

COMMORG Theoretical Framework: *NETWORK*

E-MAIL, SOCIAL STRUCTURE AND NETWORKS

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One of the most important developments in recent sociological theory is the relationship between ‘social structure’ and ‘social agency.’ According to George Ritzer (1996), this issue has been mostly investigated among European theorists, while, on the other side, the parallel issue of the ‘micro-macro linkage’ has attracted the main interest in American sociological theory. Again, according to George Ritzer (1996, pp. 390-425), the structure-agency linkage constitutes the core of the work of many European theorists, such as: Giddens’s (1979, 1984) structuration theory; Archer’s (1995) morphogenetic approach and her concern (1988) on the linkage between culture and agency; Bourdieu’s (1977, 1984) theories of habitus and field; and Habermas’s (1984, 1987) integration of life-world and system.

Among the above four theoretical perspectives, here we are going to retain only the first one (structuration theory) and to consider it as one of the three theoretical perspectives, which frame most of the recent sociological work around the new information and communication technologies. The other two are: social network analysis and actor-network theory. In a sense, all these three perspectives focus on the same issue, the structure-agency linkage, but they articulate their efforts in different ways. Structuration theory is aiming to an integration of the conflicting terms of this issue, social network analysis is focusing on the relational patterns sustained by this issue and actor-network theory is attempting a re-engineering of the inhomogeneous dynamics enacted by this issue.

Structuration Theory

Anthony Giddens’s intention was to gap the micro-macro differentiation appearing in sociology as the opposition between agency and structure (or between ‘action theories’ and ‘institutional analyses’) and in philosophy taking the form of the subject-object contrast. His concept of the ‘duality of structure’ aims to transcend

these dualisms and his theory of 'structuration' attempts an integration of agency and structure taking place in the real ways social systems are reproduced.¹

What Giddens understands as 'agency' (or 'action') refers to two components or aspects of human conduct, which he calls 'capability' and 'knowledgeability.' By the former, he means that, "whenever we speak of human action, we imply the possibility that the 'agent could have acted otherwise'" (Giddens, 1981, p. 163). By the second, he refers to the "fact that the members of a society know a great deal about the workings of the society, and must do so if that society is recognizably a 'human society'" (*ibid.*). He warns that capability should not be confused with the "ability of human beings to make 'decisions' or 'choices'" (*ibid.*). Similarly, "it is a basic mistake to equate the knowledgeability of human agents with what is known 'consciously', or 'held in mind' in a conscious way" (*ibid.*). In other words, Giddens does not believe that actions are produced by consciousness but, to the extent that human agents are engaged in practice, it is through that practice that consciousness is produced. Thus, he distinguishes between 'discursive' and 'practical knowledge' (or consciousness), where the former refers to what actors employ in the course of daily life (what they say) and the latter refers to 'tacit modes of awareness and competence' upon which actors are able to draw in action but without being able to express it (what they simply do) (*ibid.*). Beyond knowledge, Giddens is concerned with 'reflexivity,' by which he means the capability of humans to be self-conscious and to monitor their activities and their physical and social contexts exactly at the same time they are engaged in these activities (1984, p. 5).

For Giddens, the concept of institutions derives directly from action. By 'institutions,' he means, "structured social practices that have a broad spatial and temporal extension: that are structured in what the historian Braudel calls the *longue durée* of time, and which are followed or acknowledged by the majority of the members of a society" (1981, p. 164). This means that institutions are based on certain structural features that human actions have as well as social practices do. Giddens considers three of them: *signification*, *domination* and *legitimation* (1979, p. 107). Features of signification are rules governing communication; institutions developing from these rules are symbolic orders or modes of discourse. Features of domination result from the fact that human actions, being transformative, inevitably involve power; institutions based on domination over people are political institutions and those on domination over resources are economic institutions. Features of legitimation refer to the normative character of action, which involve implicit or explicit values or moral rules; the corresponding institutions are legal/repressive.

As for 'structure,' Giddens defines it differently from most sociologists, who usually, when they speak about it, they just have in mind a 'patterning' or an anatomy. On the contrary, his idea of structure comes from structuralist linguistics (Saussure). So, Giddens defines structure as "recursively organized rules and resources, having a virtual existence outside of time-space" (1981, p. 172). "The 'rules' ... are social conventions, and knowledge of them includes knowledge of the contexts of their application. By resources [he] mean[s] 'capabilities of making things happen', of bringing about particular states of affairs" (1981, p. 170).

¹ Giddens's structuration theory (1976, 1979, 1984) appeared about the same time with two other structuration theories originating from the philosophy of science, Bernstein's (1978) and Bhaskar's (1979).

By drawing on the linguistic paradigm, Giddens is using the phrase ‘duality of structure’ to mean that “structure is both the medium and outcome of the social practices it recursively organizes” (1981, p. 171) or, in other words, structure is “both constraining and enabling” (1984, pp. 25, 163). The analogy with language (or Saussure’s ‘langue’) is obvious here: When we utter a sentence, language is the medium of what we are saying, which limits what we can say, because of the syntactical rules that we have to draw upon. But at the same time, by uttering a sentence, we are reproducing these rules as structural properties of the language and, in this sense, language becomes the outcome of our speech, through which we are enabled to say something. With the ‘duality of structure,’ the dualism between agency and structure disappears, because structure is not just an object outside the agent with which she may interfere. Giddens’s structure is internalized in agent’s conduct. “Structure is not ‘external’ to individuals: as memory traces, and as instantiated in social practices, it is in a certain sense more ‘internal’ than exterior to their activities” (1984, p. 25).

Furthermore, Giddens is opposing the functionalist view that social systems are structures. By contrast, he is rather proposing that “social systems have *structural properties*, but are not as such structures” (1981, p. 169). Thus, he is assigning the conventional sense of structures to his concept of social system. Giddens defines ‘social systems’ as reproduced social practices or “reproduced relations between actors or collectivities organized as regular social practices” (1984, pp. 17, 25), which “have always to be treated as situated in time-space” (1981, p. 169). Although structures (as rules and resources) have only a virtual existence outside time-space, they do become manifested in social systems in the form of reproduced social relations, which are situated in space-time.

We now reach the concept of ‘structuration,’ by which Giddens means the processes of reproduction of a social system or “the conditions governing system reproduction” (1981, p. 172). “To study the structuration of a social system is to study the ways in which that system ... is produced and reproduced in interaction ... [so structuration refers to] the conditions governing the continuity or transformation of structures and therefore the reproduction of systems” (1979, p. 66). Thus, to talk of structuration means that (i) social systems are structured via the application of generative rules and resources “in and through their continual reproduction in day-to-day social life” and (ii) social agency, i.e., “the capability/knowledgeability of social actors is always *bounded* ... [by] the *unintended consequences* of action” (1979, p. 172).

Giddens’s structuration theory has been severely criticized by many social theorists. Ian Craib (1992) focuses his criticisms in five points: (1) lack of ‘ontological depth’ and complexity, (2) limitation of deriving further useful ideas from rejected theories, (3) lack of critical analysis of modern society, (4) theoretical eclecticism and fragmentation and (5) sometimes difficulty to understand exactly what Giddens is talking about. Margaret Archer (1995) is attacking Giddens’s conflation of agency and structure. Stewart Clegg (1989) argues that, rather than resolving the dualism of agency and structure, Giddens offers victory to the knowledgeable human actor in a particularly modern and liberal tradition.

Structuration Theory and Information and Communication Technologies

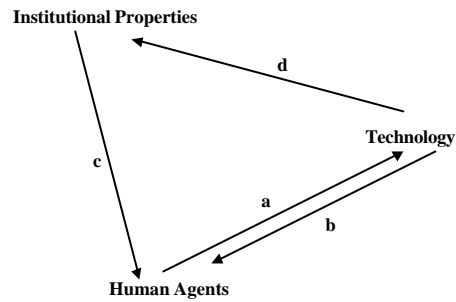
Although there is a huge literature² concerning structuration theory and information systems or information and communication technologies, the most sustained and well-articulated attempt to theorize information systems using structuration theory comes from the work of Wanda Orlikowski (1992; Orlikowski & Robey, 1991). Orlikowski examines the interaction between technology and organizations and confronts the question whether technology in organizations determines or is determined by the social. Adopting Giddens's structuration model, she attempts to transcend this dilemma by attributing to technology a dual nature ('duality of technology') and an interpretive role ('interpretive flexibility').

Orlikowski's 'duality of technology' refers to that "human actions are enabled and constrained by structures, yet these structures are the result of previous actions" (1992, p. 404). Therefore, for her, "technology is the product of human action, while it also assumes structural properties. That is, technology is physically constructed by actors working in a given social context, and technology is socially constructed by actors through the different meanings they attach to it and the various features they emphasize and use" (1992, p. 406).

However, in organizational practice, Orlikowski remarks, the duality of technology tends to be substituted by a dualism, which emphasizes only one view of technology. In fact, she argues that often many of the actions, which *constitute* technology (such as processes of development occurring in vendor organizations), appear to be separated in time and space from actions, which are *constituted* by technology (such as processes of consumption and use occurring in customer sites) (1992, p. 407). But as Orlikowski believes in the recursive character of technology (its duality), which potentially enables users to control their interaction with technology at any time during a technology's existence, the previous disjuncture between design and use becomes "artificial and misleading" (1992, p. 409). Borrowing a term from the field of the social construction of technology, she calls 'interpretive flexibility' "the degree to which users of a technology are engaged in its constitution (physically and/or socially) during development or use" (*ibid.*).

