Heterogeneity of Actors and Processes in Business Networks

Dr. Emanuela Todeva

ABSTRACT

This paper examines networks as structures of relationships between heterogeneous actors. The heterogeneity of actors refers to business organisations, individuals within them, institutions, technologies and other artefacts that participate in the development of business projects, or in supplier networks. A business project is considered to be any business activity related to production, distribution, or accumulation of resources, including tangible and intangible assets, knowledge, shared meaning and values.

The paper attempts to conceptualise also the heterogeneity of processes in business networks, such as: enrolment and network construction, ‘translation’ and the normative activities within networks, competition, co-operation, selection and ‘displacement’ of other members, as well as repositioning through strategic behaviour. This intra-organisational dynamics is analysed in the context of structural characteristics of the network, such as: configuration, size, density, cohesion, connectedness, range, multiplexity, and heterogeneity, structural autonomy, structural equivalence, and the division of labour within business networks.

The intra-organisational dynamics in our analysis emerges as a result of all co-operative and competitive efforts of the network members in fulfilling their contracts and pursuing their interests. The relational dynamics within networks is determined therefore by the position of the actors, by the contracts between them, by their individual interests and preferences, and their knowledge of the preferences of the others.

The endogenous structural characteristics of the network not only determine the network dynamics, but lead to self-regulation and self-coordination activities, that increase further the division of labour within a business network.

INTRODUCTION

The explanatory power of heterogeneous systems is in their capacity to represent complex and asymmetric processes between inter-linked elements. We have to stress from the beginning, that the conceptualisation of systems, or networks is by definition a reduction of the reality of interconnectedness and multi-directional influences between actors and entities that constitute a network. Any conceptualisation of a network is a reduction of reality, and it is a subjective interpretation, an outcome of the interpretative activity of human agents. The purpose of our theoretical analysis is to discuss the nature and the sources of heterogeneity in network systems in the context of both the interpretative and the structuralist paradigm in social sciences, and

particularly the work by Burt and Callon. We will look at the nature of heterogeneous actors and heterogeneous processes in networks, the strategic behaviour of different actors, and its effect on the network configuration and on the dynamic process of structuration of relationships.

One of the fundamental barriers to network analysis is the duality of the nature of networks - being simultaneously socio-economic structures as well as dynamic processes of exchanges and transactions between partners. The structuralist paradigm attempts to define basic assumptions that explain how network members are linked together and how these ties facilitate exchange of resources of any kind. However, this analysis is of limited value to practising managers who need not only to construct relations in the real business world, but also to fill these relationships with content, to make decisions regarding value, payments, and benefits from transactions.

The analysis of the content of network relations requires much more holistic approach - as applied in social anthropology (Buckley and Chapman, 1996). According to the interpretative paradigm, the content of a relation is determined by the two partners involved in it, their attributes and their interests, and the way they perceive each other, reflect upon the situation, and frame the transaction by selections and choices. Both actors usually define their individual interests, strategies, and exchange information about their intentions. The contract between two actors evolves as a negotiated strategy for mutual co-operation, supported by framed expectations and formal agreements. The content of the relationship therefore includes: a) the individual intentions of each partner, b) the negotiated strategy between them, and c) the exchange or the transaction itself. This complexity requires a more in-depth analysis of the set of relations for each actor, rather than merely mapping existing structural links. We see therefore, the relational approach to network analysis as complementary to the well established structural approach. This paper aims to build upon both structural and relational paradigms, and to throw some light on the underlying processes within two types of business networks – supplier networks, and project networks. They are described in the following part as examples of business network structures.

The existing research on networks puts emphasis on three aspects - the '*nodes*' (identified as the actors), the *ties* and *relations* (measured mainly through reciprocity, directionality, content and multiplexity), and the overall network *configuration*. Further in our paper we discuss in more details the concepts, categories and indicators used for theoretical reflexions and empirical investigation of business networks, and we look at the heterogeneous nature of the actors and their relationships.

THE CONCEPT OF NETWORK AND NETWORK CHARACTERISTICS

The use of the word 'network' spreads over a range of phenomena. The main examples are: a) a *communication net* (as in telecommunications); b) *interconnected desktops*, or technical operational devices for information processing (as in computer network); c) a *social structure of ties*, facilitating relations and exchanges between individual actors (as in a social network); d) *interrelated economic agents involved in a repetitive exchange* of products, services, market information, and economic benefits and payments (as in business network). What is in common between these four distinctive conceptualisations of the term 'network' is that they all refer to a

formation which facilitates exchanges of information, goods, resources, individual affection, emotions values, meaning and commitment between its members.

Each discipline dealing with these phenomena has made its own attempt to define the term. However, the concept remains a nebulous linguistic structure, inclusive of almost any intended meaning, and used in a metaphorical way. Thompson (1991, p. 173) introduces the idea of networks as '*means of co-ordination*' of social life, without specifying how this co-ordination is conducted, or by whom. If self-co-ordination is assumed, then it is not clear how a network structure facilitates this, or how network members participate in it.

Reference is made to a definition by Mitchell (1969) viewing 'network' as a *specific type of relation*, linking a defined set of persons, objects or events (in: Knoke and Kuklinski, 1982). From this definition it is not very clear what is the reason (or the purpose) of this linking, and how the links between these persons, objects and events differ from a set of relationships established in a formal organisational structure. This definition also, does not specify how network boundaries are treated. Research on social networks, for example, emphasises that one of the features that distinguish *networks* from *organisations* is that the boundaries of the former are flexible and dynamic. Another difference between the two concepts of organisations and networks derives from the purpose of their establishment. The former is conceived with a clear purpose, while the latter appears to serve multi-directional and, in many cases, contradictory aims.

Each network maintains *limited resources*, and different members have different access to these resources. It seems evident, that the unique feature of networks is that they accommodate *inequality* within their boundaries, which fuels specific network dynamics.

In review of these critical comments, our definition for networks is the following:

Networks are sets of transactions based on structural formations with dynamic boundaries that comprise of interconnected elements/members; Networks accommodate the contradictory aims pursued by each member, and facilitate repetitive exchanges that have specific directionality and flow of information, goods, heterogeneous resources, individual affection, commitment and trust between the network members.

