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***The contribution of Network Analysis to  
the Study of Social and Economic Implications of ITCs.  
A Review of Studies.***

***Annex to Report Study 1 (June 2009)  
Analysis of e-Inclusion impact resulting from advanced R&D based  
on economic modelling in relation to innovation capacity, capital  
formation, productivity, and empowerment***

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# **The contribution of Network Analysis to the Study of Social and Economic Implications of ITCs. A Review of Studies.**

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## **1. Introduction: social network analysis and network society**

Among the objectives set by the Lisbon treaty was an improvement of the perspective that the EU has of the Information Society. The relationship between the individuals (EU citizens) and social, economic and institutional implications of ITCs is expected to become more intense and to bring new ways of creating value, of customizing products and services on a variety of consumers' categories. In particular, according to EU Institutions there is the need to recognize that in a globalized world the importance of non-price factors in competition, of specialization, of rapid market entry and of complementary resources is rising and will imply social as well as economic changes. Europe objectives should focus on innovation and define and carry on a systemic approaches to it, launching projects and initiatives that bridge the 'innovation gap' and balance social and economic diversity among the regional areas of Europe. The responses needed are identified in three policy fields: a) innovation, with the development of technology driven research and demand driven multidisciplinary research in real world settings; b) creativity, supporting knowledge sharing and creation in multidisciplinary and connected environments; and finally c) inclusion, realizing opportunities for full participation of European citizens to the progress of their societies and integration of advanced technologies in professional and private roles.

Coherently, these aspects receive a specific attention in this research report, Smart 2008/0065, whose aim is an evaluation of current e-integration in the EU. The previous Study Report I (June 2009) defined the concepts of ITCs e-inclusion and its social and economic collateral implications (social exclusion and digital inequality, digital divide and integration) as sketched on by the European Institutions. The second annex to Study Report I (November 2009) described also a specific quantitative methodology that could contribute to measure e-Inclusion both at the level of the households and in the economic market (firms). Dimensions concerning access, use and impact were identified and a multidimensional approach combining several indicators for each EU country member was proposed to evaluate new forms of exclusion.

The aim of the present annex to Study Report II (January 2010) is to support the sub-theme of digital inequalities and network society with a series of contemporary and recent studies concerning ITCs and their impact both at the individual (household, firm) and at the social level (social organization, economic system and institutions). The studies analyzed adopt a specific methodology, *Social Network Analysis* (or SNA), whose relevance and usefulness is established for the study of social integration and development and is expected to be significant also for contemporary problems related to ITC implementation. The contribution that network analysis can give to the study of the digital society and its economic and social impact will be reviewed in the following document which has been organized in two introductive paragraphs and a review of the studies.

### **1. Social network analysis and network society.**

Before describing the main methodological issues of Social Network Analysis it is necessary to clarify the prospective of social network analysis and its methodological implications and to relate them to the context of a progressively IT integrated society. It has been said that the evolution of contemporary economics is progressively moving towards a network society, where the individual is acquiring new forms of relations and opportunities that may improve social and political integration. Part of these improvements are linked to the development of digital information innovations in social and economic life such as e-commerce, knowledge sharing on the Internet

and organizational integration inside productive activities and in the public sphere. Network Society theory, in particular, emphasizes the role that *information codification and transmission* is going to have in the capitalistic economy thanks to powerful forms of communication (telecommunications and Internet) and to potential global openness (across countries and inside the same country) among different groups of population) of knowledge transfer processes. In the economic discipline the references to the network society theory had a spring from changes induced by the implementation of information technology applications inside firms, services, distribution and financial activities, as well as from the debate concerning the role that institutions were expected to have in the non productive areas of the economy (education and knowledge transfer, social and government issues). Network theory of the economy, kicked off by Castells (1996) is a general theory of the evolution of the capitalistic regime that consider information and technology as the wheels of a complex global change that will involve all the aspects of society from economic structures to social and political phenomena. Empirical studies that are oriented by network economic theory can also be realized without the formalizations required by network analysis and the network evolution of a specific industry and its collateral markets is adequately represented by main stream analysis with econometric indexes.

However, some authors sustain that if we want really to investigate spillover and externalities effects that highly interconnected economies imply, a relational perspective such as the one carried on with social network analysis (SNA) may be more effective. Specifically, studies concerning *diffusion of innovations* –from technological to social ones – carried on with SNA methods, revealed that several of these processes share a common pattern that can be formalized in simplified structures (e.g. star network). The much cited piece of research on medical innovation (Coleman, Katz and Menzel, 1966) was one of the first empirical works employing network analysis that showed the social dynamics of innovation and provided an explanation of the factors that prevent and favor knowledge transfer. The study analyzed the diffusion of prescriptions with a new type of antibiotics among a population of physicians and related the rates of adoption of the new medicines to social interaction opportunities among physicians (a proxy of social cohesion among group members) and their sources of advice on medical innovations (information flow). Specifically, the interpersonal environments in which individuals practiced their professional activity (structure of their personal networks) proved to be highly relevant for understanding the differences between adopters and non-adopters and the rate of penetration of the innovation. These findings were the inspiration for a series of study on the dynamics of innovation and a stimulus to clarify the elements in a network structure (such as roles and positions) that may have a relevance in more complex processes of information transmission and may be influent in other forms of social interactions (such as economic exchange).

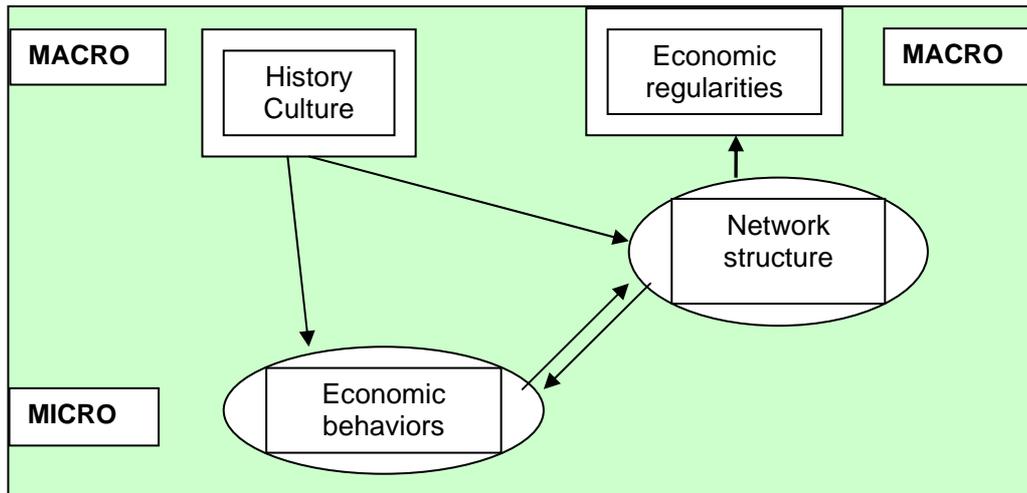
Further contributions of some authors that had conducted empirical research on less known subjects such as transaction or development economic systems (Yusheng, 2004; Stark and Vedres, 2003) contributed to clear the role of non-monetary exchanges and non economic forms of relations, as well as the possibility to create economic development from informal and apparently non rational decisions (Uzzi, 1997). For example, Gulati (1999), analyzed networks formation among firms as the product of strategic choices that improves efficiency and competitiveness of the single firm on the global market; Goyal and Joshi (2006) applied network analysis formalization to investigate free trade agreements among countries and prove that interconnected groups of countries have a regional (or cost-dependant factor) as well as a political economy determinant (see also on the same issue Roth and Dakhli, 2003). Others such as White (2002) or Burt (2004)

moved further suggesting a new vision of the market creation or of entrepreneurship that emphasizes the relational properties of networks; in their perspective economic relations are produced by specific structural (social) positions of subjects that make possible the access of a firm into the market or the profitable organization of production and commercial activities that enact entrepreneurship. Concluding, works conducted by means of SNA were particularly relevant as a stimulus to renew information and decision theory and to reconsider concepts such as asymmetric relations and market efficiency (Granovetter, 2000). They also showed that some phenomena could be interpreted in a *relational perspective*, highlighting the role that institutional factors play in the transformation of economic and social relations and the role that agents choices may have in determine the possible global outcomes of interactions and exchanges.