Thus, Orlikowski's structural model of technology comprises the following components: (i) human agents (such as designers, users and decision-makers), (ii) technological artefacts (mediating task execution in the workplace) and (iii) institutional properties (including organizational, communicational, cultural, political dimensions and socio-economic conditions). The following figure depicts the main relationships enacted in Orlikowski's structural model of technology (1992, pp. 409-412):

² There are two published reviews of structuration theory and information systems: Walsham & Han (1991) and M. Jones (1999).



Arrow	Type of Influence	Nature of Influence
a	Technology as a Product of Human Action	Technology is the outcome of such human action as design, development, appropriation, and modification.
b	Technology as a Medium of Human Action	Technology facilitates and constrains human action through the provision of interpretive schemes, facilities, and norms.
c	Institutional Conditions of Interaction with Technology	Institutional Properties influence humans in their interaction with technology, for example, intentions, professional norms, state of the art in materials and knowledge, design standards, and available resources (time, money, skills).
d	Institutional Consequences of Interaction with Technology	Interaction with technology influences the institutional properties of an organization, through reinforcing or transforming structures of signification, domination, and legitimation.

Orlikowski's approach to deal with the relationship between technology and the social has been criticized by Keith Grint and Steve Woolgar (1997, pp. 21-24). These theorists, highlighting Orlikowski's vacillation between contradictory positions, impute her of 'technicism': "what starts out as an anti-essentialist move, ... ends up as just one more version of technicism hooked into structuration theory" (1997, p. 23). Thus, Grint and Woolgar remark that at one point Orlikowski appears to accept as real the division between the 'design mode' and the 'use mode,' when she says: "Recognizing the disjuncture in time and space between the design and use mode allows us to analyze the role of multiple organizations in developing and deploying a particular technology" (Orlikowski, 1992, p. 422). However, at another point, she reaffirms that this "apparent disjuncture between the design and use stages is artificial and misleading" (1992, p. 409). Similarly, Grint and Woolgar remark that Orlikowski appears to consider technology simultaneously independent of human action and yet irrelevant without it. At one point, Orlikowski accepts that there are constraints set up by "the material characteristics of technology" (*ibid.*), which necessarily set aside any interpretive flexibility that humans might have. But, at another point, she asserts that "it's only through human action the technology *qua* technology can be understood" (1992, p. 410). Furthermore, Grint and Woolgar argue that these paradoxes are overlaid, rather than resolved and transcended, by Orlikowski's duality of technology, i.e., a view of technology as both "objective reality and as socially constructed product" (1992, 423). Because, according to Grint and Woolgar, whatever "counts as objective reality is itself a social construction. In other words, it could still be argued that 'objective reality' and 'social construction' are not two aspects of the same artefact – if they were it would imply we could separate out of the two – they are different ways of saying the same thing" (Grint & Woolgar, 1997, p. 23). Therefore, for Grint and Woolgar, what is at stake is not the understanding of the mutual determinations between technology and the social but whether all terms involved in such dualities or dualisms constitute 'negotiated orders': "Technologies need at no point be assumed to be stable entities with fixed and determinate 'uses'; rather, all

processes of design, development, manufacture, implementation and consumption are socially constructed” (1993, p. 24).

A second major attempt to theorize advanced information technologies inside the theoretical horizons of structuration theory is provided by the so-called *Adaptive Structuration Theory* (AST). According to its founders DeSanctis and Poole, AST provides “a model that describes the interplay between advanced information technologies, social structures, and human interaction” (DeSanctis & Poole 1994; Gopal *et al.*, 1993). This theory results from an integration of Giddens’s structuration theory with the decision making school of organizational studies and it provides an appropriate analytical framework for empirical work in group decision support systems (GDSS) (Poole *et al.*, 1985).

However, the definition of structure as used by AST differs from the corresponding notion in structuration theory. Now, a ‘structure’ contains both ‘structural features’ and the ‘spirit’ of these features. The structural features are specific rules and resources or capabilities, which bring meaning and control to a group interaction (corresponding to Giddens’s dimensions of signification and domination). In other words, the structural features of an advanced information technology refer to the actual design characteristics, which display how information is gathered and managed by users. For example, the structural features of a GDSS might include anonymous posting of messages and enable access at any time from any point (Fulk & Boyd, 1991, discussed AST in CMC). The spirit is the intention or purpose of these features, how designers expect people to interpret and use the system. In the previous example, the spirit of those features is to promote participation by removing social, physical and temporal constraints to communication.

As in Giddens’s theory, structuration in AST is the process of production and reproduction of social structures. But usually in AST structuration is referred as ‘appropriation’ of structures. Now, appropriation of structures and its outcomes can reproduce existing structures or transform them or give rise to new ‘emergent’ structures. In this sense, AST meets with the theory of self-organization of systems (Contractor & Seibold, 1993). The result is that existing and emergent structures (or structures in action) are continually intertwined: “there is a recursive relationship between technology and action, each iteratively shaping the other” (DeSanctis & Poole, 1994, p. 125).

However, regardless of the designed features, users mediate its effects by adapting technology to their needs, even resisting it or refusing to use it. Since group members may choose the ways to use structures in their interaction, a technological appropriation is determined by the group’s internal system (i.e., their style of interaction, norms for behavior, degree of knowledge and experience, perceptions of others’ knowledge of structures etc.). Thus, “each group forms its particular amalgam of structural features which it employs in its practices” (Poole & DeSanctis, 1990, p. 180).

Beyond Orlikowski and AST, there are also many other applications of structuration theory in information systems and information and communication technologies; characteristically, we will only refer to a few of them. Walsham (1993) provided a sustained longitudinal case study analysis of information systems strategy,

development, implementation and evaluation in three different organizations. Furthermore, he offered an interesting use of structuration as the linkage between the context and process axes of Pettigrew's (1985) content/context/process model of organizational change. Barley (1986) described the introduction of computer tomography scanners into hospitals and studied the links between institution and actions in order to outline a theory of how technology might occasion different organizational structures by modifying institutionalized roles and patterns of interaction. Karsten (1995) analyzed Lotus Notes implementations in various organizational settings. Brooks (1997) used the structurational theoretical frame in order to analyze computer-aided design. Jones & Nandhakumar (1993) studied the development of an Executive Information System. Walsham & Sahay (1996) used a combination of structuration theory with actor-network theory (that we are going to examine in the third section) in order to investigate problems in developing Geographic Information Systems in an Indian governmental department.

Social Network Analysis

As José López and John Scott remark (2000, p. 1), although there are many definitions and discussions about social agency and action, very few deal with social structure. By its meaning in everyday life, social structure refers to patterns or arrangements of whatever elements are considered to constitute society. According to the aforementioned authors, social structure points to three independent and complementary aspects of the social: the institutional, the relational and the embodied. *Institutional structure* is "comprising those cultural or normative patterns that define the expectations that agents hold about each other's behavior and that organize their enduring relations with each other." While, *relational structure* is "comprising the social relations themselves, understood as patterns of ... interconnection and interdependence among agents and their actions, as well as the positions they occupy." Finally, *embodied structure* is "found in the habits and skills that are inscribed in human bodies and minds and that allow them to produce, reproduce, and transform institutional structures and relational structures" (López & Scott, 2000, pp. 3-5).

Relational structure, i.e., social structure as a patterning of social relationships, is usually described as a *social network*, composed of *actors* and *relations* occurring among them. Actors are whoever and whatever performs the agencies through which relations among actors develop and hold them together. Thus, actors (or agents) can be individual people, objects or events but they can be also aggregate units such as organizations, institutions, firms, communities, groups, families etc. The very idea of the social network approach is that relations or interactions between actors are the building blocks or the key factors that sustain and define social structure, despite actors' 'nature' or any other attributes they might be endowed with (Wellman, 1988; Wasserman & Faust, 1994; Scott, 2000).

Typically, interactions between actors result from exchange of resources they hold in the specific social and cultural contexts they are living and communicating with each other, i.e., according to the existing distribution of power or authority relationships, accepted social norms, habits, dependencies, practices, expectations and preferences. In these interactions, exchanged resources can be either material or informational,

such as goods, money, information, services, social or emotional support, trust, influence etc.

Each kind of a resource exchange is considered to constitute a social network relation and actors maintaining the relation are said to maintain a *tie*. The strength of a tie may range from weak to strong, depending on the quantity, quality and frequency of the exchanges between actors (Marsden & Campbell, 1984). Patterns of who is tied to whom reveal the structure of the underlying network: they show how resources flow among actors and how actors are interconnected in the network. A few very well known examples of social network analyses are: Mark Granovetter (1973, 1974) who investigated exchange of job information among acquaintances and found that weak ties are quite operationally strong for the diffusion of such information. Harrison Wilson (1997) found that the urban poor in isolated Black ghettos lack connections with sources of work. Ronald Burt (1992) studied the dependency of social capital on 'structural holes' (which are particular kinds of network positioning in which a focal actor is connected to other actors who themselves are not connected with one another); thus, according to Burt, social capital is not a direct attribute of actors but rather of their ability to sustain flexible configurations within a network.