The characteristics of a network could be grouped in three main categories - *characteristics of the nodes/ members*, *characteristics of the relationships* between members, and *characteristics of the overall network structure* (Nohria and Eccles, 1992, Knoke and Guilarte, 1994). Our map of the concepts that are used in the literature to define a business network is presented in Fig. 1.

- ***Characteristics of the 'nodes'***

This category includes all measurements and characteristics that describe: the *actors* (agents, or member) of a network; the *direct vs. indirect contacts* between them (in terms of type of exchange); and the *centrality of one or more of the actors* (in terms of their capacity to receive or send a disproportionate amount of relations with others; their capacity to connect all others and therefore making them dependent, or their capacity to determine the minimal number of steps

needed for one to connect to all other network members). In addition to these structural properties of the actors, there are a number of individual properties that affect their behaviour, and how they engage in network relationships and transactions. Examples of individual properties (or characteristics and attributes) of the actors are: *size* and *history* of the firm, *ownership* and *corporate governance* structure, *assets* and *accumulated resources* (including knowledge, capital and market access), *interests*, *values*, and *expectations*. The heterogeneity of the actors stems mainly from their individual characteristics, as well as from previously established relations and presence in various organisational configurations.

Fig. 1. Network Characteristics

- **Characteristics of the relations between network members**

This group of characteristics includes the following categories introduced by network analysts: *content*, *multiplexity*, *directionality*, *transitivity* and *intensity* of the links between network members; *reciprocity*, or relational *symmetry* experienced by individual members; *incoming vs. outgoing relations* in terms of the pattern of activity - sending or receiving links; *relations and exchanges with the environment*, particularly important for channelled and repetitive exchanges like inputs, or realisation of outputs; and the *competition* between network members for the resources available in a specific network configuration. Most of these characteristics are operationalised as measurements, particularly used in social network analysis. The operationalisation of business relationships in this context has not benefited much from this research experience. While contract relationships are not difficult to analyse, there are insufficient attempts to classify business relationships for the purpose of network analysis.

- **Characteristics of the entire network structure**

A number of characteristics are included in this analytical perspective of social network analysis: the spatial configuration of individual *positions*; *structure*; *connectedness*; *hierarchy* and

efficiency (Krackhard, 1994); the formation of *cliques*; *social circles*; *power*; and *control centres*; the overall *size* of the network (measured in terms of the number of participants in it); network *density* (measured by the proximity in roles and positions of different members); *structural equivalence between positions* (in terms of responsibilities and influence); and the *social cohesion* between the actors (in terms of shared beliefs, values and understanding). These characteristics are enlisted outside of the main circle, which resembles the boundaries of our hypothetical network model.

In our theoretical discussion further we will use examples of 2 types of business networks: a) a supplier network; and b) a project network. If we look at a supplier chain of a firm as a business network, while all partners are interested in completing the exchange (a common aim), all of them negotiate individual outcomes and try to maximise the benefits that this exchange brings to them (contradictory aims). Trust in fulfilling the obligations, repetitiveness of the transactions, and mutual adaptations between interlinked firms and agents is what constitutes the set of network relations. Re-negotiation of benefits in a supplier network occasionally takes place. Usually transactions are supported by contracts, or mutual agreements based on expected and known outcomes. Project networks on the contrary are constructed on the basis of investments with unknown outcomes. Participants in project networks are selected as contributors and investors with designated roles in order to produce target outputs.

The example of a business project is taken from the detailed analysis by Callon (1986) of the construction of an electric vehicle for public service in France (VEL). Such a project requires employment of heterogeneous actors and entities. However, we have to be careful how we describe these different types of actors. The project itself is an institution that has specific aims and limited resources (including knowledge), and utilises a variety of economic, social and scientific agents such as firms, consumer associations, laboratories, government bodies, technologies, physical artefacts and documentation. These agents are either institutions that represent different interests, or non-human elements that are employed for a particular utility function. A firm, such as Renault in Callon's example, is a specific institution that represents the business interests of its owners, employees, shareholders, and the wider range of stakeholders. The particular institutional form, and the specific bundle of interests of all stakeholders makes Renault different from EDF (Electricite de France), which is a government body, empowered to launch the project for the construction of an electric vehicle for public service in France.

EDF as a public institution is one of the key agents that drives the selection of the other network members, and the construction and development of the heterogeneous network of economic and scientific actors. In our analysis further both the supplier network and the EDF project will be used to illustrate the processes that take place within heterogeneous business networks.

At a micro level the project includes technical and managerial staff, pieces of knowledge and technology (such as electrons, fuel cells, accumulator, electrodes, catalysts) and other material objects and non-human agents that represent embodiments of human knowledge, human decisions, human selections and choices, human subjectification of material objects, and human interests.

The advancement of network analysis has taken place mainly under the structuralist paradigm with empirical studies of social and communication networks. Leading in the field is the work by Knoke and Kuklinski (1982) on network analysis; Wellman & Berkowitz (1988) on social structures; Monge and Eisenberg (1987) on the traditions in communication networks; Nohria and Eccles (1992) on structure, form, and action within networks; Krackhardt, 1992 on the strength of strong ties; Wasserman and Faust (1994) on social network analysis. Within the structural paradigm three closely linked traditions evolved – the positional tradition, extended by Burt's structural hole theory; the relational tradition, developed particularly with the research at UPSALA on supplier networks; and the cultural tradition, represented by the work of Latour (1987) and Callon (1986, 1991).

One of the advancements made by the structural analysis theory is to recognise the embeddedness of market transactions in the structure of social relations. However, the practical consequences of that fact remain hidden in implicit assumptions about network ties, positions, and relations of the actors in hierarchical and network structures. In addition some managerial theories have focused on issues of actor's choices and strategies. Mintzberg's work (1983) on intra- and inter-organisational power relations, and Porter's theory of competitive advantage built by organisations through extending their control over the value chain and the value system (Porter, 1991) are some of the leading conceptual frameworks that can explain relations of power and dominance between interlinked agents.

In a recent work on choices and selection Paolo Ramazzotti and Marco Rangone (2000) conclude that the behaviour of the actors (purposive or not) affects the selection mechanism via learning and knowledge creation. Therefore, the interaction of actors in a network modifies the very framework for interpretation of market information in a network. They also confirm that key market players affect customer preferences and decisions which undermines the very principle of autonomous selection, and is another example of embeddedness of business transactions.