## **2. The use and application of Social Network Analysis**

Social perspective of network analysis, a branch of mathematics that deals with topological properties of elements, rise at the beginning of the twentieth century from empirical observations of human and animal interactions and was developed by sociologists as a specific methodological approach – the so called structural or relational sociology - applicable to several forms of social exchange. In the eighties was further refined both as survey and analytical technique (Wasserman and Faust,1994) and its use was successful for understanding determinants of processes of choice and diffusion (Coleman et al., 1966), impact of personal and informal resources in the labor market (Granovetter,1985), and in the formation of firms interlocks and social capital (Chiesi, 1985).

To introduce and situate the contribution of NA to the study of economic phenomena, sociologist P. Steiner (2005) re-interpret the theoretical scheme of James Coleman, the founder of the rational action approach in sociological theory. In Coleman's view (1984), sociological approach based on a individualistic and rational perspective of human action was able to describe and explain phenomena both at the micro and macro societal level, including economic and political ones. Network analysis due to its specific methodology was among the more suitable techniques to investigate the *connections between the macro level and the micro level* and as Figure 1.1 depicts, the type of relations that are considered as significant are all those that can be described in terms of economic behavior, from job selection choices to industrial strategic decisions. The aim of this peculiar perspective of research is to put in evidence the presence of explicatory structures in that favor or prevent the occurrence of specific outputs and only occasionally to provide descriptive account of phenomena related to exchange contexts. According to scholars (Smelser and Swedberg, 2005) social network analysis should be primarily interested in describing relations (links) that connect subjects (nodes) in significant structure (network) whose influence is found on the individual nodes' opportunities as well as on their collective output. Some researchers underline thus the strength or multiplicity of relations between nodes as main factors of influence, others emphasize the topological position of nodes and put in evidence how the structural properties of different networks. Despite these procedural differences they share a common perspective that conceives economic and social interactions at the bases of economic processes, whose outcomes may be evaluated in terms of their structural efficiency.



**Figure 1 – Explanations of economic phenomena according to Network Analysis perspective.(extract from P. Steiner; 2005).**

In the network perspective rational agents – being them individual, firms or collective actors such as governments or countries – connect in relative stable networks that are not intentionally designed as a whole, but whose structure may favor, or in some cases block the exchange of resources or information. For example, the specific structure of a network, its 'internal architecture' make possible that innovations are passed to those firms who can recognize them as profitable, and implement them into market products as well as that information flows according to specific ranks (chains) and positions (structural holes), such as in the case of the American industrial markets analyzed by Burt (1992). In economics the adoption of network analysis techniques is more recent, but steadily crescent with researches on firms alliances, decision processes in the financial market, governance and industrial organization (Grabher et al, 1993). The application of NA to economic phenomena has produced several innovations in the theoretical approaches of decision theory, industrial and labor market studies and social learning areas (Goyal, 2007). However, the application of network analysis perspective is still limited because of its methodological requisites, that may limit the use of aggregate data.

According to SNA methodology not all type of information or data that are available to social scientists give the opportunity to analyze the structure of *social interactions and exchanges*. The first aspect to be considered is whether the data contain relational information or not: any information (synthesized in numbers or indices or other formalized measure) which connects at least two units of observation can provide details about their relation such as the flow of messages between email user, the exchange of products between firms, the reception of benefits from governmental organization and citizens. Second, these pieces of information require in some cases to be re-organized, defining the boundaries of research observations (countries that belong to the WTO, firms located in the same district, social policies for specific social groups) and the type of dependant effects that the research is aimed at testing (efficacy of patents on the innovation system, social integration, e-learning or educational attainment). Finally, there should be some form of measurement in relational terms for the relation between the two units of observation such as the total number of messages or the density of communication exchanged between users

of a social site and the creation of specific sub-grouping in the network of all the firms located in a region.

Concluding, relating secondary data that contain some relational information may require to re-organize the data in a different matrix format than the usual case by variables. Social network data typically are organized according to adjacency matrices (cases by case) and affiliation matrices (cases by events), or in the case of spatial data also the incidence matrix (subjects by links) is adopted. Data that can be re-organized (re-coding or transposing data, or even extracting individual relations) according to these criteria are suitable for social network analysis. Some data however, do not consent to relate two units of observation even if they belong to the same category, while other data that connect units of observation on different dimensions can be rearranged and become suitable for network analysis. So consumers and sellers (units that belong to different categories) can be related according to network analysis criteria (e.g. by means of details about the purchase); while gross data on the sales of specific producers (e.g. number of sold licenses for ADSL connections) and aggregate data on consumers spending for specific goods (e.g. internet connections for domestic use) could not be linked according to those criteria because they lack a connection event (or affiliation).

Table 1 describes the type of data which have been used in the research literature reviewed in this paper and synthesizes some methodological indications and empirical applications, putting in evidence their suitability for exploring aspects related to e-inclusion and social and economic impact of ITs. As example we will refer to a relevant research area where the application of network analysis techniques is proficient is international trade and historical evolution of the studies in this area illustrate how the theoretical perspective of the scholars moved from the description of exchange relations among countries to a more complex interpretation of the phenomena. The classical study of world economies from Snyder and Kick (1979) in the period 1950-1970 showed that growth rates of single countries are related with their presence in sub-groups of countries showing a similar set of factors in their economic systems. Their sources were trade and exchange relations, political and military alliances, diplomatic and warfare actions involving 118 countries, which were subdivided in ten groups and placed in three different positional relevance on the world economy (core, periphery and semi-periphery). Revised by Smith and White (1992), the hypothesis on the structure of relations concerning international trade was supplemented by the analysis of more detailed trade data and extended to 1980. The authors proved that in the period from the 1965 to 1980 the world economic system had evolved towards a multicentre model with areas of similar homogeneity of conditions concerning commerce, but had also improved in competition with more countries connected in sub-networks characterized by dependant models of economy. Beside association to a sub-group of countries, other factors such as multiplicity of relations had increased the opportunity for a country to move from the periphery (or semi-periphery) to the center, but also the risk to be 'trapped' to periphery sub-groups. Recent studies moved further and combined SNA with computing techniques analyzing three possible models of wealth distribution in the world economic system. Their analysis implemented the concept of 'preferential attachment' to countries relations, showing that there is a strong theoretical relation between degrading stages of the economy of a country and an unfair distribution of wealth, while economic systems that are characterized by developmental stages or stagflation are compatible both with fair or unfair conditions of wealth distribution. These studies show that though the specific perspective of SNA is possible to move from basic or micro economic relations, such as the presence of a connection between two nodes (traders or countries), to investigate the creation of

a general or macro social outcome (prices formation or growth rates) and put in evidence the role played by structural elements of the network of relations such as positions, homogeneity and hierarchy of nodes.

<b>Type of data</b>	<b>Suitability for network analysis</b>	<b>Organization of data</b>	<b>Level of observation of the phenomena</b>	<b>Examples of empirical studies</b>
Input-output matrices	Yes	Definition of measurement indices	Structural (macro phenomena)	Foreign trade, regional economies.
Relations between firms /organizations	Yes (re-coded)	Definition of the forms of exchange and of the units of observation	Middle level phenomena (organizations, regions)	Innovation patterns, patents implementation and research networks.
Individual communications /exchanges	Yes	Definition of the group boundaries and the type of exchange	Dynamic (micro- macro phenomena)	Emails exchange, social networking sites, social capital and integration.
Recipients of benefits and information	Yes (re-coded)	Definition of the units of observation and of time interval	Middle level phenomena (organizations, regions)	Policies for social integration and education, patents adoption, geographical movements.
Hyperlinks and referred connections	Yes	Definition of scale effects	Structural (macro phenomena)	Web structure, digital transactions, bibliographical citations.