In the methodology of the social network analysis approach, the commonly addressed basic issues are five: cohesion, structural equivalence, prominence, range and brokerage (Haythornthwaite, 1996, pp. 330-336).

- o *Cohesion* (which is a *relational* property) refers to the grouping of actors because of the strength of their relationships with one another (Wasserman & Faust, 1994, pp. 249-290). Cohesive groups of actors form *clusters* or *cliques* depending on whether they are highly or fully interconnected, respectively. A measure of cohesion is the network *density*, which is calculated as the ratio of the number of actually occurring links (relations) to the number of all possible links (1994, pp. 101-103). A relevant concept is that of *centralization*, measuring the extent to which a set of actors are organized around a central one (1994, pp. 175-177).
- o *Structural equivalence* (which is a *positional* property) identifies actors who have similar patterns of relations with others, even if such actors may not have direct relations with each other (Wasserman & Faust, 1994, pp. 347-424). An actor's pattern of relations constitutes a *role*. Thus, actors playing similar roles occupy similar (or equivalent) structural or status positions. A technique for assessing structural equivalence is known as *block modelling*. In this technique, one first calculates correlations between all pairs of actors and then reorders the actors into sets on the basis of the correlation values in such a way that pairs of actors that are highly correlated (and, therefore, most structurally equivalent) should appear together in the same group (or block).
- o *Prominence* reflects the hierarchical status of an actor (Wasserman & Faust, 1994, pp. 169-174). It can be measured by assessing the *centrality* of an actor in a network, which is derived by measuring the actor's connections in the network, i.e., its *degree*. (This differs from the previously mentioned centralization, which measures the configuration of the network as a whole.) The actor with the highest degree (i.e., the most relationships with other actors) is the most central. Another measure of an actor's prominence is *global centrality* (or *closeness*) and it is

derived by measuring the *distance* between this actor and any other actor, which is defined as the number of connections in the shortest path between the actors (Wasserman & Faust, 1994, pp. 184-186). The actor with the lowest sum of distances to all other actors is the most globally central actor.

- o *Range* refers to a combination of network size and heterogeneity that jointly increases the ability of actors to have access to a variety of resources (social support, social capital) (Wellman & Potter, 1999, pp. 65-67). The bigger a network is, the more information an actor will have access to and the more complex the accessed information will be. Moreover, heterogeneous networks may provide a greater variety of social support.
- o *Brokerage* activity puts interested actors in touch with one another so that they might strike a deal (Knoke, 1990, pp. 144-146). It involves at least three actors with the intermediary relegating transactions between the others. According to Gould and Fernandez (1989), there are five ideal-typical roles of brokers: liaison, representative, gatekeeper, itinerant and coordinator. Brokerage can be measured by *betweenness*, the extent to which an actor is located between others in the network (Wasserman & Faust, 1994, pp. 189-191). Where opportunities of brokerage exist but have not been exploited yet, there is a 'structural hole,' in the terminology coined by Burt (1992). However, brokerage indicates not only opportunities to further exploit the network potentialities but also points of possible resistance by those currently playing the gatekeeper's role who have the power to control and filter imported or exported information.

Although network analysis may complement other methods, such as rich ethnographic description, it is often criticized of persistence towards a rigid structural modality in its effort to distil a structural essence out of empirical data. For instance, sometimes, social network analysis is imputed on its static structuralism, which is incapable to grasp the dynamic and transformative attributes of human agency (Emirbayer & Goodwin, 1994; Emirbayer & Mische, 1998). Social action is the key concept to assist a theoretical understanding of the interplay between structural relations and discursive processes, i.e., social network analyses and ethnographic studies. Because "social action is interaction that induces interpretations and thus builds continuing relations" (Mische & White, 1998, p. 695).

One of the ways that has been suggested to achieve a commingling of 'conversations and situations' is by conducting a paradigm shift, an exploration of new operational metaphors to describe social topologies (Urry, 2000, 31, 38-39). From the network paradigm, grounded in an imagery of atomic particles, it has been suggested to pass to the flow paradigm, grounded on an imagery of fluids, where "neither boundaries nor relations mark the difference between one place and another; instead, sometimes boundaries come and go, allow leakage or disappear altogether, while relations transform themselves without fracture" (Mol & Law, 1994, p. 643).

Such a 'phase transition' (a liquidation of solid structures) is assumed to be produced by two interacting kinds of uncertainty (White, 1992, pp. 102-115). On the one side, there is ambiguity, designating uncertainty in purely cultural context. On the other side, there is what Harrison White calls 'ambage,' designating uncertainty in purely social-structural contexts. Ambiguity is about fuzzy meanings and interpretations

while ambaige “concerns the concrete world of social ties, in networks of ties and corporates among nodes” (p. 107). According to White, “A polymer gel is more like social networks. These very long molecules reptate through messy, inhomogeneous environments which include other such chains and induce new ties” (p. 70). “We are creatures living within social goos, shards, and rubbery gels made up by and of ourselves” (p. 337).

The above metaphors designate some possible future directions towards which social networks might develop in order to synthesize adequately social structural and cultural analyses and to reconcile the structure/agency (or social topology/dynamics) dichotomy. It is interesting that, by highlighting processes of uncertain interactions and dynamic social change, these directions appear to approach the fractal landscapes of nonlinear dynamics and complex systems by following certain precipitous non-Euclidean sticky pathways.

Social Networks and Information and Communication Technologies

As new information and communication technologies are increasingly used in society, one can study social networks, which are mediated by these technological developments. Sometimes, these are called *computer-supported social networks* (CSSN) and they play an important role in the modern workplace and the household, in community and public life (Fulk & Steinfield, 1990; Wellman *et al.*, 1996; Wellman & Gulia, 1997). In these social networks, actors may be human, such as users, communicants, information producers and consumers, citizens, public or market organizations etc., or non-human, such as computer machines, information databases, (hyper-) documents, multimedia resources etc. Now relations among actors refer to informative and communicative uses, access, provision, procurement, commerce, work, education etc. Although human actors are always beneath the non-human ones,³ typical relations among the latter consist of information (data) flows, traffic, exchanges of e-mails and postings in web pages, links, connections, network topologies etc.

At this point, we need to mention the fact that the network concept is nowadays considered as an appropriate and useful perspective to represent organizations as social structures (Nohria, 1992). Therefore, it follows from this fact that social network analysis is an appropriate and useful method for framing and describing organizational systems through a study of organizational forms, i.e., the structural features or patterns of relationships and information flows of organizations (Zack, 2000). At the same time, his is one of the contexts for the investigation of how new organizational forms are produced by new information and communication technologies (Monge & Contractor, 2001).

In what follows, we are going to briefly review some specific studies, where social network analyses are applied, aiming to comprehend the effects of new information and communication technologies. The first impact of these technologies on social structure, we would like to discuss, is the constitution of a new form of ties by such a technological mediation: *electronic weak ties* (Papakyriazis & Boudourides, 2001).

³ Some have been attracted by the idea that in a complex heterogeneous translation network agency can be performed by both humans and machines. This is the dogma of the ‘Actor Network Theory,’ as we are going to see in the next section.

Martha Feldman (1987) was one of the firsts to stress the novel character of computer-mediated communication, which, among others, facilitates information sharing through weak ties, organizational socialization and problem solving. Jeanne Pickering and John King (1995) examined interorganizational modes of computer-mediated communication based on maintenance of external weak ties among employees who are members of professional, dispersed occupational communities. They argued that the growth of such infrastructures might encourage a shift from hierarchical to market forms of organization, at least in professionalized sectors. Furthermore, the viability and usefulness of electronic weak ties have been empirically tested by Constant, Sproull and Kiesler (1996) in their study of distant employees (strangers) exchanging technical advice through a large organizational network. They found that indeed there was an information flow between information providers and information seekers, despite their lack of personal connections, and they discussed how such weak ties were sustained by the organization's culture.

Everett Rogers (1987) was perhaps the first to preach for the use of social network analyses in investigations of new information and communications technologies. At the same time, Rogers was cautioning against problems of network sampling, data-gathering and measurement, which restrict the generalizability of network analyses. However, he believed that some of these problems might be resolved in the network research on new interactive communication technologies and media.

Eveland and Bikson (1988) empirically tested the hypothesis that information and communication technologies change the work group structures both quantitatively and qualitatively. For this purpose, they experimented with two task groups, each composed equally of recently retired employees and employees still at work but eligible to retire. Both groups were given identical tasks to prepare reports for their company on retirement planning issues but they were randomly assigned to different technologies in order to implement their tasks. One group relied on traditional office support while the other could in addition use computers and e-mail. The findings of this research indicated that there were differences in the work produced, the emerging group structures and the evaluations of their own performance: The electronically supported group developed a wider, more active, more flexible and less centralized communication structure (electronically mediated). In this way, retired members could play a more active role and contribute to a primary leverage. However, it was remarked that to sustain the operation of the electronically supported group needed significant investments in time and energy for the learning of the used technologies and the provision of a relatively high level of assistance.