HETEROGENEITY OF ACTORS

The literature on business networks usually refers to companies as the main agents and members of a network configuration. While there is no doubt that behind each firm stands a management team, composed by professionals in their own field, the literature is still dominated by the neo-classical assumptions of the firm as the main actor, as well as the homogeneity of actors in a market place.

In a supplier network the difference between the firm which supplies with components and services, and the firm which procures them is not merely a distinction between a buyer and a seller. The dyadic relationship is usually mediated by contracts and conventions, and by a set of intermediaries, offering legal, financial, or other business services. These intermediaries are not considered as crucial actors in a traditional analysis of economic transactions. They are, however, not merely elements of the external business environment, but intrinsic components constituting the relationships in a network. We argue that the heterogeneity of actors in a supplier network stem from the nature of different agents, their individual properties, the roles they play

in the network. This heterogeneity is increasingly in a correspondence with the complexity of contemporary market transactions.

Regarding project networks, or what Callon calls actor-networks (1986), in addition to the variety of institutional actors and firms, there are fundamental differences between the original actors that invent new technologies, instruments and other non-human components, and the new actors that employ them for a new purpose. These are different types of actors, with different interests, objectives, intentions, and strategies. These leading human actors are involved in the process of selection and enrolment of all other institutions, human and non-human actors.

The heterogeneity of human actors derives from the specific institutional form, which they take, from their properties, and from their different position in the enrolment process. This means that different human actors perform different roles in the process of decision making, resource allocation, and ‘translation’ of the properties of other potential actors (technologies, technical artefacts, human beings, skills, money, texts, and other resources) (Callon 1992).

In Callon’s example, the Ministry – Electricite de France (EDF) - is a type of institution that represents the interests of different stakeholders. It is empowered by a Government decision to select and enrol other elements into the project (VEL). The EDF’s knowledge that the car maker Renault has the capabilities to perform the required task is crucial in driving their decision to ascribe to the firm a specific role in the project. The decision to enrol Renault as an actor is made on behalf of the institution and the institution stands behind the decision. However, institutions, or organisations in general have no decision-making capabilities. They are only intermediaries that facilitate the decision-making and the resource allocation process. The actual decision-makers within EDF are individuals, or groups that can be named, and who represent particular interests.

Callon in his initial definition of ‘actor-world’ states that actor-world is “the world of entities generated by an actor-network” (Callon 1986b, p. xvi). The actor-world is composed of all elements and their contexts that they bring to the network. Institutions as actors in an actor-network are themselves heterogeneous networks / systems of human elements (agents), rules, procedures, and accumulated resources. Important distinction here is the fact that human decisions, made by individuals or groups, are announced (and therefore encrypted) as institutional. For an experienced observer, it should be clear that institutions only represent human interests. However, it is the human beings that attribute value to objects, and therefore associate interests with these selected objects (such as the development of electric vehicle).

The two actors already described – EDF and Renault – are different in type. They differ in their access to resources, in their position in the decision-making process, concerning the ultimate purpose for the project-network – the construction of the electric vehicle (VEL), in their responsibilities, interests, and commitment to this project. This is what makes the project-network heterogeneous.

In our analysis further in this paper, we will interpret heterogeneity only in terms of variation between actors, and more precisely qualitative differences regarding their institutional form, their

access to resources, their interests, their position in the network configuration, and their effect on the decision-making process.

Most of the research in network analysis has assumed equal properties of the actors. This is a fundamental barrier to understanding the behaviour in a network beyond connectedness between actors. Two actors act in a dyadic relationship driven by their individual properties, by the properties of the link, and by the overall network properties, including the level of cohesion, connectedness and structural equivalence between positions.

The properties of the actors derive from their own constitution, from the relationships they are engaged in, and from the attributed characteristics and ascribed roles to them by their relational partners. Following this logic we can distinguish not only between buyers and sellers, but also between different types of buyers and sellers. We can differentiate between a number of other economic actors such as regulatory bodies, national and international institutions and other constituting bodies, technical and managerial staff, technologies, documents and instructions, as well as accumulated resources, particularly in the form of capital and knowledge.

Non-human actors

Strategic action could be only attributed to human and institutional entities in the actor-network. Only human elements could act strategically beyond their individual attributes. All non-human elements ‘act’ only by their presence (as being ‘enrolled’ in the network), and according to their attributes (as employed by the human actors). While Callon suggests that technologies and industrial standards may determine strategies of business actors as far as they are accepted, selected by these same actors because of their properties. Once enrolled, technologies and their documentation do play a significant role, shaping the development of the project. The non-human elements could also be used by the human actors in a specific way which may look as having a prescribed role. However, they don’t ‘perform’ this role, because they don’t ‘act’ purposefully. They are merely employed in the process, or used as a point of reference by the human actors to acquire more resources, or to achieve other objectives.

The Power of Contracts

From this analysis, it should be clear that the electric vehicle project (VEL) is constructed from a range of heterogeneous actors, and a range of enrolled heterogeneous elements only according to the knowledge and the capabilities of the human beings working on behalf of EDF. While EDF appears as a leading actor in the VEL project, the leadership belongs to EDF employees responsible for the interpretation and translation of the interests and the properties of all other actors and elements.

EDF is therefore the contracting agent, but the clauses of the contract, which are used in the enrolment process, are textual constructions of the employees, and therefore they are the employees’ inscriptions of the roles, and responsibilities of each other actor and element in the network. The employees’ inscriptions represent the way EDF employees interpret and translate the EDF function. The power of these inscriptions derives from the incentives build in the

contract with each other actor in the network such as Renault. Therefore, it is the EDF employees that allocate resources for future performance of all other human and institutional actors.

Other non-human actors, such as electrons and pieces of technology, could be referred to in the contract, but are not recipients of contracts themselves. The human (individual or institutional) actors, through an elaborate process of translation and enrolment directly or indirectly employ the non-human actors. The translation in this case means selection among alternatives, or association with other human and non-human entities for a specific purpose.