**Table 1- A synthesis of network data type and empirical studies characteristics.**

In the following paragraphs a review of the research literature applying social network analysis to different aspects of the European society (households, policies and public administration, firms and economic organizations) will be presented. For each research presented will be sketched out the focus of the study, its main hypothesis and the type of data used (according to the criteria for network data defined in the previous paragraphs). The organization of the studies has been organized by subject, since SNA studies are spread among different disciplinary approach and no systematic study has been carried on till now with a comparative perspective on EU member countries. Issues related to social integration, in particular, tend to concentrate on the psycho-social dimensions (family relations, local community support and urban or rural context) and do not consider the aspects implied by the digital transformation of information and policies. The review will specifically explore the contributions that network analysis have given to social integration, knowledge creation and innovation diffusion related to implementation of ITs, while third and fourth paragraphs will report the main contributions of network analysis for the understanding of contemporary emerging economic phenomena (the embedded firm and the digitalization of the markets).

### **3. A review of SNA studies on ITs social and economic impact**

#### **a. Social relations, social integration and policies.**

Since the establishment of the Internet our society has come a long way; according to scholars the stage of computerized technology has now entered a transitional period, characterized by a proliferation of computing infrastructures and the penetration of ITCs in everyday life by means of portable computers and telephones, readers, mobility devices and other 'invisible' technologies that support work and leisure time (wireless connections, automatized access and so). The social relevance of the expected impact is enormous but the knowledge concerning the factors that influence use and favor tolerance for more complex communication systems is still developing (Kostakos and Little, 2005). Specifically, it has been said that with the increase of the so called 'systemic technologies' it would be harder to interpret the adoption of technologies in terms of demand and use and other perspectives of the commodity chain should be implemented in empirical study of technology social and economic impact. A model based on economic rationality which rely on a established representation of the competitive market , in particular, is counterproductive to understand real use of technology into the households, its effects in terms of social and economic relations and finally the innovative role that ITCs may have in the transformation of society (Kaponen, 2002).

A perspective that see *technology as incorporated into social relations* and embedded in the making of goods (of different type, from commercial to public ones), instead, may recognize an active role to users in adopting technologies for purposes unintended by the producers or re-cycle them according to innovative patterns of social interaction (Hull et al., 1999). According to this point of view an interesting suggestion for reading research contributions concerning ITCs consumption is the theoretical scheme adopted by Steward (2003). The first category, experience, refers to the subjective reaction that originate from the experience with technology such as emotions, cognitive effort, fascination. The integration category gives the subject (user) the opportunity to identify with a specific activity with technology (becoming a computer person, playing the expert among friends), or to benefit from it such as in job (production, telework etc) and in personal knowledge. The category of play is both autotelic (having no other reason but itself) and socializing as it open opportunities to communicate, work together, share interests and construct relationships based on the common use of technology. Finally, classification category is related with aspects of ownership of technology (Mac or MS person, Ipod user, etc) and representation of the subject towards the others in terms of technology (game expert, innovator,) or perform specific actions that relate with technology (ITCs proselitism, teaching how to use the PC).

Social and economic analysis of technology adoption tend to concentrate on a limited range of activities and to emphasize the importance of the classification category and, in particular in sociological analysis, the integration category. Individuals and their associations, including organizations, however, tend to adopt technologies and make use of them for a variety of reasons and 'domesticate' ITCs according to criteria that may come from a wider range of categories. For example, a study of ITCs in households adoption conducted by Steward, revealed that 'consumption varies across groups and individuals and frequently within groups it is possible to see

differences in the way people engage with technologies and how these differences reflect and enforce local relationships' (Steward, 2003:10). The network of relationships of individuals, in particular, is considered as a source of information about technology use, of advice in problem solving and support in case of conflicts. It is used also as a repository for sense-making and compromise concerning problems and use of new technologies, especially for those groups like seniors that are reluctant in introducing innovations in their lifestyle. By means of personal networks some subjects can resist to innovation and rely on other people with technological competences for operating appliances and perform actions (for example type and print a letter on the PC, operate a new video-recorder). Personal relations can also be a source of second hand experience or of indirect use of technologies (ask the neighbors to record a program from satellite television), and this is relevant because it implies that statistics will not be able to report these benefits because they are not real external services to the household, nor significant from the commercial point of view.

	<b>Autotelic</b>	<b>Instrumental</b>	
<b>Object action</b>	Experience	Integration	<b>Structure of action</b>
<b>Interpersonal</b>	Play	Classification	
	<b>Purpose of action</b>		

**Table 2 - Four dimensions of consumption (extract from Steward,2003).**

Social Network studies analyzed the problem of information seeking and the processes of networks formation either as a product of social homophily (social ties rise more frequently among people with similar socio-economic characteristics), or physical proximity (likelihood of communication increases with personal knowledge or vicinity among subjects, like colleagues or neighbors) ; it could also be the effect of increase in mobility or serendipitous interactions as the case of exposure to cultural or lifestyle innovations. This is particularly relevant if we consider digital innovations or knowledge which concerns the use of ITCs, where a limited proportion of population is expected to be able to access initially the market of products (because of cost limit) or have a direct competence in the use and applications of new technologies. The more recent tendency is to interpret the process of formation of information networks as a dynamic choice process (Borgatti and Cross, 2003), where the subject evaluate the expertise of acquaintances, their accessibility and the potential costs in seeking information from each specific person.

The empirical work carried on by Borgatti and Cross in two organizations shows that costs have a limited role in affecting the behavior of the information seeker, while direct access to a person and personal knowledge increase the probability to introduce her among the network of 'informants'. Furthermore, in problem framing situations, social and individual costs such as trust, seem to be more relevant, while in simple information exchange it is easier that people seek for fast, easy instructions, giving priority to learning out of necessity. If these results are significant also in the area of technology appropriation, we see that the insistence of economic perspective to limit its analyses to integration and classification categories of ITCs consumption may generate problems (Currah, 2007). First, because data concerning use and penetration in the domestic sphere of digital technologies express only a fraction of users and do not account for 'second-hand' or sterile adoptions (such as buying a high tech product for status reasons and do not operate it).

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Second, because the standard economic model attributes a distorted role to information networks concerning technologies not recognizing the social integrative role that they have for specific groups (for example the elderly) and individuals (people with special disabilities) which depend more (intentionally or not) on other's people technological competence. Instrumental purpose of technologies is significant for firms but not for individuals, and users of ITCs frequently engage themselves in activities which do not have an immediate or significant economic return (such as keeping a diary on the Internet), nevertheless are equally significant and satisfactory for the individual.

An attempt to measure these *'learning' effects generated by social networks of ICTs* at the consumer level (household level) has been carried on by Goolsbee and Klenow (2002); their analysis focused on the adoption of home computer in the US in 1997, and put in evidence the spillover effects that generated from these innovations in the domestic sphere. Households are more likely to buy their first computer when a significant rate of their acquaintances already have computers and this propensity is higher if experienced or intensive users of ITCs are present among friends and family. Other factors such as local computer prices, local industry composition (state and regional level), peers pressure or local school were not as much significant as the social network. Furthermore, an exploration of the use of personal computers in the households put in evidence that computer ownership was connected to e-mails and Internet use, generating a so called 'hub effect' for personal and family interactions that increased in intensity and geographical range. The authors interpreted the results as a combined presence of learning effects (spreading of knowledge on ITCs among personal networks) and network externalities, where the positive social outcomes (socialization, communication opportunities) at the household level encourage a further expansion of personal computers in the single household (from one to two PC) and in the market (more demand for PC).