Ronald Rice (1990) explicitly highlighted the relevance of the social network paradigm for studying computer-mediated communication (CMC). Arguing that theories of communication have shifted away from viewing communication as a linear transmission of a message by a source through a channel to a receiver (Shannon & Weaver, 1949) to conceptualizing communication as a process of interaction, Rice suggested social network analysis as an appropriate theoretical framework (Rogers & Kincaid, 1981) to grasp the social and organizational embeddedness of CMC.

Using network analytic methods, Rice and co-workers (1990) worked on longitudinal data from a small government office implementing an electronic messaging system (EMS). Their goal was to test hypotheses about adoption and usage of EMS from the

point of view of three theoretical frameworks: theories of social influence, critical mass and information processing. They found strong support for the role of a critical mass in influencing adoption and for the role of previous expectations about the outcomes of this technology. They also found a slight support for the roles of social information processing and some organizational information processing variables.

Rice and Aydin (1991) used social network analysis to investigate the mechanism by which individual attitudes toward an integrated health information system were influenced by the attitudes of socially proximate others. They identified three mechanisms for proximity: relational, positional and spatial. They found that social information processing results greater social influence from relational and positional sources than from spatial sources.

Burkhardt and Brass (1990) used social network analysis in order to analyze the organizational impacts of the new information and communication technologies and to study the relationship between centrality, power and the timing of adoption of a new distributed computing system. They argued that new technology might increase uncertainty and, so, might contribute to raising the power of those able to mitigate that uncertainty, while at the same time focusing communication around these uncertainty problems might alter the social network. They found that early adopters increased their power and centrality to a greater degree than later adopters and observed changes in the network structure because of the new technology.

McKenney, Zack and Doherty (1992) explored the managerial use of e-mail for task-oriented communication by examining over time the different roles of computer-mediated and face-to-face (FTF) communication within the work routines of a computer programming team. They argued that the work of managers fell into two categories: problem solving and organizing activities, both tending to reduce ambiguity and to construct a shared interpretive context. The findings of this work (obtained by social network analysis) suggest that the use of communication media is influenced by the team's different information processing needs: rich FTF communication dominates in problem-solving tasks and lean CMC is more efficient in organizing tasks.

Zack and McKenney (1995) examined how existing social structure influences the ways an organization appropriates computer-mediated communication. Through direct comparisons between networks and between organizations, they found that the CMC network closely reflected the social structure. In cases of collaborative communication and participative management, CMC was extending the range of the networks and making them more responsive. In cases of conflicted relationships and strict centralized hierarchy, CMC tended to reinforce the hierarchy. Moreover, they tried to relate performance effectiveness to followed communication patterns and to examine the impact of technology on organizational performance.

In some more recent studies, Garton, Haythornthwaite and Wellman (1999) assessed the role of e-mail and desktop videoconferencing within the context of overall communication. Haythornthwaite (2000) collected data from four computer-supported distance-learning classes in order to build a picture of the size and composition of personal online networks. The relevant questions were referring to the maintenance of four types of relationships through work and non-work interactions: collaboration on

class work, exchange of information or advice about class work, socializing and emotional support. Furthermore, students reported their frequency of communication with each member of class via each of the available means of communication: Webboard, IRC, e-mail, telephone, face-to-face scheduled or unscheduled meetings or other media they indicated they used. Haythornthwaite (2001) studied the strength of interpersonal ties among new media communicants arguing that, when the medium changes, weak ties are more vulnerable to dissolution while strong ties remain more robust. Boudourides (2001) analyzed the social network of the European University sites as well as the social network composed of the communicants in a mailing list.

Actor Network Theory

An interesting approach to think about society, technology and nature is provided by the so-called *Actor-Network Theory* (ANT), sometimes also referred as *sociology of translation*. This is a theory coming from Science and Technology Studies (STS), the field of modern sociology of science and technology (Michel Callon 1986a, 1986b; Bruno Latour, 1987, 1988; John Law, 1988, 1991). ANT sets out a structuration-type plan to describe the complex social processes underlying the construction, development and stabilization of forms of the social, the technological and the natural world and their combinations, a “mechanism by which the social and natural worlds progressively take form” (Callon, 1986b, p. 224).⁴

As conceptualized by ANT, processes of socio-technical development occur in a series of negotiations among the involved actors (to recall Latour’s famous slogan “follow the actors”). Aligned actors construct and maintain a network by enrolling allies, mobilizing resources and translating interests. In this sense, *translations* are understood as the actors’ activities of ongoing negotiations, which define actors’ physiognomy and the relations among themselves, “their identity, the roles they should play, the nature of bonds that unite them, their respective size and the history” (Callon, 1986a, p. 24). Callon distinguishes three different aspects of translations: those of the translator-spokesman, translations as obligatory points of passage and translations as displacement (pp. 24-28). To be internally organized translations in an actor-network necessitate a certain element of simplification. By *simplification* Callon means that when some entities constitute the actors of a network, only a limited number of all their possible qualities and possibilities are mobilized; a “reduction of an infinitely complex world by means of translation” (p. 29).

Actors of heterogeneous networks of translation, association and alliance more correctly could be labeled as ‘actants’ so as to emphasize the semiotic inclusion of both humans and non-humans. Thus, in ANT, heterogeneous networks, as concrete alignments between human actors, natural phenomena and social or technical aspects, result in the construction of scientific and technological objects (facts and artefacts,

⁴ What follows is an attempt to present a personal account of ANT, although the meaning of such an enterprise is questioned as problematic by the very protagonists of the theory, who hesitate to produce such a summary. In fact, a better idea would be to follow John Law’s suggestions: “That one might [better] represent actor network theory by *performing* it rather than *summarising* it. By exploring a small number of case studies rather than seeking to uncover its ‘fundamental rules’. By telling of examples, representatives of actor-network theory, that are *both* faithful and unfaithful. By stressing that *traduction* is also *trahison*. To do this we would need to tell stories, stories about noise. Actor-network noise. The kinds of noises made by actor-network theory. Noises on. Noises off” (Law, 1997).

respectively). Furthermore, even social instantiations (for example, society itself) can be produced by such actor-networks (Woolgar, 1991). However, typically the actual products of such processes are never purely one or the other but they appear as 'hybrids' comprising all three domains simultaneously (Latour, 1987).

The process of translation, through which an actor network is configured by the negotiated alignment of allies (both human and non-human), involves four stages (Callon, 1986b). First is the *problematization* stage, in which key actors are identified and persuaded that aligning themselves in the new network may provide solutions to their problems; this would involve that certain actors should become indispensable to others and, thus, access to obligatory passage points of the network should be negotiated. In the second stage, called stage of *intéressement*, actors are locked by other actors into prescribed roles so that old networks might dissolve and a new network might emerge. Third comes the stage of the proper *enrolment*, in which the identity of the new network is achieved through consent, seduction or even coercion. Final is the *mobilization* stage, in which the established representation delegations are assured and the fear of betrayal is removed.

Drawing its origin in science and technology studies, ANT's provenance lies in poststructuralism (Foucault and Serres): "The vision is of many semiotic systems, many orderings, jostling together to generate the social. On the other hand, ... [ANT] tends to tell *stories*, stories that have to do with the processes of ordering that generate effects such as technologies, ... stories which erode the analytical status of the distinction between the macro and micro-social" (Law, 1994, p. 18). Three are the main methodological principles, through the prism of which ANT analyses proceed (Callon, 1986b, p. 196): 'agnosticism' or impartiality among actors; 'generalized symmetry,' guarantying the application of the same terms and methods for different entities; and 'free association,' signifying the rejection of all (a priori or not) distinctions between the so-called 'social' and the so-called 'natural' world.

John Law (1994, p.100-1) considers that three are the main characteristics of how ANT treats agency: (i) as a relational effect, (ii) as a contingent and precarious achievement and (iii) as a collection of fragmented bits and pieces of the social world, a "recursive but incomplete performance of an unknowable number of intertwined orderings" (p. 101).

According to Nigel Thrift (1996, p. 23), five are the main contributions of ANT to theories of practice: (1) It provides a way to understand how everyday practices are incorporated into processes of social formation but without building a sophisticated theoretical construction (as Giddens's structuration theory). (2) Rather than assuming agency to be a property of these social processes, ANT displays how agency is practically constructed. (3) Such a process of construction is portrayed as requiring constant effort (thus, the importance of work of maintenance of networks) and exhibiting frequent uncertainties (thus, the importance of mistakes both in positive and negative sense). (4) Adopting a generalized notion of actors, ANT makes problematic the subject-object dualism. (5) It identifies specific accounts of practices, which are strategically responsible for the social construction of reality.

ANT is often presented as combining the insight of economics, which highlights material exchanges that actors draw in their relationships, with the insight of

sociology, which prioritizes the fact that actors come to define themselves through their interactions. Thus, Michel Callon states that “actors define one another in interaction – in the intermediaries that they put in circulation” (1991, p. 135) and also that “an intermediary is anything passing between actors which defines the relationship between them” (p. 134). In *techno-economic networks*, Callon distinguishes four types of intermediaries: (1) texts or more generally literary inscriptions (such as reports, articles, books, patents etc.), (2) technical artefacts (such as scientific instruments, machines, consumer goods etc.), (3) human beings (together with their skills, knowledge and know-how) and (4) money in all its forms (1991, p. 135). The task of such intermediaries is “more or less explicitly [to] define and distribute roles to humans and non-humans” in the network (1991, p. 137).