The association of technology and other non-human or human entities in an actor-network is not a spontaneous process. It is directed, controlled, and co-ordinated by the **key human actors** that set up the aims of the network. These leading actors can do this on their own behalf, or on behalf of the institutions they represent. They design the contracts with all other players, encrypt incentives for performance, allocate resources, actively enrol, translate and associate other elements, already accessible to their knowledge. Therefore, of primary interest to network analysis is to identify the key actors in a network, and to deconstruct their strategies and their interests, encrypt in their properties, in their institutional form, in their position in the network (in terms of responsibilities, authority, and access to resources), in the contracts they are engaged in, and in their current and past decisions.

Structural Autonomy and Individual Attributes

Structural autonomy, according to Burt, is the ability of actors to pursue and realise their interests and to circumvent market constraints (Burt, 1982:265). Structural autonomy derives not so much from the position of actors, but from their power and ability to control information and resource flow within the network. This power and control may derive both from the status/role-set of the actors, and from their attributes.

For Burt, structural autonomy is highly correlated with a specific relational pattern (common for all occupants of this status), and involves low competition with one-another and high competition with non-occupant actors, or actors occupying other positions in the network (Burt, 1982:15). It remains unclear how individual actors make choice to compete vs. to co-operate with other status groups.

Burt also assumes that occupants of a status have equal control of resources. There are no empirical evidence that this assumption is true. Control of resources depends both on the position of the actors, and on their individual attributes. Occupants of the same status may have different capabilities to utilise their position.

A contradiction in Burt's theory is also the statement that occupants of a status have common interests (to the extent they control equally resources (Burt, 1982:266), and at the same time they are expected to compete for these resources. Competing for the same pool of resources makes them substitutable, and make the relationships with structurally equivalent actors redundant. The competition between structurally equivalent actors for control over the same pool of resources would exclude by definition any commonality in their behaviour and strategic

intentions beyond their efforts to overcome their adversaries, and their mimicry to copy each other.

If we translate this to the case of supplier networks, competition takes place in specific product markets or resource markets, and under the conditions of limited resources, or limited buyers. Competition therefore derives from the limited opportunities for realisation of actors' interests, rather than directly from the network properties, such as structural autonomy.

Network Position and Structural Equivalence

For Burt actors jointly occupying a position pursue similar structural interest and do not compete with one-another, while simultaneously competing with non-occupants. This certainly is not the case in the context of input-output relations, where all suppliers occupy similar positions, pursue similar interests, but engage in direct competition for contracts with buyers. Suppliers therefore compete with those occupying similar positions (i.e. other similar suppliers), and co-operate with non-occupants (i.e. buyers). The structural equivalence, therefore, in a supplier network will be a measure of competition. Larger number of structurally equivalent actors will characterise higher level of competition in a supplier network. In a project network with designated roles and responsibilities actors with structurally equivalent positions may be both co-operation and competing for the same pool of resources and more influence over the decision making process.

Burt acknowledges that “a position only constitutes a status when its constituent relations define rights and duties uniquely significant within a system” (Burt, 1982: 41). This means simply that the status/role-set depends on the rules within the network. The logical expectation is that in a network, there are rules that associate rights and duties to individual actors according to their attributes and the position they occupy within the geodesics of relations. The whole question of competition vs. co-operation and strategic behaviour of the actors then becomes dependent on the question of network rules and ways of allocation of rights and duties.

Burt makes it clear that one of the assumptions of his model is that “interests pursued by occupants of different statuses are not complementary” (Burt, 1982:286). This fundamentally contradicts with the notion of division of labour, which assumes complementarity between actors that specialise in different points of the input-output chain. If the suppliers have no complementary interests with the buyers, no transaction could ever take place. Equally important is the complementarity between heterogeneous actors in a project network aiming jointly at the completion of the project.

The Source of Status-Norms in a Network

Even though as a sociologist Burt stands closer to the side of the *normative perspective* in network analysis, he does not openly reject the *atomistic perspective*. His attempt to seek complementarity between alternative scientific paradigms is one of the most admirable features of his argument. However, the acceptance of the utility factor as the driving motive for each actor is a retreat to the atomistic perspective. Burt admits, that an actor evaluates the utility of an action both in regard to his/her personal conditions and the conditions of the others (Burt, 1982). However, it remains an individual evaluation of the structural constraints, experienced by each

actor in a network. Network rules induce norms of behaviour and prescribe both transactions and allocation of resources beyond the utility function. Individual choices, therefore, are affected both by normative prescriptions and utility incentives.

Actor's autonomy is also defined through constraints. For Burt the autonomy of the actors as occupants of a status is determined by the extent to which they are capable to realise interests without, or despite the constraints from others. However, the constraints from others derive from the relationships with them. Burt is not interested how individual actors are capable of affecting the content of their relationships with others in order to diminish the constraints. For the author, constraints are fixed by the status/role-set, and the structural equivalence position of each actor.

This static view of actor's autonomy does not tell much about the individual strategies that actors employ in their attempts to reposition themselves in a network, to gain more access to resources, or to overcome constraints, and to realise their interests. The status of an actor in a network is a result of both the individual strategies employed by this actor, and the effect of all strategies employed by the network members.

Not only the individual strategies disappear from Burt's structural theory of action, but also the normative aspects of actors' behaviour. There is almost no discussion of where norms in a network derive from. The notion of a norm is reduced to the concept of 'status norm', and makes no reference to the institutional aspects of conventions, internalised as norms of behaviour. Burt acknowledges that there is an inherited contradiction between his prediction for occupants of a status to share a status norm (merely by their equal structural equivalence position) even if they are not connected, and the traditional normative argument, that social norms are a result of strong socialising relations between people who share the norm (Burt, 1982:14).

THE NETWORK AS A STRUCTURE OF RELATIONSHIPS

Business relationships in a network are expressed in forms of transactions between firms, exchanges of resources, information and payments between interlinked heterogeneous actors, and unilateral strategic and responsive behaviour of the actors themselves. The structure of relationships determines both individual and collective behaviour of network agents. Their responsive behaviour is directly linked to opportunities and threats in their internal and external environment. At the same time they act strategically with their choices and selections. The accumulation of resources by firms and the allocation of these resources for further development is a form of strategic positioning within the set of relationships.