Specifically interesting for their social implications are the research projects that the NA group of Barry Wellman has been carrying on since the nineties focusing on the *impact of ITCs in social integration and socializing patterns* (1999). According to Wellman the presence of new technologies for communication (emails, Internet and telecommunications) have influenced the patterns of socialization and creation of personal networks among the new generations and also are modifying the integration processes of historically 'marginal' social groups such as the elderly, ethnic minorities and the disables. Interactions that are supported by ITCs can be more intense than initially foreseen and contribute to re-create forms of 'local community' that the industrialization process had prevented, especially in countries such as the US and Canada where geographical mobility is more intense.

The recent findings of an extensive research study of *social network composition among Internet users* report an impact in three aspects (Wellman and Haythornthwaite, 2002). First, an increase in the volume of communication with each and every network member; second, an especially higher volume of communication with network members who live further away and thirdly a great number of active ties, both intimate and significant, a result that question the hypothesis of a decrease in intense social relations in the digital age. Few ties flourish as Internet-only relationships and the forms of communication which are carried on in virtual space are characterized by a strong 'public' connotation, such as information seeking, advisory and supportive conversations, display of interests, capabilities and opinions, and finally aid to real life inconveniences and objectives. According with this viewpoint some authors (Blum and Goldfarb, 2006) ironically commented with the saying 'the net is global but tastes are local' the results of a

comparative survey of online activities which reported a preference for expressive forms of behavior (including online shopping, pornography, gambling and so) in those countries characterized by lower population density and higher degrees of social distance. Others, put in evidence that the 'domestication' of ITCs is creating new forms of sociability such as the case of 'connected presence', where the availability and use of new forms of communication encourages new forms of personal network production and reproduction, and is less dependent on physical distance criteria. Young couples studied by Licoppen and Smoreda (2005) use physical encounters, letters, phone calls, emails and SMS to connect with very different types of receivers (friends, family members, acquaintances and colleagues) with a similar emotional intensity despite physical distance. To balance costs (of services, time) with reproduction of significant personal links, they have so developed a sort of relational economy applied to personal communication and strategically manage their resources (access to ITCs, time, financial availability) in accordance with their lifestyles and the one of their receivers.

Knowledge flow can also be relevant for evaluating *social policies and the diffusion of specific knowledge in organizations and groups* (Serdult and Hirshi, 2004). Reconstructing the process of formation and diffusion of the UN convention on Climate Change in Switzerland as a series of interactions between actors (political actors) and events (decision making process for implementing the convention), Serdult and Hirshi (2008) were able to represent in dynamic terms the structuring of relations between governmental agencies, federal councils and environmental organizations. Other examples such as the works of Montoya (2008) adopted also a perspective focused on the relations between actors (organizations, individuals) to put in evidence the results in terms of knowledge exchange. Montoya's analysis of the participation of NGOs and national organizations to the European project DAPHNE (a program for preventing violence and sexual exploitation of women and children) explores the evolution of diffusion of good practices among the stage members from 1997 to 2004. The analysis of the enlargement of the core member countries and of the progressive involvement of new EU member countries (Hungary, Bulgaria, Czech Republic, Baltic Republics), shows that the transformation of the policy network was not limited to simple enlargement but involved also a more central position of the organizations active in the Eastern countries and their increasing access to policy resources. Knowledge networks generated by EU policies in the area of education (Eurasmus student exchange program) and research (project financed by the 5th EU Framework) were instead the focus of Maggioni and Uberti's work (2009). The authors analyze the networks generated by these programs, as institution generated interactions that improve knowledge creation at the European level and put in evidence their effects on regional innovation systems. Social network analysis provides also a structural representation of the virtual distances among innovation sectors and their tendency to form clusters and shape also the inter-regional knowledge flow.

## **b. The economic impact of ITs. Innovation and transformation of production.**

Traditionally in network analysis the diffusion of information and the adoption of innovations have been approached under the perspective of 'social contagion': the proximity (either physical or social) of people facilitate the flow of information, including those concerning costs and benefits associated to a specific innovation (Burt, 1987). The *transmission of innovations* from one subject to the other is regulated by imitation and contagion among members of proximate groups, and the piece of information is passed through social interactions more or less unintentionally. Innovations can consist in ideas, practices, habits and modes of relations which are at the bases of social

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change and social transformation. Specifically, a great number of analysis of Information and Communication Technologies (ICTs) adopt a top-down approach and observe the patterns of indicators (patents, productivity, employment and e-commerce, access and use of Personal Computers and automated Data Processing, R&D firms growth rate, etc.) inside group of countries with the aim to identify economic, social and policy implications of these innovation trends. For example, Block and Keller (2009) recent analysis of US economy in the period 1970 to 2000 highlights the role that innovations, and specifically commercial product innovations, had for the emergence of a networked model of economy. Their work put in evidence that in the period considered the transformation of the American economy to a post-industrial model was favored by the changes in the economic production induced by innovation patterns and by the way in which government interacted with business. The shift from vertical integration to networked forms of organization of the American firms, according to the authors, is linked to a more central role of research and development functions (which frequently leads to inter-organizational collaboration) as well as to decentralization and firms commercial strategies.

As some critics had advised (Hull et al. 1999), however, this type of approach see firms as agents of change and diminish the role that consumers and institutions (governments, international agreements, world level crisis) have in demanding and sustaining the adoption of new technologies. Furthermore, these analysis forget to take in count the role that competition and industrial strategies may have in blocking innovation adoption in the industry and the problems that are provoked by technological advancement or knowledge transfer among countries in terms of political international relations. Network analysis studies, on the contrary, put in evidence how the flow of innovations among firms and inside an industrial system is subject to 'rules' which are not necessarily only the ones expressed by the market.

Let's consider as example the preliminary work performed by Breschi and Lissoni (2005) on *knowledge externalities generated by innovations*, using data on patents and mobility of scientists they measured the flow of innovations inside Italian economic system in the period from 1985 to 1995. Deriving from NA the concept of social proximity, the authors interpreted the networks of collaborations to patents' discovery both in terms of research affiliation (citations) and location affiliation (location of laboratory or research institution). Affiliation to a research group as in co-location, in particular, is considered equivalent in economic terms to adhesion to a club good, whose benefits – knowledge concerning the patent – are restricted to members, while simple participation in co-authorship is a signal of affiliation to a public club, equivalent to presence in the network of inventors. Their results show that innovation flow and its 'commercial' outputs (aka patents) is more productive in those geographical areas that can attract 'technological stars', such as metropolitan areas. However, this productivity is not necessarily a benefit for local firms as 'mobile inventors' tend to maintain old collaboration links with distant colleagues and fellow researchers working in other firms. Bounded inventors, on the contrary, though less productive were able to generate more localized knowledge externalities.