The stability of an actor-network is assured not only by the strength of its ties but also because of the robustness of its nodes, which is again estimated in network terms. The way Michel Callon formulates it, “a network is durable not only because of the durability of the bonds between the points ... but also because each of its points constitutes a durable and simplified network” (1986a, p. 32). Now, the persistence in time, i.e., the durability in time of an aligned network, is assessed by its *irreversibility*, which captures any available resistance against possible changes. Callon (1991, p. 149-150) argues that “the degree of irreversibility of a translation depends on two things: (a) the extent to which it is impossible to go back to a point where the translation was only one amongst others; and (b) the extent to which it shapes and determines subsequent translations.”

Commonly the finalization of an actor-network product appears as a ‘black box,’ containing “that which no longer needs to be considered, those things whose contents have become a matter of indifference” (Callon & Latour, 1981, p. 285). Thus, in any ‘setting,’ i.e., in “assemblies of humans and nonhuman actants where the competences and performances are distributed” (Akrich & Latour, 1992, p. 259), despite its complexity and its historical contestation, a ‘black box’ can be considered as a stable fact, in which only the input and output matter.

As we have seen, according to ANT, when a network is in action, facts, artefacts and instantiations of the social are produced and may be sealed in ‘black boxes.’ But several activities may apply to disclose the contents of a ‘black box.’ *Description* is the “analysis of what the various actors in a setting are doing to one another” (Akrich & Latour, 1992, p. 259). The opposite movement, *inscription*, is the activity of understanding the way technical artefacts embody patterns of use: “Technical objects thus simultaneously embody and measure a set of relations between heterogeneous elements” (Akrich, 1992, p. 205). In fact, the notion of inscription represents the structurational model favored by ANT, in which concrete anticipations and structural constraints in the use are already involved in the development phase of a technology. Madeleine Akrich explains this as follows: “Designers thus define actors with specific tastes, competences, motives, aspirations, political prejudices, and the rest, and they assume that morality, technology, science, and economy will evolve in particular ways. A large part of the work of innovators is that of ‘inscribing’ this vision of (or prediction about) the world in the technical content of the new object ... an attempt to predetermine the settings that users are asked to imagine” (1992, p. 208). One type of inscriptions is particularly helpful for the phase of description: *prescription* (or proscription or affordance or allowance), i.e., usually texts (such as manuals,

brochures, promotional material, critical reviews of others etc.), which explain the technical object. Hence, prescription is “what a device allows or forbids from the actors (humans and non-humans) that it anticipates; it is the morality of the setting both negative (what it prescribes) and positive (what it permits)” (Akrich & Latour, 1992, p. 261).

Bruno Latour (1990, pp. 44-47) offers an interesting list of advantages that inscriptions exhibit. Among them, one is particularly important: this is the concept of ‘immutable mobiles.’ Here is how John Law (2000) describes the way Latour employs this concept: “He [Latour] talks of objects such as vessels (though the description applies equally well to electronic messages passing round the globe, or travellers, or letters in the postal service) as *immutable mobiles*. Mobile, yes, because they move around ... And immutable because they hold their form, their structure. Here, then, the network-ness of the metaphor works in two ways ... The immutable mobiles are *themselves* a network, an array. They *are* objects. But they also pass down or through a network, held in an array of secure and stable surroundings as they move around.”

During the last few years, there are some developments in ANT, which have led to the so-called perspective of *Actor-Network Theory and After* (Law & Hassard, 1999). As in the new perspective, emphasis is given in situations of instability and tensions in networks, there is also a shift in the employed paradigms and metaphors to think about social complexities. For instance, John Law and Annemarie Mol (2000), in their effort to follow the change of focus in techno-science from the universal to the situated local, are now proposing four different spaces or social topologies: (Euclidean) *region*, *network*, *fluid* and *fire* (cf., Mol & Law, 1994). As social topology changes, from regions, to networks, to fluids and finally to fire, social objects sustain a corresponding series of transformations, from *immutable immobile*, to *immutable mobile*, to *mutable mobile* and finally to *mutable immobile* (Law & Mol, 2000). As we are passing in the ‘after’ phase of ANT, these new metaphors are provoking a new sensitivity and awareness of varieties, alternatives, partial connections, fractionality and otherness.

Beyond the latest developments, ANT has concentrated a lot of criticisms from the first period (1980s) of its appearance, although it was not before the 1990s that at least the most pungent of these criticisms were stated. Basically, ANT was attacked from the outside and the inside of the field of science and technology studies. Here we will only quote some of the latter criticisms (just remarking the anti-social-constructivist flavor of the former ones throughout typical incidents in the skirmishes of the ‘science-wars’). The first wave of rather mild attacks against ANT included Knorr-Cetina (1985), Shapin (1988), Schaffer (1991) and Sturdy (1991). The second wave was certainly more trenchant: Amsterdamska (1990), Collins and Yearley (1992), Collins (1994), Gingras (1995), van den Belt (1995), Bloor (1999) and Elam (1999). Some of these criticisms have been replied by the ANT theorists: Woolgar (1992), Callon & Latour (1992), Latour (1999) etc. The range of the contested issues was wide and it included the role of sociology, anthropology, cultural studies, science and technology studies and also the status of the grand divides, such as humans vs. non-humans, man and nature, society and technology, modern vs. postmodern. Gerard de Vries (1995) has attempted to provide a description of the positions that both sides

(personalized in the couple of Bruno Latour and Harry Collins) were holding in this theoretical battlefield.

Actor-Network Theory and Information and Communication Technologies

There are many investigations of information systems and information and communication technologies inspired by ANT. However, one has to bear in mind that ANT is not (and cannot function as) a theoretical armory from which one could draw resources when trying to explore an issue. ANT simply provides a space of problematization on which a number of questions can be formulated. This is why in 'applications' of ANT in computers and computer networks one has to follow the interpretivist/ethnomethodological strategy of ethnographic explorations (or discourse analysis) by means of empirical research and field/case studies.

A very illustrative such analysis was performed by Steve Woolgar (1991; Grint & Woolgar, 1997, pp. 65-94), who, for eighteen months, committed a participant observation study in a company manufacturing computers. Underlying these investigations are two incentives: First is a version of the argument of 'taking the social dimensions of technology into account,' according to which technology is socially shaped in such a way that its resulting material form should reflect the social circumstances of its development. Thus, technology can be regarded as incorporating 'congealed social relations,' i.e., practices, predispositions, assumptions, beliefs and other factors involved in its design and manufacture (in the production stage) but which might have consequences in subsequent usage (in the consumption stage). Second is Woolgar's determination to explore the metaphor of 'the machine as text' in order to discern the 'social dimensions' of technology. In fact, "when construed as a text, technology is to be understood as a manufactured entity, designed and produced within a particular social and organizational context. Significantly, this is often done with particular readers or sets of possible readers in mind – it is fabricated with the intention that it should be used in particular ways" (Woolgar, 1996, p. 92). Now, such processes do not simply result the (social) construction of the user, because it is not just the identity of the putative user, which is constructed through them. Concurrently to negotiations (translations) over the user's identity, it is a set of design activities (but also involving manufacturing and sales), which are attempting to delimit and constrain the user's possible actions. In this sense, Woolgar is arguing that "by setting parameters for the user's actions, the evolving machine effectively attempts to *configure* the user" (1991, p. 61). Furthermore, by an analysis of audio and video records of usability trials, Woolgar suggested the importance of this type of 'boundary work' in "deciding the adequacy of the relationship between machine and user" (p. 59). Let's add that, in another study, Rachel and Woolgar (1995) examined 'technical' talk as a categorizing device intended to do boundary work by expressing social relations and norms of acceptance. They argued that 'technical' talk invokes and performs a disjunction between networks of social relationships and stipulates a moral order with associated norms to acceptance and transition. Therefore, the difficulty of penetrating the intelligibility of 'technical' talk is construed as a struggle for familiarization with the routine social actions of a separate community.

In another 'textual research,' Bloomfield and Vurdubakis (1994b) examined the reports produced by management consultants, as exercises in textual reality construction, in order to discuss the textual practices through which the boundary

between the 'technical' and the 'social' is constructed and sustained in organizations. Their starting point was to think of these reports as 'inscriptions,' used to represent reality in order to act on it, control or dominate it, as well as to secure the compliance of others in that domination. Concentrating on a particular variant of this genre, namely, the information technology strategy report, they focused on the ways in which 'reality' and the forms of knowledge appropriate to it are constituted in the course of certain communicative practices.

As for the boundary between the technical and the social, Bloomfield and Vurdubakis (1994a) argued that any attempt to unravel it threatens the validity of the various narratives in which technologies play a mediating role. However, they claimed that it is only by addressing such issues that one could better understand how different narratives construct and reproduce different views of technology and society. In fact, their point was that such representations of reality actively construct rather than passively reflect an apparent 'solidity.' To discuss such 'boundary disputes' between the technical and the social, the authors attended two case studies. The first referred to relationships between IT professionals and users developed during the implementation of a hospital information system. The second focused on a project to develop a knowledge-based system providing solutions to problems associated with IT system evolution, which included a consortium composed of financial and academic institutions and software consultants.