The strategic behaviour of the actors is also a driving factor for the network design, as well as being directly influenced by the network structure. Strategic behaviour in a network is a result of the actors being aware of opportunities that exist within the network, and actors being capable of employing these opportunities and utilising the existing resources in their pursue for realisation of their interests.

If we return to Callon's reference to strategic behaviour, it is very clear, that all human elements of an actor-network or a project-network could exhibit strategic behaviour. They could be: *translators* (ascribing roles to others); *spokesmen* (representing and speaking on behalf of the other enrolled entities); *positioning themselves* (an actor to render itself indispensable, or to oblige other entities to detour); *displacing others* (or creating links and associations between entities as obligatory points of passage) (Callon 1986). When the strategic behaviour of actors is driven by complementary interests, the relationship between them takes the shape of co-operation. When their interests in the process of allocation of resources become contradictory, the relationship becomes competitive.

If we look at the non-human elements of a project-network – they can only perform a specific role ascribed to them by the human actors. However, they can displace other actors through connecting and carrying associations between numerous other entities. For example, in a project network the technology may determine not only the enrolment of new actors, pooling in resources, but also the exclusion of previous network members on the bases of their limited capabilities to participate in the further development of the project. The decision for this selection though is a prerogative of an institutional agency where the purpose and the criteria are determined by human actors.

The strategic behaviour of key actors transform the existing and accessible knowledge of the properties of potential network partners, into ascribed roles, encrypt in texts, documents, and contracts. The heterogeneity in this sense means different actors are performing different roles, doing different things, performing specialised tasks within the network. They also extract different benefits for themselves according to their interests. Some actors (laboratories) explore alternative technical solutions, and therefore they bring more knowledge (i.e. more resources) to the network, and accumulate by themselves more knowledge and intangible assets. Other actors (firms) receive 'payments' for their activities, and may use their participation in the existing network to develop experience and as a bridge - to enrol to other networks of potential clients. Third type of actors (EDF) could use the current network to develop unique expertise and to extend their capabilities and their profile (which is part of their identity) in management of public projects.

Purposeful Action

Fundamental point in Callon's actor-network theory is the notion of actors as entities of varying type. By definition the entities are pro-active. They act as a focal point in a network, capable to associate other entities into their actor-world (Callon, 1986). These actor-networks resemble also Burt's Ego-networks - comprised of the leading actors (Egos) that participate in the emergence of a network (Burt, 1982). Egos have the capacity to define and construct networks of associated elements. This construction activity assumes a purposeful action. Without a purpose, these leading entities (or Egos) can only affect other entities (or 'Alters' - agents, technologies, resources), but can not prescribe roles and engage these 'Alters' in purposeful activities. It is important to stress that some activities in a network could be spontaneous, driven by the responsive behaviour of network members. However, the very existence of a network requires a purpose, or the collective intentions of inter-linked actors. Otherwise, it is simply an aggregation

of actors and entities. The leading actors therefore could only be human, or capable of making decisions and conducting purposeful selections, structuring and translation of roles.

While the purposive action is not so explicit for Callon, it is one of the round stones for Burt. The purpose for Burt's actors is taken to an extreme, almost denying spontaneous activity in the network. The social topology as role sets for Burt arises from dyadic relationships, actively manipulated by the network members. The purpose is defined either as intention for an action, or as an attribution used by the actor to explain and justify her/his own behaviour (Burt, 1982).

The postulates, that Burt introduces, are: action is *purposive*, and actors *evaluate the marginal utility* of an action in reference to some *criterion*, including the social structure as an actor's *status/role-set*, generated by the division of labour, the actor's *interests*, and the *action* itself. (Burt, 1982: 329) The status/role-set of an actor is therefore a fundamental constituent factor for exchanges and building relationships in a network.

Managerial Choices and Coalition Strategies

The concept of a status/role set derives from social network analysis and is applicable to human actors. Managers within firms occupy status/role sets which are constructed by their relationships both within and outside the firm. The concept is applicable to supplier networks, where the status/role of the supplier is determined by the length and the conditions of the contract. The concept also assumes homogeneity of suppliers. More difficult is to describe a status/role set in a project network, where heterogeneous actors are not in a vertical or a horizontal relationship. Their status position is a function of both their choices, and their prescribed role at the initial enrolment.

Insights on managerial choices could be found in the work on power in organisations by Mintzberg (1983) and Pfeffer (1992), and the work on interlocking corporate directorates by Burt and Scott (Burt, 1979, Scott, 1987). Mintzberg's definition of power as "the capacity to effect (or affect) organisational outcomes" (Mintzberg, 1983: 4) suggests that managers purposefully construct and engage in relationships that secure certain outcomes. They form coalitions in order to achieve certain objectives. These coalitions usually aim to ensure that all participants share similar objectives and similar views on how to achieve them. A collective strategy will obviously improve the efficiency of an action in organisational or network settings. Forming a coalition in network analysis is known as formation of cliques, and is seen as having a negative impact on the equality of distribution of information and resources.

Transformation of Identities in a Network

Describing the negotiated market, Callon asserts that the actors "negotiate their own identities and interests" (Callon 1998: 295). Their identities are both independent properties evolved during their past history and a negotiated outcome of the negotiation process. The institutional framework that facilitates the negotiation process, according to Callon, is composed of 'instruments' that impose the notion of objectivity of facts upon agents' subjective viewpoints. It is assumed that every member of the network agrees to surrender one's own subjective

viewpoint, and accepts to behave according to agreed scenario. In other words, the identity of an actor is constructed institutionally by the agreements of the negotiating parties.

Only through negotiation and agreements network members ascribe and accept roles. Then they perform according to these roles, and act strategically, realising their interests and fulfilling their commitments, accepted within the agreement. Technologies and other non-human actors do not participate in agreements. They could be subject of these agreements, providing opportunities or constraints for the strategic behaviour of the human actors.

HETEROGENEITY OF PROCESSES

In our analysis, the heterogeneity of the actor-network derives from both heterogeneity of actors and heterogeneity of processes.

