Schrader 1991) or 'virtual networks' (Easton and Araujo 1993) capable of generating other, more institutionalized forms of inter-firm coordination. In fact, it has been argued that personal networks, in which a firm is involved through its members, are crucial for maintaining a reasonably large and varied pool of trustworthy potential partners among which to search for acceptable partners for more tightly-coupled action-oriented networks (Granovetter 1985; Aldrich and Glinov 1990).

Social studies of inter-firm networks have thrown light on the importance of inter-firm personal networks where there are problems of occupational mobility (Breiger 1981; Burt 1980), resource mobilization (Galaskiewicz 1989; D'Aveni 1978), the reproduction of skills (Grieco and Hosking 1987) and communication effectiveness (Bonacich 1990).

In addition, to employ communication and joint decision-making mechanisms, some interpersonal inter-firm networks are also characterized by the emergence of group norms and social control mechanisms. Social control among firms may be able to regulate exchanges in which the contribution and performance of each partner — and even that of the whole network — is very ambiguous and difficult to measure so that both contractual and bureaucratic mechanisms are likely to fail, as in research or professional activities (Ouchi and Bolton 1988; Karpik 1989). Personal and confidential contacts may also be the sole viable

coordination mechanism — if not unlawful — in highly delicate, failure-prone and volatile agreements such as those among colluding oligopolists (Pfeffer and Salancik 1978).

Interlocking directorates represent a more institutionalized form of social networking, based not only on communication but also on joint decision making, formalized linking-pin roles and social control (Burt 1979; Mizruchi, Brewster and Stearns 1988; Mizruchi and Bunting 1981). It has been maintained that they are effective in regulating uncertain relations with important resource sources that cannot be integrated or contractually bounded (Pfeffer and Salancik 1978; Dooley 1969).

Some forms of *industrial district* are also salient versions of social networking. The traditional 'Marshallian' district, based on horizontal clones and imitation among small firms, sustained by personnel mobility and geographical and cultural proximity, is a case in point (Bellandi 1986; Brusco 1982). Besides industrial districts in the traditional sense, high-tech firm districts (Dalum 1993) and R&D 'poles' (Kreiner and Schultz 1993; Saxenian 1990) have been shown to be effectively manageable through informal social networks, at least for purposes of information and know-how barter.

The forms of social network mentioned thus far are, fundamentally, *symmetric* or *parity-based*. Another class of social networks, characterized by the presence of a central agent, is *asymmetric* or *centralized*. Most often, these are networks coordinate vertical or transactional interdependencies between firms, whereas the former horizontal versions of social networking are often connected with horizontal interdependencies. Given that transactions are in order, firms will often be linked by contracts, but these contracts — if any — only specify the terms of goods and service exchange and not the organization of the relationship between the firms. Therefore the *network itself*, as a *mode of coordination*, is not formalized into a contract.

Putting-out is an old, now re-emerging form of inter-firm network (Kieser 1993). This system includes the outplacement of materials over which a focal firm maintains property rights to other firms that transform them into more final outputs. This arrangement typically gives rise to star-like, centralized, inter-firm networks as in the textile-clothing industry (Mariotti and Cainarca 1986) in which reciprocal social coordination and control among firms is usually accompanied by relations of authority (Whitley 1990).

A similar form is that of *constellation* in which a vertical *filière* of firms is informally coordinated, usually by a firm controlling the critical competencies and uncertainties (Lorenzoni and Ornati 1988), e.g. silk-districts coordinated by the firm controlling the final commercial stage.

Sub-contracting is a third important form in this class. Here, by definition, there is a central firm, the main contractor, who negotiates the entire job with a client (e.g. a construction, a plant) and assigns parts

of the job to specialized sub-contractors. This arrangement is very common in the construction industry (Eccles 1981; Dioguardi 1987), as well as in other mature industries such as the automobile industry (Sabel et al. 1987; Cainarca and Colombo 1990). Actually, some forms of sub-contracting should be attributed more to social networks and others to bureaucratic networking. In fact, in some cases, sub-contracting is governed by a social and cultural network (Barney and Ouchi 1984; Dioguardi 1990). In other cases, the 'contract' formalizes not only the selection procedures of sub-contractors, but also the control systems on their performance and the incentive schemes (Albino, Costantino and Sivo 1989).

Bureaucratic Networks

Bureaucratic forms of network are those inter-firm coordination modes that are *formalized in exchange or associational contractual agreements*. The formal agreement specifies the organizational relationships between allied parties, and not only — if any — goods and services exchange terms. The degree of formalization — as it occurs for any sort of organization — can vary and is never complete, i.e. the complex organizational contracts constituting bureaucratic networks are never complete and assist, but never substitute for, the presence of a social network. The source of enforceability of inter-firm formal organization is by and large the legal system, protecting the parties' reciprocal rights to compliant behaviour. The most important forms of bureaucratic network can be grouped into two sub-classes, as in the case of social networks: *the classes of symmetric and asymmetric coordination structures*.