Bloomfield and Vurdubakis (1997) have also studied the representational practices of information systems development. In particular, they focused on a group of representational practices centered on data modelling and information requirements analysis undertaken by the UK National Health Service. Their intention was to investigate how particular 'inscription devices' institute versions of the objects they purport to render visible. In this way, the authors explored the way visions of organization (articulated through vocabularies of efficiency, effectiveness, the centrality of information in management, management by objectives etc.) were translated into specific alignments of the gaze, i.e., specific organizations of vision (such as data modelling etc.).

Recently, Bloomfield and Vurdubakis (1999) focused on science fiction and ANT as ways of writing displacement in the organizational context. Such a perspective is encouraged since the articulation of organization as a privileged site of presence is made possible by that which is Othered and excluded (or rather deferred) because it represents disorganization and disorder. In this sense, organizations constitute incomplete and transient accomplishments, which are always under threat from various forms of intrusion and displacement. Thus, the aim of the authors was to explore how the Other, the alien and the out of place are realized in representation.

Manning (1996) examined the use of the cellular telephone in police agencies as an example of 'low-tech' innovation in information technology. Drawing on qualitative data (such as interviews of focus-groups and ethnographic description), the study illustrated the impact of cellular phones on the social organization of police work in the early 1990s. The methodological tool was a dramaturgical analysis of the selective use of messages to communicate to an audience. Thus, dramaturgy revealed how the emergent meanings of information technology, arising from changes in communication and symbolization, might shape police work processes and authority.

Technology, in this instance, is 'read' by organizational routines and structures and acts as a 'text' for informing particular audiences about the impressions, which organizational actors wish to present.

There are certainly more papers on ANT and information systems (IS) research. Additionally, we are briefly referring to the following ones too: Walsham (1997) has written an overview on ANT in IS research. Tatnall & Gilding (1999) have reviewed the literature on ANT applications in diffusion and implementation of information systems and other situations involving technological innovation. Jones (1998) has compared the ANT approach to IS with that of structuration theory. Monteiro (1999), Monteiro & Hanseth (1995), Monteiro & Hepsø (1998) and Hepsø (2000) have explored applications of ANT in IS with emphasis on information infrastructures and human stakeholders.

Finally, the following papers discuss issues relating ANT and e-mail:

Lea, O'Shea and Fung (1995) presented a case study of the development of electronic communications in a changing organization. Their aim was to study the relationship between content and context in the design and implementation of a CMC system, which was followed over a period of four years, during which time the observed organization expanded, reformed and evolved into a networked organization. The ANT approach was used to explore the co-construction of the new organizational form and the new communicational system. Furthermore, this approach was contrasted with other more traditional ones.

Brigham and Corbett (1997) performed a case study of how people and technology act upon each other within an organization. Because of a dissatisfaction with the 'media choice' approach, they preferred to follow the actor-network theory, since "relations are never purely social: they are partly social, partly technological, partly textual, and partly to do with naturally occurring events, objects and processes" (p. 26). In this view of the social network, power is "conceptualised as a relational effect which is characterised by the action of others" (p. 27). They found that the introduction of e-mail in the observed organization brought about both a decentralization of power (giving all employees a PC and the consequent displacement of much decision-making to groups or individuals) and increased centralization of power (greater accountability requirements and ease of long-distance control with everyone on the e-mail network). They also note that "as with many forms of advanced communication technology, e-mail impersonalises the authorship of the system thereby making control more difficult to perceive" (p. 30).

In a recent work, Brigham and Corbett (2001) attempted to describe the relational processes of virtual organizing through ANT. They made an ethnographic study of the largest provider of English language courses to adults in Denmark. The aim was to illustrate the multiplicity of virtual organizing and ordering and to explore "the ways in which human and non-human actors are attributed, distributed, connected, circulated and transformed." Furthermore, on the occasion of their (virtual) ethnographic study, the authors commented upon the main elements of ethnographic work comprising observation, presence, social relations and community.

Lin & Conford (2000) explored IS implementation in the early stages of a project following the theoretical framework of ANT. The paper was based on a case study of the early stages of a new e-mail system in an international banking institution. The findings suggest that a translation process at both the individual and the organizational level, which takes place at the initial stage of an IS project, might have significant consequences for the overall implementation process.

References

- Akrich, M. (1992). The de-scription of technical objects. In W. Bijker & J. Law (eds.), *Shaping Technology / Building Society: Studies in Sociotechnical Change*, pp. 205-224. Cambridge, MA: MIT Press.
- Akrich, M., & Latour, B. (1992). A convenient vocabulary for the semiotics of human and nonhuman actors. In W. Bijker & J. Law (eds.), *Shaping Technology / Building Society: Studies in Sociotechnical Change*, pp. 259-264. Cambridge, MA: MIT Press.
- Amsterdamska, O. (1990). Surely you are joking Monsieur Latour! *Science, Technology, & Human Values*, vol. 15, no. 4, pp. 495-504.
- Archer, M.S. (1988). *Culture and Agency: The Place of Culture in Social Theory*. Cambridge, UK: Cambridge University Press.
- Archer, M.S. (1995). *Realist Social Theory: The Morphogenetic Approach*. Cambridge, UK: Cambridge University Press.
- Barley, S.R. (1986). Technology as an occasion for structuring: Evidence from observation of CT scanners and the social order of radiology departments. *Administrative Science Quarterly*, vol. 31, pp. 78-108.
- Bernstein, R.J. (1978). *The Restructuring of Social and Political Theory*. Philadelphia: University of Pennsylvania Press.
- Bhaskar, R. (1979). *The Possibility of Naturalism: A Philosophical Critique of the Contemporary Human Sciences*. Brighton, UK: Harvest Press.
- Bloor, D. (1999). Anti-Latour. *Studies in the History and Philosophy of Science*, vol. 30, no. 1, pp. 81-112.
- Boudourides, M.A. (2001). New directions of Internet research. Presented at the GOR 2001 Conference, Göttingen, May 17-18, 2001. Electronically available at: <http://www.math.upatras.gr/~mboudour/articles/ir.pdf>
- Bourdieu, P. (1977). *Outline of a Theory of Practice*. London: Cambridge University Press.
- Bourdieu, P. (1984). *Distinction: A Social Critique of the Judgment of Taste*. Cambridge, MA: Harvard University Press.
- Bloomfield, B.P., & Vurdubakis, T. (1994a). Boundary disputes: Negotiating the boundary between the technical and the social in the development of IT systems. *Information Technology & People*, vol. 7, no. 1, pp. 9-24.
- Bloomfield, B.P., & Vurdubakis, T. (1994b). Re-presenting technology: IT consultancy reports as textual reality constructions. *Sociology*, vol. 28, no. 2, pp. 455-477.
- Bloomfield, B.P., & Vurdubakis, T. (1997). Visions of organization and organizations of vision: The representational practices of information systems development. *Accounting, Organizations and Society*, vol. 22, no. 7, pp. 639-668.
- Bloomfield, B.P., & Vurdubakis, T. (1999). The outer limits: Monsters, Actor Networks and the writing of displacement. *Organization*, vol. 6, no. 4, pp. 625-647.
- Brigham, M., & Corbett, M.J. (1997). E-mail, power and the construction of organisational reality. *New Technology, Work and Employment*, vol. 12, no. 1, pp. 25-35.
- Brigham, M., & Corbett, M.J. (2001). Virtual organising, virtual worlds: An ethnography of (Actor-Net) Working (working paper). Lancaster University Management School. Electronically available at: <http://www.lums.lancs.ac.uk/BINO/working%20papers/Brigham.1.pdf>
- Brooks, L. (1997). Structuration theory and new technology: Analyzing organizationally situated computer-aided design. *Information Systems Journal*, vol. 7, pp. 133-151.