Callon (1986) suggests three distinctive processes in a network:

- **enrolment** (or allocation of roles) as part of the construction process, when leading actors translate properties of potential members into roles and functions;
- the **translation** process involves the strategies (of the translator), and the **selection** and **displacements** imposed upon others in the creation of the actor-world;
- the **problematisation**, or making oneself indispensable to the network, is a selective process of framing of alternative problems, choosing one to solve, and selecting an appropriate solution.

The ‘construction’ process, or what Callon calls ‘enrolment’ and ‘translation’ involves a process of selection of partners in the network, interpretation of tasks and roles, decisions on values, modes and content of transactions and exchanges. The translation and interpretation of roles and interests requires not only **self-awareness** of the actor, but also **knowledge** of the properties of the entities that the actor is trying to enrol. Without self-awareness and knowledge, actors can not have strategies for the process of network construction. They can induce effects on other entities by their mere existence, but they would not have the ability, which Callon ascribes to them, to build links and relationships, to mobilise other actors, to associate various human and non-human elements, to reveal contexts in which transactions and exchanges take place. Most of these activities are assisted and supported by contracts and various documents, which rise to the point of an artefact that induces further changes in the network (Callon 1986, 1992). The mobilisation process requires not only individual or collective strategies, but requires pro-active and purposeful behaviour on behalf of the acting agencies. The proactive behaviour involves a process of selection of a particular course of action from a range of alternatives, or requires a decision before any action takes place.

Enrolment and Network Construction

At the beginning of any enrolment stands **a human act of knowledge construction**, which brings to life the entity of technical and other material objects. New product designs and technology inventions and new realisation of outputs are at the foundations of a new network construction. Even when the very product and technology design is the aim of the project network, it builds

upon previous human inventions and knowledge embodied in texts and documents. These non-human elements have no capabilities or power in themselves to enrol other entities. They only facilitate the enrolment process by carrying ascriptions from one human actor to another.

The reconstruction of the economic and social context in which various ascriptions take place is possible only as ‘selective, or subjective interpretation’ of this context. If we would like to employ the electron for example in a new process, we have to reconstruct in our mind, or to understand the experimental context in which the original properties of the electron have been observed. Only based on our *understanding* of the electron and its properties, we can ascribe a new role for it. These ascriptions, enrolments and translations take place outside the eye of the original observer – the physicists that have discovered and registered the properties of the electron in the first place. It is true that the physicists and the new actors, that are trying to construct a new actor-network with the electron enrolled in it, are connected. They are connected through the information they share, and their knowledge of the electron. With the enrolment of the electron, the new actors enrol the physicists as well, and their texts in which the properties of the electron are described.

To summarise this discussion, our argument is that non-human actors in heterogeneous networks don’t act by themselves, and don’t speak for themselves, as argued by Callon (1986, 1992). They are enrolled in the new project along with the incorporation of their previous actor-network relationships. We enrol not only the electron in our network, but also the physicists that invented it, and their knowledge of the electron. This new complex actor-network enables us to achieve our own objectives.

The construction of networks also refers to the concept of ‘framing’, which is raised in the most recent work by Callon (1998). Within the framing process network members behave in a strategic manner, negotiate the frame for their interactions and exchanges, i.e. the rules and the roles that each of them has to play. At the same time they employ resources, including their own cognitive and relational resources, offering their actor-world for the integration of the network, and the negotiation of the frame. The frame of a network is composed of negotiated and agreed roles, positions, and relationships between actors, and it includes the network structure, as well as the rules that govern transactions and exchanges within the network.

Another metaphor, used by Callon, is ‘staging’. This describes how actors interpret the wider surroundings in order not only to position themselves in a network, and to prescribe for themselves performance roles, but also to relate to the wider socio-economic conditions. This effort of establishing a relationship between themselves and the wider context is also described as strategic behaviour beyond the network boundaries. This active enrolment and translation of multiple elements from the environment serves multiple purposes – the construction of the network itself, the positioning of the actor in it, and the positioning of the network in the wider context (i.e. promotion practices by businesses).

Texts and Interpretation

Only human actors can select, interpret texts, ascribe roles, and put exchange value to resources, objects and processes¹. By interpreting texts we understand the ability of an actor to attribute meaning to a link / relationship with another entity. The texts themselves have no capabilities of that kind. They don't speak for themselves. Audiences and readers can speak for texts by attributing meaning and constructing other 'texts' in order to 'express' and to make explicit their own understanding of what they have read and observed.

Callon quite rightly puts the texts into the category of 'pure intermediaries' (Callon 1992). Texts and documents participate in the process of *ascription, translation, and enrolment* but only as intermediaries, i.e. carrying the message of the translator, to the reader, and the audience. Texts could be spokesmen only within the boundaries of the *translator's knowledge*. The *translator's capabilities of translation and enrolment* are crucial as much as the reader's capabilities of 'decoding' and 'deconstruction' of the meaning of these texts. Beyond the capabilities of the translator and the reader-observer, the texts themselves are merely complex entities, containing coded information and meaning about other entities and various associations between these other entities.

An important implication of our reasoning above is the point of the double interpretation – first, the coding when the text is constructed by the 'author', and second, the decoding, when the text is received by the 'reader-observer'. Therefore, each text brings two additional agents – the author of the text, and the reader-observer. Here, Callon has a very good concept of an actor-network in a network. However, the network of the text is composed of the author and the reader. The text itself is merely a carrier of the *interests* and the *knowledge* of the two actors.

The scientific text can only be a representation of a heterogeneous network of authors, audiences, research laboratories - using the 'text', firms, government agencies – certifying the 'text', pieces of knowledge and technology, or other objects reflected in this 'text'. Yet this heterogeneous representation could be subjected to re-interpretation only by a reader-observer. But the observation, or the deconstruction of the text (and the accompanying interpretations of the associations that are encrypted in the 'text') has to be performed by a knowledgeable agent, or by a human actor.

The text or documentation is an encryption of existing objects, entities, and relationships. The existence of the electron in Callon's scientific network is only within the text and the knowledge boundaries that describe the properties of the electron as discovered by the physicists. The various characteristics of the electron are translated into 'scientific text' by the physicists. The text as a holder of the physicists' knowledge enables other human actors to 'employ' the electron in new technologies, products, or processes. Other actors can employ the electron within the boundaries of their own knowledge and understanding, based on the texts and the coded knowledge from previous actors. The new actors can ascribe new roles to the electron in their own actor-network, which goes beyond the original knowledge & text.