The analysis of the structure of the scientists' network (scientists' personal networks of collaborations as evidenced by co-authorship links) showed also that social connections are relevant for both types of inventors, but co-localization, which implies a propensity to mobility by researchers and the presence of newly and purposely formed research teams, seem to be the most effective element to favor innovation diffusion. Many public policies designed to attract R&D firms and high tech companies in regional and urban areas, will have a minor efficacy, the authors advise, if they not consider that network effects may introduce a structural flaw in the process of

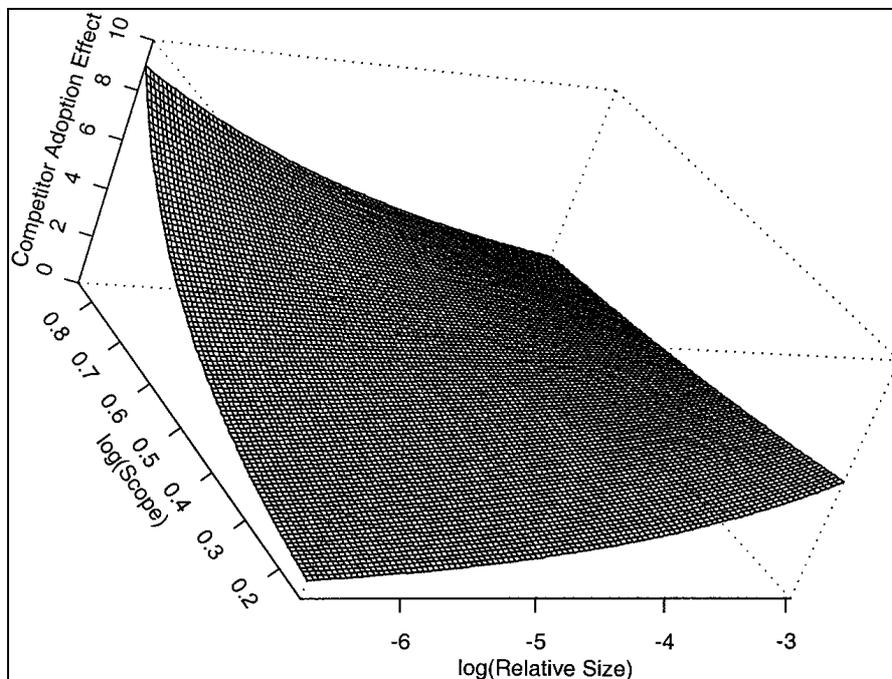
creation of local spillover. The ideal model for producing economic benefit by innovation at the regional level is in fact that of a club good (specific knowledge and economic spillover from patents), not of a public good (already represented at the national level by the network of inventors, which share general knowledge), requiring a simultaneous investment both in firms' incentives and researchers recruitment criteria.

Study of information selection processes and in particular *innovation implementation* is thus becoming central to understand the socio-economic evolution and to design policies that are effective in reducing diseconomies and social exclusion. Moreover, with the increasing presence of mass media and professionals paid to disseminate and collect information on innovation, obtaining information in the ITC society is less problematic than in the past; nevertheless, the large availability of 'generalized' knowledge has shifted the target to the identification of trustworthy information and their reorganization into profitable knowledge. One of the most influential theory that has approached these problems is Burt's theory of structural holes; his first proposal rely on an extensive study of economic market organization (1992) which has been refined and tested with empirical work in several production and non-productive sectors of society. According to Burt, some structural positions inside a network (or an intersection of networks) are given an advantage in terms of opportunity to manage the information flow and select those information which are more valuable. Brokerage across groups or organizations is therefore associated to 'social capital' and the structure of some networks (a formal representation of a real social or economic context) may favor or prevent transmission of innovations. The mechanism described by Burt is valid both for positive and negative returns such as positive performance in organizations and organized crime or corporate misgovernance (Gargiulo and Benassi, 1999; Baker and Faulkner, 1993), and has been reported in diverse contexts from biotechnology and electronics firms (Baum et al, 2000; Podolny et al., 1996) to the art and entertainment industry (White, 1993). A study of a large electronics company (Burt, 2004) and the dynamics of information flow along the supply chain illustrate the presence of several social mechanisms that positively and negatively influence the process of innovation adoption; for example, social convenience (measured as cohesion with other members group) was one aspect that prevent managers to mobilize support for specific ideas, despite the presence of specific organizational code that rewarded managers creativity.

Burt's conclusion is a suggestion for further more complex analysis of innovation to separate between *information distribution networks and innovation creation networks*; economic constraints, he underlined, influence individual and organizational initiative in different ways inside the two contexts and hence inhibit or support those positions which hold a structural advantage (such as being across the intersection of social and knowledge worlds). In particular, the presence of profit from bridge relations through which employees broker technology flow between industries may be a specific product of brokerage across organizations, where structural holes emerge from specific technological and production type dependencies, while in other social contexts, such as large corporations the brokerage effect may hold less validity for information flow dynamics. The theory of structural holes has proved able to interpret firms creation of value in interorganizational networks, where the firm's brokerage ability is articulated in the creation of new commercial value from joint ventures, project and participation to commercial networks. Connections with other firms may not be economically profitable in se, but the opportunity to access product know-how and exchange knowledge with other firms may generate occasions for the emergence of unrecognized opportunities or, as Burt define them, good ideas. Here we report two exemplary

case study, where the application of SNA was complementary to the economic analysis of innovation impact in two industrial sectors.

Ahuja's (2000) study of the international chemical industry apply the theory of structural holes and puts in evidence how *interfirms collaborative networks* influence the outcomes in terms of innovation and productivity. The longitudinal study of the patents and formalized collaborative projects among 97 large international companies in Western Europe, the US and Japan revealed that links among firms could signify different types of relations from direct exchange of know-how and sharing of resources and infrastructures for research, to knowledge spillover benefits that transmit information and innovative ways of approaching problems. Competition was co-existent with collaboration and the presence of strong or formalized links do not exclude the possibility of spillovers; moreover, the benefits that a firm could derive from a direct (formalized sharing of resources) link with another firm, were in magnitude higher than the benefits which could be derived from indirect links which had a higher risk of being non productive. Ahuja compared his results with other studies on structural holes and innovation and concluded that 'where developing a collaborative milieu and overcoming opportunism are essential to success, closed networks (e.g. a prevalence of strong links) are likely to be more beneficial. When speedy access to diverse information is essential, structural holes are likely to be advantageous.' The ideal network for a firm whose primary business is the brokerage of information or technology, as is the case of most ITCs companies, for example, is the one which includes many non overlapping ties and empowers brokerage positions in knowledge spillover. In other types of industry, the greater benefits may be experimented if collaboration between competitors is endowed by cooperation norms, which are more frequently associated with interconnected and closed networks of relations.



**Figure 2 - Firm response to the adoption of innovation by competitors by relative size and scope of the firm. (Extract from Bothner, 2003).**

Description of *search and selection processes of business ties* is also the aim of the study of Bothner (2003) on supercomputers industry; his research analyzed the impact of the introduction of a new technology– a new fast processor for PCs – in the market and traced its diffusion at the world level through the main producers of PC, monitoring their market positions, their sales and their market strategy. Figure 3 illustrate the results of one of his models of interfirm influence and specifically the presence of a relation between the adoption of the innovation by a firm (given the structurally equivalent rivals the vertical axis measures the competitor adoption effect as odds of adoption), its dimension (horizontal line) and its scope or strategy (mid horizontal line) in relation with the competitors. The adoption of the innovation by a direct rival increases three times the rate of adoption of a firm; moreover, smaller firms and especially those which are in a market weak position (or firms with a 'limited scope' in Bothner's perspective) are more responsive to their peers and tend to imitate their choices. This imitative strategy may carry the risk of initiate competition with larger companies, as well as being effective in increasing the survival chances. Social influence, Bothner concludes, is at the bases and at the same time resolves competition on the market, as hierarchical ranking of firms reinforces the selection effects that are associated with the adoption of a new technology.