- Burkhardt, M.E., & Brass, D.J. (1990). Changing patterns or patterns of change: The effects of a change in technology on social network structure and power. *Administrative Science Quarterly*, vol. 35, no. 1, pp. 104-127.
- Burt, R. (1992). *Structural Holes*. Chicago: Chicago University Press.
- Callon, M. (1986a). The sociology of an Actor Network: The case of the electric vehicle. In M. Callon, J. Law & A. Rip (eds.), *Mapping the Dynamics of Science and Technology: Sociology of Science in the Real World*, pp. 19-34. London: Macmillan.
- Callon, M. (1986b). Some elements of a sociology of translation: Domestication of the scallops and the fisherman of St Brieuc Bay. In J. Law (ed.), *Power, Action and Belief: A New Sociology of Knowledge?* pp. 196-233. London: Routledge & Kegan Paul.
- Callon, M. (1991). Techno-economic networks and irreversibility. In J. Law (ed.), *A Sociology of Monsters: Essays on Power, Technology and Domination*, pp. 132-161. London: Routledge.
- Callon, M., & Latour, B. (1981). Unscrewing the big Leviathan: How actors macro-structure reality and how sociologists help them to do so. In K. Knorr-Cetina & A.V. Cicourel (eds.), *Advances in Social Theory and Methodology: Toward an Integration of Micro- and Macro-Sociologies*, pp. 277-303. Boston: Routledge & Kegan Paul.
- Callon, M., & Latour, B. (1992). Don't throw the baby out with the Bath school! A reply to Collins and Yearley. In A. Pickering (ed.), *Science as Practice and Culture*, pp. 343-368. Chicago: The University of Chicago Press.
- Clegg, S.R. (1989). *Frameworks of Power*. London: Sage.
- Collins, H.M. (1994). Bruno Latour: We Have Never Been Modern. *Isis*, vol. 85, no. 4, pp. 672-674.
- Collins, H.M., & Yearley, S. (1992). Epistemological chicken. In A. Pickering (ed.), *Science as Practice and Culture*, pp. 301-326. Chicago: The University of Chicago Press.
- Constant, D., Sproull, L., & Kiesler, S. (1996). The kindness of strangers: The usefulness of electronic weak ties for technical advice. *Organization Science*, vol. 7, no. 2, pp. 119-135.
- Contractor, N., & Seibold, D.R. (1993). Theoretical frameworks for the study of structuring processes in group decision support systems: Adaptive Structuration theory and Self-Organizing Systems theory. *Human Communication Research*, vol. 19, no. 4, 528-563.
- Craib, I. (1992). *Anthony Giddens*. London: Routledge.
- DeSanctis, G., & Poole, M.S. (1994). Capturing the complexity in advanced technology use: Adaptive structuration theory. *Organization Science*, vol 5, no. 2, pp. 121-147.
- de Vries, G. (1995). Should we send Collins and Latour to Dayton, Ohio? *EASST Review*, vol. 14, no. 4, 3-10.
- Elam, M. (1999). Living dangerously with Bruno Latour in a hybrid world. *Theory, Culture & Society*, vol. 16, no. 4, pp. 1-24.
- Emirbayer, M., & Goodwin, J. (1994). Network analysis, culture, and the problem of agency. *American Journal of Sociology*, vol. 99, pp. 1411-1454.
- Emirbayer, M., & Mische, A. (1998). What is agency? *American Journal of Sociology*, vol. 103, pp. 962-1023.
- Eveland, J.D., & Bikson, T.K. (1988). Work group structures and computer support: A field experiment. *ACM Transactions on Office Information Systems*, vol. 6, no. 4, pp. 354-379.
- Feldman, M.S. (1987). Electronic mail and weak ties in organizations. *Office: Technology and People*, vol. 3, pp. 83-101.
- Fulk, J., & Steinfield, C.W. (eds.) (1990). *Organizations and Communication Technology*. Newbury Park, CA: Sage.
- Fulk, J., & Boyd, B. (1991). Emerging theories of communication in organizations. *Journal of Management*, vol. 17, pp. 407-446.

- Garton, L., Haythornthwaite, C., & Wellman, B. (1999). Studying on-line social networks. In S.G. Jones (ed.), *Doing Internet Research: Critical Issues and Methods for Examining the Net*, pp. 75-105. Thousand Oaks, CA: Sage.
- Giddens, A. (1976). *New Rules of Sociological Method: A Positive Critique of Interpretive Sociologies*. New York: Basic Books.
- Giddens, A. (1979). *Central Problems in Social Theory: Action, Structure and Contradiction in Social Analysis*. Berkeley: University of California Press.
- Giddens, (1981). Agency, institution, and time-space analysis. In K. Knorr-Cetina & A.V. Cicourel (eds.), *Advances in Social Theory and Methodology: Toward an Integration of Micro- and Macro-Sociologies*, pp. 161-174. Boston: Routledge & Kegan Paul.
- Giddens, A. (1984). *The Constitution of Society: Outline of the Theory of Structuration*. Berkeley: University of California Press.
- Gingras, Y. (1995). Following scientists through society? Yes, but at arms length! In J.Z. Buchwald (ed.), *Scientific Practice*, pp. 123-148. Chicago: Chicago University Press.
- Gopal, A., Bostrom, R.P., & Chin, W.W. (1993). Applying Adaptive Structuration Theory to investigate the process of group support systems use. *Journal of Management Information Systems*, vol. 9, pp. 45-69.
- Gould, R.V., & Fernandez, R.M. (1989). Structures of mediation: A formal approach to brokerage in transaction networks. *Sociological Methodology*, vol. 19, pp. 89-126.
- Granovetter, M. (1973). The strength of weak ties. *American Journal of Sociology*, vol. 78, pp. 1360-1380.
- Granovetter, M. (1974). *Getting a Job*. Cambridge, MA: Harvard University Press.
- Grint, K., & Woolgar, S. (1997). *The Machine at Work: Technology, Work and Organization*. Cambridge, UK. Polity Press.
- Habermas, J. (1984). *The Theory of Communicative Action. Vol. 1, Reason and the Rationalization of Society*. Boston: Beacon Press.
- Habermas, J. (1987). *The Theory of Communicative Action. Vol. 2, Lifeworld and System: A Critique of Functionalist Reason*. Boston: Beacon Press.
- Haythornthwaite, C. (1996). Social network analysis: An approach and technique for the study of information exchange. *Library and Information Science Research*, vol. 18, pp. 323-342.
- Haythornthwaite, C. (2000). Online personal networks: Size, composition and media use among distance learners. *New Media and Society*, vol. 2, no. 2, pp. 195-226.
- Haythornthwaite, C. (2001). The strength and the impact of new media. In the Proceedings of the IEEE Hawaii International Conference on System Sciences, January 3-6, 2001, Maui, Hawaii.
- Hepsø, V. (2000). The involvement of human and non human stakeholders: Combining Actor Network Theory and Action Research. In Proceedings of *IRIS 23*. Electronically available at: http://www.apertura.ntnu.no/vidar/html/default_stakeholder.html
- Jones, M. (1998). Information Systems and the double mangle: Steering a course between the Scylla of embedded structure and the Charybdis of strong symmetry. Presented at the IFIP WG8.2 & WG8.6 Joint Working Conference on *Information Systems: Current Issues and Future Changes*, Helsinki, Finland, December 10-13, 1998. Electronically available at: <http://www.bi.no/dep2/infomgt/wg82-86/proceedings/jones.pdf>
- Jones, M. (1999). Structuration theory. In W.L. Currie & B. Galliers (eds.), *Rethinking Management Information Systems*, pp. 103-135. Oxford: Oxford University Press.
- Jones, M., & Nandhakumar, J. (1993). Structured development? A structural analysis of the development of an executive information system. In D.E. Avison, J.E. Kendal & J.I. DeGross (eds.), *Human, Organizational, and Social Dimensions of Information Systems Development*, pp. 475-496. Amsterdam: North Holland.
- Karsten, H. (1995). 'It's like everyone working round the same desk:' Organizational readings of Notes. *Scandinavian Journal of Information Systems*, vol. 7, no. 1, pp. 7-34.
- Knoke, D. (1990). *Political Networks: The Structural Perspective*. Cambridge, UK: Cambridge University Press.

- Knorr-Cetina, K. (1985). Germ warfare. *Social Studies of Science*, vol. 15, pp. 577-585.
- Latour, B. (1987). *Science in Action*. Cambridge, MA: Harvard University Press.
- Latour, B. (1988). The Prince for machines as well as for machinations. In B. Elliott (ed.), *Technology and Social Process*, pp. 20-43. Edinburgh: Edinburgh University Press.
- Latour, B. (1990). Drawing things together. In M. Lynch & S. Woolgar (eds.), *Representation in Scientific Practice*, pp. 19-68. Cambridge, MA: MIT Press.
- Latour, B. (1999). For David Bloor... and beyond: A reply to David Bloor's 'Anti-Latour.' *Studies in the History and Philosophy of Science*, vol. 30, no. 1, pp. 113-129.
- Law, J. (1988). The anatomy of a socio-technical struggle: The design of the TSR2. In B. Elliott (ed.), *Technology and Social Process*, pp. 44-69. Edinburgh: Edinburgh University Press.
- Law, J. (1991). Introduction. In J. Law (ed.), *A Sociology of Monsters: Essays on Power, Technology and Domination*, pp. 1-23. London & New York: Routledge.
- Law, J. (1994). *Organizing Modernity*. Oxford: Blackwell.
- Law, J. (1997). Traduction/Trahison – Notes on ANT. Department of Sociology, Lancaster University. Electronically available at: <http://www.comp.lancs.ac.uk/sociology/stslaw2.html>
- Law, J. (2000). Objects, spaces, others (draft). Centre for Science Studies and the Department of Sociology, University of Lancaster. Electronically available at: <http://www.comp.lancaster.ac.uk/sociology/soc027jl.html>
- Law, J., & Hassard, J. (eds.) (1999). *Actor Network Theory and After*. Oxford: Blackwell.
- Law, J., & Mol, A. (2000). Situating technoscience: An inquiry into spatiality (draft). Centre for Science Studies and the Department of Sociology, University of Lancaster, and the Department of Philosophy, University of Twente. Electronically available at: <http://www.comp.lancaster.ac.uk/sociology/soc052jl.html>
- Lea, M., O'Shea, T., & Fung, P. (1995). Constructing the networked organization: Content and context in the development of electronic communications. *Organization Science*, vol. 6, no. 4, pp. 462-478.
- Lin, A., & Cornford, T. (2000). Framing implementation management. In Proceedings of the International Conference on Information Systems, Brisbane, Australia, December, 2000. Electronically available at: <http://acm.proxy.nova.edu/pubs/articles/proceedings/misc/359640/p197-lin/p197-lin.pdf>
- López, J., & Scott, J. (2000). *Social Structure*. Buckingham: Open University Press.
- Manning, P.K. (1996). Information technology in the police context: The 'sailor' phone. *Information Systems Research*, vol. 7, no. 1, pp. 52-62.
- Marsden, P., & Campbell, K.E. (1984). Measuring tie strength. *Social Forces*, vol. 63, pp. 482-501.
- McKenney, J.L., Zack, M.H., & Doherty, V. (1992). Complementary communication media: A comparison of electronic mail and face-to-face communication in a programming team. In N. Nohria & R.G. Eccles (eds.), *Networks and Organizations: Structure, Form, and Action*, pp. 262-287. Boston: Harvard Business School Press.
- Mische, A., & White, H. (1998). Between conversation and situation: Public switching dynamics across network domains. *Social Research*, vol. 65, no. 3, pp. 695-724.
- Mol, A., & Law, J. (1994). Regions, networks and fluids: Anaemia and social topology. *Social Studies of Science*, vol. 24, pp. 641-671.
- Monge, P.R., & Contractor, N. (2001). Emergence of communication networks. In F.M. Jablin & L.L. Putnam (eds.), *New Handbook of Organizational Communication*, pp. 440-502. Newbury Park, CA: Sage.
- Monteiro, E. (1999). Monsters. In K. Braa, B. Dahlbom and C. Sørensen (eds.), *Planet Internet*, pp. 239-249. Lund: Studentlitteratur. Electronically available at: <http://www.idi.ntnu.no/~ericm/ant.metode.FINAL.htm>
- Monteiro, E., & Hanseth, O. (1995). Social shaping of information infrastructure: On being specific about the technology. In W. Orlikowski, G. Walsham, M.R. Jones & J.I. DeGross (eds.), *Information Technology and Changes in Organisational Work*, pp.