¹Interaction in networks involves various forms of exchanges of information, resources, personal commitments and affiliations, and each of these has a different exchange value for the 'donor' and for the 'recipient'.

NETWORK DYNAMICS

Once constructed, networks generate their own dynamics of transactions, exchanges, and relationships. The uneven distribution of resources, unequal participation in decision making and allocation of resources is associated with concentration of power and produces various forms of co-ordination.

Power and Network Co-ordination

Mintzberg (1983) refers back to a 1952 paper by Papandreu about the existence of multiple objectives coming from the internal and the external environment, passing through a *peak co-ordinator* that reconciles these goals into a single *preference function*. The concept of a peak co-ordinator could be liased with the concept of a co-ordinating agency in a network, or actors with high concentration of non-redundant contacts who occupy positions of high centrality, and are located close to structural holes (Burt, 1992, Brass, 1992). The difficulty with a network analysis is to identify the main co-ordinating agency that sets communication and decision priorities for the entire net. Usually it is assumed that networks imply a mechanism of self-co-ordination and self-organisation among de-centralised parts (or agents), in a process of information exchange.

However, network analysis has not found yet significant evidence for self-co-ordination as a widely implied mechanism in the real business world, but rather as an exception. On the contrary, the dynamics of relations between different agents suggest that network structures do transform into hierarchies under certain conditions (i.e. in joint ventures, acquisitions, horizontal and vertical integrations), or represent equally competitive environments, such as markets (i.e. in the case of subcontracting, outsourcing, and alternative suppliers).

Mintzberg's discussion in this respect is quite adversarial and suggests that members of an organisation (assumed as an intra-organisational network of individuals) are involved in a complex process of negotiation over organisational objectives. As an introduction to his theory of power in organisations, Mintzberg refers to the work by Cyert and March (1963) on coalitions to discuss the fact that the establishment of organisation's goals is far from a rational process. All outside and inside participants in the decision making process are continuously bargaining and negotiating with each other the inducements in return for contributions. Therefore the determination of the outcomes (or the organisational goals) is a result of the dynamics of 'shifting participants, shifting needs, shifting power within the coalition' (Mintzberg, 1983: 16).

Business and management networks exist in a broader environment, which usually provides a set of rules, and regulations that affect the network performance and operations. Some networks in their evolution achieve high level of cohesion based on trust and commitment by all members to prolong the existing relations. However, we may expect that the majority of networks envisage a certain level of asymmetry which is generated by larger firms, more experienced managers, or charismatic leaders. These network leaders are expected to have a major impact on the structure of the entire net, the rules and regulations for performance, and specific distribution of inducements, incentives and profits.

In a network there is an ongoing process of re-distribution of resources and information which aims to shift the balance of power and influence. This adversarial tendency between network members could be outwitted in two ways: either by enhancing control and dependency (and creating hierarchy of subordination in a network), or by developing trust and commitment to the existing contracts and relations. This analysis suggests that there are two main types of networks - *self-regulating* (through norms, rules, loyalty, commitment and trust) and *regulated* (either internally by powerful members, or externally through hierarchies). It is important to mention that the two types are ideal and form a scale that may accommodate all practical cases of business networks. Both project networks and supplier networks can be regulated, as well as self-regulating.

To establish the intra-organisational dynamics, Mintzberg (1983) refers to the work by Petro Georgiou (1973) which looks at the concept of the organisation as an arbitrarily defined focus of interests. Georgiou views the internal and the external participants in organisational goal setting as a strategic force in an organisation, whose behaviour is determined by the rewards they pursue. The process of decision making and goal setting is seen as a market exchange of incentives. In this view the market is seen as a fundamental process, which is part of the functioning of organisational hierarchy.

This translated into the concepts of network analysis means that a relationship in a network structure exists because of the outcomes, or the rewards it brings to the related members. The incentives they exchange between themselves serve to maintain the existing relations. However, a relation is initiated by one member (called by Burt a 'network entrepreneur'), who is the first to identify a new opportunity, and in pursuit of realisation of that opportunity he/she establishes a new relationship (see Burt, 1992). This means that usually one member of the network will have at least the time advantage in negotiating a formal contract that is to substantiate a relation between two partners.

Entrepreneurs who establish links with other agents for exchange of goods and services, information and ideas, affects, or influence (Tichy, Tushman, and Fombrun, 1979: 508) usually build networks. It is expected that these entrepreneurs will have high level of centrality in a network, and will have initially high level of control over decisions in the network. The evolution of the network will depend to a great extent on the vision of these 'network designers' and their ability to lead the network processes.

CONCLUSIONS: COMPLEMENTARITY OF THE 'RELATIONAL' AND THE 'POSITIONAL' APPROACHES

The interest in network analysis has significantly grown during the last decade. The lack of leading theory is evident looking at the fragmentation of empirical research. The structural paradigm remains dominant, even though there are serious attempts to investigate the relationships between business actors. Burt makes a significant step forward with his theory of action resourcing from both the '*relational*' and the '*positional*' approaches in network analysis. However, for his mathematical modelling he acknowledges that the relational approach is not suitable, as it requires all respondents and observers to know the network boundaries. He acknowledges that the advantages of the relational approach are that network models describe

the intensity of dyadic relationships, and that researchers could describe an actor's behaviour knowing only few of his/her relations, and without attending his/her many other relations (Burt, 1982: 30). Appropriate measures are *density* and *transitivity* in networks, as well as directionality, reciprocity and multiplexity. The focus on relationships diminishes the role of the fact that the actors are heterogeneous.

On the contrary, the positional approach allows research without knowing the network boundaries, but requires knowledge of all relationships of an actor (or building Ego-networks for each actor), in order to determine his/her position in relation to all maintained contacts. Burt systematically explores different options within the positional approach, and develops his arguments about *redundancy*, *structural equivalence*, and *structural holes*. The main measures that he uses within the Ego-network are: *range*, *density*, *multiplexity*, and *heterogeneity* of contacts. Range is measured by the diversity of actors enrolled by the Ego in its network. Density of Ego-network is measured by the average intensity of contacts, maintained by the Ego. Multiplexity and heterogeneity are measured by the content of the dyadic relationships, where heterogeneity derives from the properties of each actor and his/her relationships. While range assumes diversity of actors, the measure of density assumes homogeneity. This approach is particularly enriched by Callon's work on actor-networks, with the focus on technologies and other scientific artefacts as agents in a project network.