### **c. Economic Networks and Innovation**

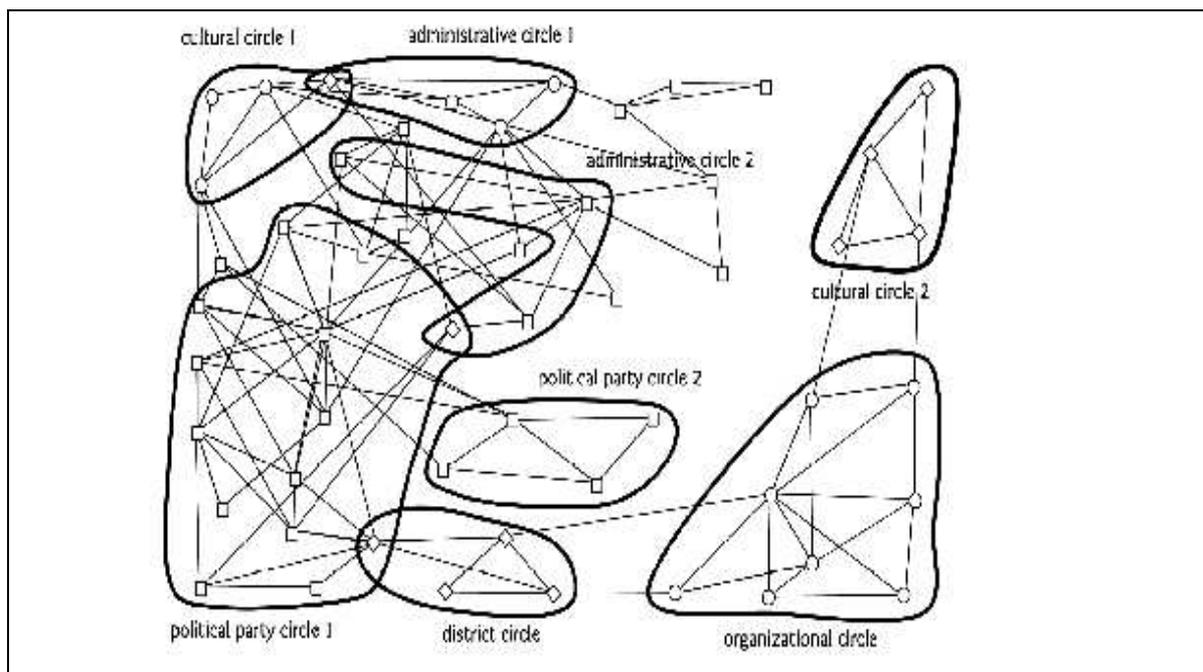
According to modern growth theory investments in technology and the development and diffusion of technological knowledge are the main factors explaining growth. Innovation diffusion and spillovers can be represented rather accurately in the form of networks and links can be traced among different subjects such as in case of urban economics and regional systems. Typically, empirical studies analyze input-output tables with the methodology derived from the network analysis such as the comparison of the Italian and German technological assets carried on by Leoncini (Leoncini et al., 1995); the study of the two systems revealed the German system is characterizes by a high connectivity network with firms interdependency focused on manufacturing processes, while the Italian system is a more polarized network where most of the links represent flow of material among firms. Despite these structural differences, in both systems the role of public expenditures is similar and interfere slightly with the intersectoral innovation flow networks.

An interesting perspective of the *relation between firms networks structures and innovation* in the economic system is provided by a series of studies that have been carried on in Post-socialist countries. The study of Stark and Vedres (2006) analyses networks ties and regime change in Hungary in the period 1987-2001, and puts in evidence the effects of foreign investors and privatization policies. The authors analyzed data on the firms ownership and the alliances among them and mapped the evolution path of companies from state-owned to private owned: the sequences of networks that represent firms transformation reveal that the majority of the companies tend to distance the state and its control, while trying to connect with other companies and create a sub-network of alliances. This evolution path was interpreted as a response to economic uncertainty generated by the change in institutional and political regime: the so called 'satellite organization' was functional both to foreign investment strategies of indirect control and to the increasing national competitiveness.

McDermott (2007) research of the Czech economy analysis the impact that change in political regime has had on the connection between firms and between these and the state. The changes in economic policy and the privatization process, according to McDermott, destabilized the

networks of resource and information exchange among companies which were functional to the old regime, but neither the state or the firms were able to substitute them with more efficient connections. The result was a lack of control over restructuring processes and a reduced attractiveness for foreign investors: only when the state engaged in new forms of economic sharing with national companies, adopting a participatory strategy for restructuring, the inter-firms connections re-started to flourish and open to effective foreign investment projects. Concluding, McDermott discuss the different outcomes that may result from institutional regulatory policy, and specifically the implications that state indirect control may have on the chain of networks of trust that provide investment and resources for companies innovativeness. The case of Czech economy illustrate that a stable institutional setting can be produced by the state also by means of indirect measures, while the competitiveness on the market requires instead a more straight procedure in order to support organizational change and production re-configurations processes in the companies. Both of these studies on post-socialist countries integrated social networks measurement with document and data extracted at the national and companies level; the exploration of connections at the firm or territorial level is instead generally conducted by mean of survey techniques.

Other approaches oriented the study of economic connections at the regional level using instruments and techniques from economic sociology analysis such as Furst et al. (2001) investigation of the regional actor network of the Hanover area. By means of an extensive survey of persons and organizations, the authors map – see Figure 4 - the business and private relations among the most relevant actors and measure their propensity to adopt stationary (direct links characterized by a high rate of embeddedness in the region) or mobile social capital (multiple and indirect links with actors outside the region). Each social circle is characterized by subjects (nodes) and relations (links among subjects) with other circles' members and with other subjects of relevance in the socio-economic environment. The circles vary in size (number of members) and in internal structure (connections among members); what was interesting in the perspective of the researchers, however, were the associations that the different circles established among them. The pressure exercised by globalizing factors such as new technologies and new economic forms, according to the authors, should solicit the actors to implement a series of administrative reforms to promote development. *Globalization impact* was also monitored in relation of definite issues, and specifically the organization in 2000 of the Hannover Exposition (Expo2000), which encouraged the formation of new relations and had a great potentiality in terms of innovation diffusion among the different circles of actors. One of the most prominent factor in network creation was party affiliation, which structured informal communication and meetings among actors; differences between city and country actors were also relevant, with city actors having more active (frequency of contacts) and more dense relations (multiple links). The authors concluded that transformation of the regional economy, such as the creation of new supply networks, was influenced more than from social capital of the actors or their individual resources, from collaborative links that endorse the creation of a collective social capital (a form of collective good); social circles, in this case, would act as a mobilizing agents for innovations and initiate positive responses to external pressure factors, as the case of the Expo2000 confirmed. On the contrary, expected administrative reforms, which were more depending on individual social capital (and subject to party's control), may have a limited role in transforming the economy and a higher risk to be used for reproducing present economic structure, with reduced innovativeness for all the regional system.



**Figure 3– Social circles of business and private relations in the regional network of Hannover (extract from Furst et al., 2001).**

Another assessment of the different social (and economic) efficiency of forms of social capital, is expressed in the study of Crowe (2007), which analyses *the network structure of six rural communities in the South states of the US* and evaluate their impact on two economic development strategies: industrial recruitment (development of and industrial park, seek outside investors, etc) and self-development (for example, agricultural diversification and development of a local retain center and so..). Different network properties impact the success of the two strategies: cohesiveness of the local network, for example, is positively associated with projects and initiatives that rely on local resources and require a cooperation effort within the community. Industrial and external initiatives require coalitions and relations that bridge across social circles and sometimes across communities; the network should also be more open to external links and the information flow rapid and diffused among all the members. The study revealed that development choices were not influenced by income or racial composition of communities, preferential forms of development were instead associated with constrains or limitation of the community's opportunities (such as lack of private land or poor infrastructures) to pursue specific economic strategies. The development path is thus related to intervening factors that pertain mainly to the institutional sphere, and cultural aspect have a saying too, as is expressed in Rus study (2002) of entrepreneurship in transition economies and specifically Slovenian firms. Rus highlights the role that managerial culture is having in the process of re-organization of the national economy and the transformations of their personal networks into business opportunities embedded in the market. Professionalization and value changes appear as independent aspect in the management of the economy, but not in the managers intent; the effect of such separateness , however, is relevant for the system. Despite the involvement of the Slovenian economic elite into the process of privatization, as Rus note, a complete renewal of the economy has not been

possible and the competitiveness and effectiveness of national companies is still limited and will require time to be fully implemented.