- 325-343. London: Chapman & Hall. Electronically available at: <http://www.ifi.uio.no/~oleha/Publications/siste82.html>
- Monteiro, E., & Hepsø, V. (1998). Diffusion of infrastructure: Mobilisation and improvisation. In T. Larsen & L. Levine (eds.), *Proceedings '98 IFIP WG 8.2 & 8.6*, pp. 255-274. IFIP. Electronically available at: <http://www.idi.ntnu.no/~ericm/monteiro.pdf>
- Nohria, N. (1992). Is a network perspective a useful way of studying organizations? In N. Nohria & R.G. Eccles (eds.), *Networks and Organizations: Structure, Form, and Action*, pp. 1-22. Boston: Harvard Business School Press.
- Orlikowski, W.J. (1992). The duality of technology: Rethinking the concept of technology in organizations. *Organization Science*, vol. 3, no. 3, pp. 398-427.
- Orlikowski, W.J., & Robey, D. (1991). IT and the structuring of organizations. *Information Systems Research*, vol. 2, no. 2, pp. 143-169.
- Papakyriazis, N.V., & Boudourides, M.A. (2001). Electronic weak ties in network organizations. Presented at the GOR 2001 Conference, Göttingen, May 17-18, 2001. Electronically available at: <http://www.math.upatras.gr/~mboudour/articles/ewt1.pdf>
- Pettigrew, A.M. (1985). *The Awakening Giant: Continuity and Change in ICI*. Oxford: Blackwell.
- Pickering, J.N., & King, J.L. (1995). Hardwiring weak ties: Interorganizational computer-mediated communication, occupational communities, and organizational change. *Organization Science*, vol. 6, no. 4, pp. 479-486.
- Poole, M.S., & DeSanctis, G. (1990). Understanding the use of group decision support systems: The theory of Adaptive Structuration. In J. Fulk & C. Steinfield (eds.), *Organizations and Communication Technology*, pp. 173-193.
- Poole, M.S., Seibold, D.R., & McPhee, M.D. (1985). Group decision-making as a structuration process. *Quarterly Journal of Speech*, vol. 71, pp. 74-102.
- Rachel, J., & Woolgar, S. (1995). The discursive structures of the social-technical divide: The example of information systems development. *Sociological Review*, vol. 43, no. 2, pp. 271-273.
- Rice, R.E. (1990). Computer-mediated communication system network data: Theoretical concerns and empirical examples. *International Journal of Man-Machine Studies*, vol. 32, pp. 627-647.
- Rice, R.E., & Aydin, C. (1991). Attitudes toward new organizational technology: Network proximity as a mechanism for social information processing. *Administrative Science Quarterly*, vol. 36, 219-244.
- Rice, R.E., Grant, A.E., Schmitz, J., & Torobin, J. (1990). Individual and network influences on the adoption and perceived outcomes of electronic messaging. *Social Networks*, vol. 12, pp. 27-55.
- Ritzer, G. (1996). *Modern Sociological Theory*, fourth edition. New York: McGraw-Hill.
- Rogers, E.M. (1987). Progress, problems and prospects for network research: Investigating relationships in the age of electronic communication technologies. *Social Networks*, vol. 9, pp. 285-310.
- Rogers, E.M., & Kincaid, D.L. (1981). *Communication Networks: A New Paradigm for Research*. New York: Free Press.
- Schaffer, S. (1991). The eighteenth brumaire of Bruno Latour. *Studies in the History and Philosophy of Science*, vol. 22, pp. 174-192.
- Scott, J. (2000). *Social Network Analysis*, second edition. London: Sage.
- Shannon, C., & Weaver, W. (1949). *The Mathematical Theory of Communication*. Urbana: University of Illinois Press.
- Shapin, S. (1988). Following scientists around. *Social Studies of Science*, vol. 18, pp. 533-550.
- Sturdy, S. (1991). The germs of a new enlightenment. *Studies in the History and Philosophy of Science*, vol. 22, pp. 163-173.

- Tatnall, A., & Gilding, A. (1999). Actor-Network Theory and Information Systems research. Paper presented at the 10th Australasian Conference on Information Systems. Electronically available at: <http://www.vuw.ac.nz/acis99/Papers/PaperTatnall-069.pdf>
- Thrift, N. (1996). *Spatial Formations*. London: Sage Publications.
- Urry, J. (2000). *Sociology Beyond Societies: Mobilities for the Twenty-first Century*. London: Routledge.
- van den Belt, H. (1995). How to critically follow the agricultural technoscientist: Kloppenburg versus Latour. In The Agrarian Questions Organisation Committee (eds.), *Agrarian Questions: The Politics of Farming anno 1995*, pp. 43-53. The Netherlands: Wageningen.
- Walsham, G. (1993). *Interpreting Information Systems*. Chichester: Wiley.
- Walsham, G. (1997). Actor-Network theory and IS research: Current status and future prospects. In A.S. Lee, J. Liebenau & J.I. DeGross (eds.), *Information Systems and Qualitative Research*, pp. 466-480. London: Chapman & Hall.
- Walsham, G., & Han, C.K. (1991). Structuration theory and Information Systems research. *Journal of Applied Systems Analysis*, vol. 17, pp. 77-85.
- Walsham, G., & Sahay, S. (1996). GIS for district-level administration in India: Problems and Opportunities. *Management Information Systems Quarterly*, vol. 23, no. 1, pp. 39-65.
- Wasserman, S., & Faust, K. (1994). *Social Network Analysis: Methods and Applications*. Cambridge, UK: Cambridge University Press.
- Wellman, B. (1988). Structural analysis: From method and metaphor to theory and substance. In B. Wellman & S.D. Berkowitz (eds.), *Social Structures: A Network Approach*, pp. 19-61. Cambridge, UK: Cambridge University Press.
- Wellman, B., & Gulia, M. (1997). Net surfers don't ride alone: Virtual community as community. In M.A. Smith & P. Kollock (eds.), *Communities in Cyberspace*, pp. 167-194. London: Routledge.
- Wellman, B., & Potter, S. (1999). The elements of personal communities. In B. Wellman (ed.), *Networks in the Global Village: Life in Contemporary Communities*, pp. 49-81. Boulder: Westview Press.
- Wellman, B., Salaff, J., Dimitrova, D., Garton, L., Gulia, M., & Haythornthwaite, C. (1996). Computer networks as social networks: Collaborative work, telework, and virtual community. *Annual Review of Sociology*, vol. 22, pp. 213-238.
- White, H.C. (1992). *Identity and Control: A Structural Theory of Social Action*. Princeton, NJ: Princeton University Press.
- Wilson, W.J. (1997). *When Work Disappears: The World of the New Urban Poor*. New York: Alfred A. Knopf.
- Woolgar, S. (1991). Configuring the user: The case of usability trials. In J. Law (ed.), *A Sociology of Monsters: Essays on Power, Technology and Domination*, pp. 58-99. London & New York: Routledge.
- Woolgar, S. (1992). Some remarks about positionism: A reply to Collins and Yearley. In A. Pickering (ed.), *Science as Practice and Culture*, pp. 327-342. Chicago: The University of Chicago Press.
- Zack, M.H. (2000). Researching organizational systems using social network analysis. *Proceedings of the 33rd Hawaii International Conference on System Science*. Electronically available at: <http://www.cba.neu.edu/~mzack/articles/socnet/socnet.htm>
- Zack, M.H., & McKenney, J.L. (1995). Social context and interaction in ongoing computer-supported management groups. *Organization Science*, vol. 6, no. 4, pp. 394-422.