In this context, both human and non-human actors have a duality of existence in a network: they exist by themselves with their own properties, and they exist as enrolled, incorporated, mobilised, or absorbed by the network, with ascribed roles, functions and characteristics. This fact raises the fundamental question of research perspectives. This is the choice between: on the one hand, conceptualisation of the network members with their properties, and on the other hand, conceptualisation of the actor-world through 'reading' the translations and prescriptions of roles in various texts, research maps, or business contracts. Both approaches have to address in addition the question of the relationship between the strategic behaviour of the core actors, and the roles imposed and ascribed to periphery actors and non-human entities. The network dynamics takes place both within the core and the periphery of a network. It is driven both by the key players and by the strategic behaviour of all human actors.

The dynamic change of suppliers and buyers depends usually on the activity of the central and leading members of the network, who control the negotiation process and determine the 'membership status' of the peripheral members. As more control is spread amongst different members of the network, more interconnected are the members overall and more complex exchanges take place within the network.

The fact that the behaviour of the actors is socially constructed does not invalidate the fact that this behaviour exists independently of the 'construction process', and observers usually are collecting and interpreting evidence about this behaviour – using a de-construction approach.

The distribution of resources amongst network members is determined by the *centrality of their location* in the network, and particularly in relation to the flows of information, goods and services. Centrality and coalitions in networks are the means used by network agents to acquire

and maintain access to resources. In this respect network processes are a result of both spontaneous and strategic behaviour.

Important elements of the actor-network are the *outcomes* from the activities of the enrolled actors. Business networks, particularly, are judged by the results, which sometimes are re-invested into the network. The results could range from skills, experience, profits, or new technologies. The research questions related to evaluation of network outcomes are long overdue to be explored.

BIBLIOGRAPHY

- Brass, D. (1992) "Power in Organisations: A Social Network Perspective", In: *Research in Politics and Society*, Vol. 4, pp. 259-323, JAI Press Inc.
- Buckley, P. and Chapman, M. (1996) "Economics and Social Anthropology - Reconciling Differences", In: *Human Relations*, Vol. 49, No. 9, pp. 1123-1150.
- Callon, M., Ed. (1986a). Mapping the Dynamics of Science and Technology. London, Macmillan Press Ltd.
- Callon, M., Ed. (1986b). The Sociology of an Actor-Network: The Case of the Electric Vehicle. Mapping the Dynamics of Science and Technology. J. L. Michel Callon, Arie Rip. London, Macmillan Press Ltd.: 19-34.
- Callon, M., Ed. (1992). The Dynamics of Techno-Economic Networks. Technological Change and Company Strategies. P. S. V. W. R. Coombs. London, Academic Press: 72-102.
- Callon, M., Ed. (1998). An Essay on Framing and Overflowing: Economic Externalities Revisited by Sociology. The Laws of the Market. M. Callon. London, Blackwell: 279-301.
- Cyert, R., and March, J. (1963) *A Behavioural Theory of the Firm*. Prentice-Hall, Englewood Cliffs, N. J.
- Georgiou, P. (1973) "The Goal Paradigm and Notes Towards a Counter Paradigm", *Administrative Science Quarterly*, 1973, pp. 291-310
- Knoke, D. and Kuklinski, J. (1982) *Network Analysis*. Beverly Hills: Sage Publ.
- Knoke, D. and Guilarte, M. (1994) "Networks in Organisational Structures and Strategies", In: *Current Perspectives in Social Theory*, Supplement 1, pp. 77-115, JAI Press Inc.
- Krackhardt, D. (1992) "The Strength of Strong Ties: The Importance of Philos in Organisations", In: *Networks and Organisations: Structure, Form, and Action*, Ed. by Nohria, N. and Eccles, R., Harvard Business School Press, Boston, Massachusetts.
- Krackhardt, D. Brass, D. (1994) Intra-organisational Networks: The Micro Side. In S. Wasserman & Galaskiewicz (Eds.) *Advances in Social Network Analysis: Research in the Social and Behavioural Sciences*. (pp. 207-229). Thousand Oaks, CA Hills, CA: Sage.
- Latour, B. (1987) *Science in Action*. Harvard Univ. Press, Cambridge, Mass.
- Mintzberg, H. (1983) *Power In and Around Organisations*. Prentice-Hall, Englewood Cliffs, N.
- Monge, P. & Eisenberg, E. (1987) Emergent Communication Networks. In F. M. Jablin, L. Putnam, K. Roberts, & L. Porter (Eds.) *Handbook of Organisational Communication* (pp. 304-342). Newbury Park, CA: Sage.
- Nohria, N. & Eccles, R. (Eds.) (1992) *Networks and Organisations. Structure, Form, and Action*. Harvard Business School Press, Boston, Massachusetts.

- Papandreou, A. (1952) "Some Basic Problems in the Theory of the Firm", In: *A Survey of Contemporary Economics*, Vol. 2, ed. B. Haley. Irwin, Homewood, Ill.
- Ramazzotti, Paolo and M. Rangone (2000) Firms and Selection: Possible Features of Innovation Processes, presented at the XII EAEPE Annual Conference, Berlin, November 2-5, 2000.
- Thompson, G. (1991) "Networks: Introduction" In: *Markets, Hierarchies & Networks: The Coordination of Social Life*, Ed. by Thompson, G. *et. al*, Sage Publ., London.
- Tichy, Tushman, and Fombrun (1979) "Social Network Analysis for Organisations", In: *Academy of Management Review*, 4, pp. 507-519.
- Wellman, B. (1988) "Structural Analysis: From Method and Metaphor to Theory and Substance", In: *Social Structures: A Network Approach*, Ed. by Wellman, B. and Berkowitz, S., Cambridge, Mass: Cambridge University Press.
- Wasserman, S. & Faust, K. (1994) *Social Network Analysis. Methods and Applications*. Cambridge University Press.