#### **d. From the Embedded Firm to Digitalized Markets**

In the social networks literature there has been a preference to analyze the integration of the firms into the economy from the point of view of the connections that entrepreneurs and managers or employees create and reproduce in the practice of daily business, and in particular in the occasion of external events or economic trends.

The longitudinal qualitative study of McKenzie (2008), for example, analyzes the restructuring process of a large ITC company putting in evidence the role that networks of clients and subcontractors had in facilitating the organizational change. The advent of the so called 'contract regime' in Eircom organization (the major telecommunication company in Ireland) has been scrutinized in the study of McKenzie; the results of a long term observation of the organization decision making processes and the analysis of the impact of subcontracting is associated to a progressive decentralization of the organization and an increase in networks and hence interdependencies among companies and their goals. The internal reorganization of structures and production processes in Eircom, at the same time, has been sustained and supported by intraorganizational and interorganizational *networks of knowledge sharing among managers*. This created the path to a development of trust connections, opportunities for contracts and eventually the reconfiguration of the initial hierarchy. However, , the formal mechanism of connections created by joint ventures could give way to a shared understanding of business visions and a shifting balance of collaborative and competitive relations between the main company, Eircom and its subcontractors. 'Inter-organizational relations', as McKenzie remarks, 'must be seen as dynamic, not static, and therefore despite arrival at this advanced stage of development, the tensions inherent within the process would continue to herald change. The interorganizational relationship witnessed at the conclusion of the research represented a considerable development since the earliest stages of subcontracting. This incumbent contract regime, however, could not be viewed as an end state— but rather the latest stage of a dynamic process that would continue to be driven by the emergent contradictions inherent within it' (McKenzie, 2008).

A combination of qualitative and quantitative research on social networks has been instead adopted by Elfring and Hulsink (2007), who analyzed the impact of ITs from the point of view of entrepreneurship by looking at how firms identify their own strategy on the market and exploit their links to expand activity or survive competition. The authors select *three ideal type situations of a firms' network*: firms which are based on the founders' personal network, those which have been established by the merging of personal and institutional connections (typically spinoff projects) and finally those firms which originate from a 'incubator' such as a larger company that benefit from the activities of the former and provides a certain number of links and services. The study involved 32 different IT companies in the Netherlands and surveyed the relationships of the founders with social network research techniques (in depth interviews and reconstruction of the business history); the cross comparison among cases was accurate and the authors compared three elements in the structure of the firms' network, weak and strong ties, 'resource embeddedness' and legitimacy. The networks in which an entrepreneur more or less actively participates can give opportunities for new ideas and business options, for accessing resources and also, for obtaining information. Weak ties are supposed to lead to a more varied set of information

and resources than strong ties can (Granovetter, 1973), and consequently weak ties enhance the ability of entrepreneurs to spot opportunities. Furthermore, connections may offer the start-up further access to financial resources, production know-how and complementary technology, distribution channels, in other terms a 'resource embeddedness' that is critical in start-up and consolidation phases as well as in the moment of opening innovative projects. Finally, legitimacy is identified with the spread of knowledge regarding the new business and it is particularly relevant for the IT sector, where firms deal also with problems of conveying new ideas about technology use and culture. The ability of relationships to boost a company's reputation in terms of business or market position is not secondary and can make the difference between firms with very short timelines of production and fast knowledge obsolescence. Concluding their inquiry, Elfring and Hulsink, describe the differences among the firms in terms of different network development patterns with a initial phase of tie formation process that is quite similar for all the cases, and a second stage of changes where weak and strong connections are renewed or confirmed according to the firms' strategy and identity. The process of development of ties and its transformation is complex and according to the authors, may involve a certain amount of risk such as the firm being locked-in business connections that do not provide adequate support for a competitive market or overloading the company with redundant connections that reduce the efficacy of radical innovations.

The role that commercial connections play for the evolution and structuring of the firm is also object of the study of Darr and Talmud (2003), who explore *the market of emergent technologies* and test some hypothesis concerning the structure of communication networks in this area. Recent literature suggest that in high tech markets the distribution of knowledge impact costs and quality in a different way than in mass product markets and on the bases of such suggestions the authors carried on an empirical study with network analysis, applied to the information and connection structures in two samples of high tech firms. Their perspective is based on the observation of diversity in type of production juxtaposing craft markets to mass markets, where the first are characterized by a higher level of uncertainty concerning cost and quality of the products. The digitalization of production systems and services, however, has introduced new requirements for producers such as the customization of the products and this has driven both craft and mass producers to engage in more extensive information search. Informal ties and connections with clients and experts are thus becoming part of a strategy to innovate, together with research and development of new products. To test their theory, Darr and Talmud study measured structural properties of networks in two types of industry organization, one for mass products and one for high-tech products. They consider that buyer and seller relation imply an exchange , sometimes unintentionally, of contextual knowledge on the products and their specifics (production process, problems and comparative advantage); technical expertise is also part of the relation among participants to negotiations and finally, the negotiation process involves also a variable number of individuals that are affiliated either to the seller or the buyers organizations. Results show that the size of a network is related to the relationship between the buyer and the seller, and its structure (density, intensity of connections and type of links) are a function of the content of the exchange. Concluding, the authors highlight that the expected impact of digitalization of production and the introduction of higher levels of uncertainty has been significant on the micro-ties and coordination processes in both mass and craft production segment of high tech products, but the results proved to be distinct for them in terms of network structure.

In particular, according to the authors, the internal hierarchy of a connection is influenced by the rate of technological innovativeness that is associated to the product. Mass product or standardized product involve a chain of connections which are linear, more centralized and less informative on the specifics of the product; while high tech products need a more complex and articulated network of relations to be exchanged with profitable results both by seller and buyer. The seller- buyer network of emergent technology is larger and more heterogeneous than the one of firms oriented towards mass production, and also the size of their information flow was significantly larger with experts and collaborators from different product area and occupational background. Since knowledge and expertise are 'traded' aside their associated high-tech products, the structure of the relations between members of two organizations in the high tech sector is more flexible and oriented to collaboration. Discussing these results, Darr and Talmud underline that this perspective of the buyer-seller relationship is consistent with the theory of social embeddedness of economic activity and can be useful for sketching out the relationship between consumers and industrial markets (Granovetter, 1985). They point to the possibility to break the dichotomy hierarchy versus market introducing a third form of organization structure, based on the temporary integration of cross-firm expert ties. These ties, characterized by rules and norms of decision related to professional and stratified according to production goals, can be transformed by the firm either in vertical integration links or removed when a project end. A potential variety in organizing production and commercial activities is present in the economy and structural differences can emerge as a result of internal innovation, as well as by request to compete and adapt to the marketplace requests.

#### **e. The rise of marketplaces and the social implications of the digital economy**

The transformations in the structure of world economics that arouse in the nineties and specifically the ITC society are interpreted as the interlinkage of three major processes: the computerization of almost all the human activities, the progressive convergence of computers and telecommunications and finally the spread of the Internet and of web-based application in the economic and social sphere. Thanks to innovations such as the sharing of common technical standards and channels and large population access to computing, formerly separate industries such as computers, communications, software, media and entertainment give life to a galaxy of business opportunities. Their impact on market has been massive and in few years is going to transform deeply most of the economic structures of western economies and creating a system of niches where products are not anymore characterized by the old standards.

The concept of network, and specifically the use of the term to signify interconnectivity between apparently unrelated phenomena, has become central in studies on the ITC society (Malecki and Moriset, 2008). The complexity of the subject, however, had a twofold impact: on one side, empirical studies of ITCs impact adopted network analysis formalizations on specific sub-themes (such as studies on the social impact of telecommunications on social integration). On the other side the availability of data which are suitable for network analysis has become impressive (see the works dealing with evolution of the structure of the Internet by Gonzalez Bailo, 2009) and created sub-disciplinary areas of study where sociological analysis has been 'replaced' by social physics (Dorogovtsev and Mendes, 2003). The theorizations and the results of studies on information flows and on social network structures, also offered the opportunity to debate the concept of *innovation and of knowledge spillover* which has become central for the evolution of the digitalized economics and for the emergence of the so-called 'embedded firm' (Grabher, 1999).