Among *symmetric* forms, inter-firm *associations* are a particularly important and studied type of network. *Trade associations* have been traditionally employed to provide common services to coordinate behaviours among large numbers of similar firms (Staber and Aldrich 1983; Staber 1987; Phillips 1960) where inter-firm interdependency matters are not highly specific and complex. For the same reason, *cartels* could be assimilated to an horizontal association, when lawful and explicit (Bower and Rhenman 1985; Pfeffer and Salancik 1978), as well as *federations* (Provan 1983; Daems 1983).

The domain of effectiveness of the association form need not be that of coordinating all the firms belonging to an industry or category, without any further selection system. For example, the Best Western Hotel chain is an association of entrepreneurs and not a franchising contract, but the coordination mechanisms employed range from quality-based selection of affiliates, internal information system, to reporting and control systems (Grandori 1987a).

A more complex form of symmetric bureaucratic network is the *consortium* (Evan and Olk 1990; Aldrich and Sasaki, forthcoming; Losano 1989). Consortia differ in their degree of formalization. The characteriz-

ing coordination mechanisms of production consortia are planning and programming systems defining the internal division of labour between firms (e.g. what parts of a complex industrial project will be realized by what firm), control systems for monitoring performances, incentive systems based on an *a priori* division of the quotas of income pertaining to each firm, to penalty systems, and to some central staff (Bertolini and Grandori 1990). This is a particularly bureaucratic set of coordination mechanisms, usually formalized by means of both an associational agreement and a set of exchange contracts. On the other hand, in addition, these consortia are usually assisted by and blended with intense social coordination.

R&D and technological cooperation consortia seem to be characterized by a somewhat lower bureaucratic intensity (Aldrich and Sasaki, forthcoming; Evan and Oik 1990; Ouchi and Bolton 1988), in line with usual organization theory expectations. Still, they are characterized by some formal agreements, are endowed with some central staff, and hold some specified right over the result of cooperation. Given the difficulties in starting and sustaining cooperation in innovative activities for appropriability problems (Teece 1986; Ouchi and Bolton 1988), public support is often an essential mechanism in these networks. In addition, public support and external legitimation may be critical for symmetric bureaucratic inter-firm networks, to the extent that they regulate cooperative interdependence among otherwise competing firms, thereby altering the regime of competition.

Among *asymmetric forms, agency networks, licensing and franchising* are probably the most important ones. The agency network, intended here as a form of external organization, is notoriously widely used in the distribution of semi-standardized products and services of intermediate complexity, e.g. insurance policies. Contracts specifying this relationship have a high organizational intensity, including exclusivity clauses, inspection and control rights, modes of know-how transfer and participative incentive schemes that can re-align the objectives of agents with those of the principal firm.

Licensing is a relatively 'old' and well-known form of inter-firm coordination. It used to be considered a form of market contract, but there is evidence that licensing contracts include more and more organizational clauses and are accompanied by extra-contractual organizational relations (Soda 1992), such as in the cases of pharmaceutical production or of authorized car sale and assistance points.

The inadequateness of considering a franchising agreement simply as a commercial contract regulating the transfer of a right to use a brand against royalties is all the more evident. In fact, an effective franchising agreement is supposed to be able to guarantee a high and standard quality and visibility of services and goods that may otherwise be costly to search for and evaluate by customers. These advantages will apply, for example, where services are moderately complex. The reason is that it is difficult to monitor the quality of services *ex-ante*. The franchising

allows for control over services which are of moderate complexity, where quality matters and is brand specific, but which are not of such high complexity that quality criteria cannot be standardized.

In order to perform these functions, the franchising contract should contemplate a variety of operating mechanisms which allow the standardization and transfer of managerial and technical know-how and the control of performance from the franchisor to the franchisees and among the franchisees. For these reasons, franchising is quite a 'bureaucratic' form of network: it requires the standardization of outputs, formalized procedures, uniform accounting systems, central personnel training and standard contracts; it can take advantage of highly integrated information-technology networks and common central marketing, purchasing and financing activities; it needs a good degree of hierarchical supervision due to the high free-riding potential in this kind of cooperation and it is characterized by incentive systems involving gain sharing (Rubin 1978; Brickley and Dark 1987; Daems 1983; Pilotti and Pozzana 1990).

Proprietary Networks

Inter-firm cross-holding of equities and property rights is not a mechanism of organizational coordination *per se*. These operations may have exclusively financial purposes. Property rights over economic activities are of relevance here as incentive systems for sustaining some form of cooperation. Organizational economics has maintained that property-based incentives are necessary where uncertainty and opportunism are particularly prevalent.

Property rights on economic assets are usually formalized. Therefore, property networks are conceived here as a bureaucratic form of formalized networks that, *in addition*, are founded on some proprietary commitment.