The contribution of Network Analysis...

From an integration perspective, however, the most relevant type of networks are those which can contribute to knowledge about socio-economic transformations of everyday life of the average citizen, such as e-government and virtual governance preferences or those concerning the reproduction/ creation of social inequalities in ITCs use.

One of the most visible effects of the ITC society is the transformation of the way the firms are approaching their clients and suppliers. The introduction of a series of innovations concerning communication processing, archiving and marketing data has given to the companies the opportunity to segment the market according to several criteria and in some sectors, to eventually 'create' their own production niche, with competition and risks of innovation reduced. Specifically, the Internet has emerged as a new channel for the distribution of digital information such as software, news stories, stock quotes, music, photographs, video clips, and research reports. The development of the Internet as an infrastructure for the distribution of digital information goods is dramatically affecting the marketing of firms (Dickson, 2000); moreover, the presence of 'economies of aggregation' for information goods can provide powerful leverage for obtaining new content, increasing profits, protecting markets, entering new markets, and affecting innovation, even in the absence of network externalities or technological economies of scale or scope.

However, providers of digital information goods are still experiencing different revenue models and diversity in strategies for pricing, packaging and market their products and services. Some firms, usually characterized by larger dimensions, have succeeded in selling very large aggregations of information goods from articles to stock and sports reports, advice on health and housekeeping and other personal services that can be delivered to the subscriber's for a single flat monthly fee or, in return for advertisement exposure freely accessed in large websites. Such aggregations of content would be prohibitively expensive, not to mention unwieldy, using conventional media. Other firms, with smaller dimensions have made successful attempts to charge for a more focused format on the Internet, and specialized on niche products and segmented markets of amateurs. Also this type of organization would have had problems of competitiveness if was not for the advantages given by ITCs in terms of costs/ time containment and market visibility.

Specifically, some recent contributions focus on the structure of the digital markets and describe the dynamics of selection and choice - of firms and of clients - that are induced by socio-economic factors. The impact of ITC on economic issues has been extraordinary and in a decade almost all the main sectors of the production and distribution of goods as well as travel and personal services have been transformed profoundly. The *reduction of transactions costs*, a more efficient distribution of information and the opportunity to organize with more efficacy manufacture and delivery processes also benefit clients and consumers, and transformed the form of relationships previously established between competitors and collaborators.

In a recent contribution, Rossignoli (2009) analyses the role played by ITC in the development of an electronic market place; the study, based on empirical observations of a new established portal which connects manufacturers and users, giving access to information and services concerning quality products (Italian ceramics). A E-marketplace networks can be considered as a third form of coordination mechanism alternative to market and hierarchy; the intensity of the relations among the participants in the network is a function of their interdependency and is related to the type of relations they have established. These can assume the form of transfer/exchange of resources and goods, affiliation to the same organization, spread of

information or knowledge or re-inforce preexistent personal relations. Typically, an increase in the intensity of the connections between the participants is associated with embeddedness and encourages trust and cooperation. The marketplace in the perspective of the author is a form of strategic network where transactions are carried on in an alternative way with respect to the traditional market. Information that are less available or more complex to collect such as prizes, are available with reduced cost and collaboration is easier to achieve; in economic terms the E-marketplace can reduce transaction costs even of its role is not really a negotiation one. 'This determines – say Rossignoli – increased interest on the part of retailers and manufactures in being present in the E-marketplace, therefore creating positive side effects and increasing the richness of the e-marketplace offering, (...) and contemporary increasing the disadvantages for those not participating in it' (Rossignoli, 2009; 74). The result of the activity of the virtual marketplace according to the author are visible in three areas: communication with an increase in connections and participants, brokerage which was not among the initial intentions of the site but developed further and occasionally gives the participants to participate to deals online and finally, the integration effect that has fostered the creation of cooperative relations among the participants and encouraged the creation of joint ventures and projects among firms. The relative increase in density and strength of relations among participants, affirms Rossignoli, is supported by ITCs and the visibility of the E-marketplace has opened the range of interested participants to professionals (architects, designers) and the quality of services offered. The results of the study of Rossignoli show that some of the worries about electronic commerce are not the case: the role of E-marketplaces is important but has not implied any reduction of prices and intermediaries.

The study concludes that ITCs have a positive effect on economic relations because they allow to design and strategically plan the connections between the enterprises that cooperate in the marketplace and help them to reach a common goal. The network structure of the E-marketplace has strategic implications with the participants (enterprises) but also for the external participants (clients, customers, retailers). Furthermore, cooperation can be designed with either integrative or competitive focus: some E-marketplaces specialize in brokerage function with auctions and catalogs on line, while others privilege a focus on planning and commercialization of new products, and prefer to develop post-sales and coordination activities among enterprises. The rules of behavior of a firm that operates on a transaction oriented marketplace are different from those of a firm that is oriented to cooperation. The case analyzed by Rossignoli is a virtual marketplace that supports cooperative relations and tends not to interfere in negotiations but instead to create positive connections among enterprise that belong to the same productive sector or to the same supply chain. The marketplace encourages and favor connections with manufactures of ceramic equipment and machinery, suppliers of raw material and marketing services; it also gives information and support to retailers and distributors of the products.

A reprisal of these concepts and its economic translation is present in Malecki study of urban economic systems (2002): the *competitiveness of cities* is measured looking at *interactions between enterprises* that belong to the same urban environment. To illustrate the role of different types of network structures the author distinguishes between 'hard networks', those related to the implementation of the Internet economy in production and infrastructures, and the 'soft networks' which represent the social connections that gather and distribute knowledge about the local economy at the regional, national and international level. The measurement of networks, however, is carried on preliminary on a sample of ten European cities, evaluating their level of integration in the ITC society and the opportunities for digital connectivity that are offered to the urban

population and to the industry and service economy. This last factor is of extreme relevance not only for its economic implications (e-trade and production and logistic structures) but also for the issue of social integration. The author interprets the possibilities of access to ITC as forms of investment that can support spin off effects and raise the level of competitiveness of a local economy. The conclusions of this preliminary study is that integration between the two types of networks is the best combination, because only 'hard networks' or 'soft networks' cannot efficiently promote innovations or develop the right use of the system on the public infrastructures. Moreover, as the author notes, 'digital divides' between the computer-literate and the rest of the population is a risk both for ubiquitous e-commerce and e-government even more, because governments cannot choose to serve only select 'customers'. One suspects that some differentiation will set in: they can provide services tailored to different groups—for example, those interested in sports and recreation, cultural activities, or crime prevention might have websites tailored to their specific needs. Cities and other levels of government clearly have a great deal to learn from businesses about how to do this' (Malecki, 2002:941).

Concluding, as innovations that imply transformations of social and economic relations, ITCs can be viewed as agents of deep modification of the main elements of our society, from social role of consumers to firms differentiation strategies; moreover, as factors that induce changes in the production and commercial spheres, ITCs are means to support collaborative ways of knowledge creation and adopt socially integrative innovations. The review has showed that this integration has been possible for those relations that pertain to the sphere of production and economic exchange and the few recent empirical works concerning policies implementation also report positive scientific results. The research perspective, especially in the socio-economic disciplines, however, has still to implement a relational point of view in collecting, processing and interpreting data and information flows that are at the bases of the digital transformation. Aspects concerning access to information, transformation of the peoples' attitudes and socializing institutions that are induced by the progressive integration of ITs in daily life as well as in decision making processes of consumers and firms, in particular, need to be approached with a research perspective more attentive to connections and interactions among behaviors and knowledge.

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