Let us briefly review here two important forms of inter-firm coordination based on property rights: *joint ventures* and *capital ventures*.

The joint venture is probably the most researched form of inter-firm network in the economic and managerial literature (e.g. Harrigan 1985; Balcer 1990; Beamish 1988; Contractor and Lorange 1988; Killing 1983). In the field of industrial economics, the joint venture has been studied as a form of governing innovation, focusing on technical complementarities. This view has been integrated in organizational economics by highlighting the 'hostage exchange' function effectively played by the proprietary commitments implied by joint ventures under conditions of weak appropriability of the results of collaboration, low measurability of partners' performances, and highly specific transactions (Hennart 1988; Williamson 1983). In fact, joint ventures have been shown to be effective for regulating R&D and innovative activities (Ouchi and Bolton 1989; Teece 1986), production in high-technology

industries or highly automatized production (Mariotti and Migliarese 1944), and informationally complex and firm-specific activities in general (Killing 1988; Turati 1990).

Once it is acknowledged that a specific alliance between two or more partners generates enough surplus to cover the cost of a joint-venture governance structure, the issues over which the division of this surplus takes place (shares, patent regimes, mark-ups, managerial positions, commercial agreements, joint-venture location) can be specified by negotiation analysis and some generalizable bargaining solutions can be offered (Contractor 1984, 1985; Grandori 1991).

There has been a wide discussion in the managerial literature about joint ventures. The main interest has focused on understanding the causes behind the high failure rate among joint ventures, such as poor partner analysis, 'psychological distance' between partners, difficult career and incentive system design (Lyles 1987; Gomes-Casseres 1987). A rich prescriptive literature is also available on the general conditions for joint-venture success (Lorange and Probst 1987; Harrigan 1985) and on specific operating systems in the areas of human-resource management (Lorange 1986), performance control (Anderson 1990), and information systems (De Michelis 1989).

Although they are often qualified as 'equity networks', joint ventures are much more than that, and, where they are effective, they employ *all* the coordinating mechanisms described above (Turati 1990). In fact, in the definition of a joint venture, it is usually assumed that two or more mother firms, in order to conduct joint activities, jointly create, own and manage a third enterprise, thereby needing to use the full range of coordinating mechanisms from effective communication, joint decision-making and negotiation processes to well balanced capital commitments.

Although the ownership structure of a joint venture need not be symmetrical in the strict sense of a 50-50 equity holding, it is fundamentally a *symmetric* type of alliance, in our sense. In spite of the fact that the different firms may confer assets of different value (that give rise to 'asymmetric' equity distributions) there is no central coordinating firm and the coalition power of the partners needs to be balanced.

By contrast, an example of an often *asymmetric* proprietary inter-firm network is the *capital venture* (Roure, Keeley and Van der Heyden 1990). Capital ventures cannot be explained as a mere form of financing, but should involve an organizational relationship between the investor and the partner firm, i.e. some form of networking. In fact, if it were a matter of just financing well-established economic activities, stock exchanges and financial institutions should work well, in principle. The problem is how to provide capital to relatively risky and innovative undertakings, which have difficulty in getting credit by traditional means. This should make new firms, especially in high-tech or 'advanced' sectors, the typical target for capital-venture firms (Robert 1991). In-depth information about the partner, significant property

rights held by the venture capitalist, the setting up of channels for joint decision making and the transfer of managerial know-how are likely to be required. The frequent plea in managerial literature for the managers of the capital-venture firm to become more involved, as a condition of success, in the financed firm supports this contention.

Summary and Conclusions

The literature on inter-firm networks reviewed in this paper has led to the identification of some of the basic elements necessary for conducting future systematic comparative research on inter-firm organization structures and processes. More specifically, three classes of elements have been reconstructed. First, by reviewing a number of approaches to network study across the social sciences, the most relevant antecedents of network formation and form have been identified. For this purpose, each perspective on inter-firm networks has been analyzed with the aim of identifying its differential contribution to the study of inter-firm organizational coordination, in contrast to any other approach. A second class of elements reconstructed on the basis of our review is that of the organizational coordination mechanisms sustaining and regulating inter-firm cooperation. Ten basic coordination mechanisms are identified. Third, a variety of important discrete network forms have been reconstructed and analyzed in terms of the distinctive mix of coordination mechanisms employed.

The framework developed in this paper, therefore, can be used as a basis for developing testable comparative models of inter-firm organizational coordination, an area of study that is underdeveloped, at present. In fact, all that are usually available are overall comparisons between the network mode of coordination and the alternative modes of markets and integrated firms (Williamson 1991), or comparisons between two or three particular forms (Lei and Slocum 1990; Osborn and Baughn 1990). Finally, because this paper is based on a review of the literature, it can be used to gain an insight into the state-of-the-art in this research field.

Notes

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1. Personally conducted interviews with managers of the Italian fashion house Versace and with managers of the international engineering firm Techint.

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