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Interactive networks are places where local meets global. They are still geographically specified places. But at the same time beyond territorial boundaries.

Also, interactive networks are bases both of social structure and social change.

Previously social structure and social change are regarded as opposite forces of our society, which are based on different grounds. But dynamic networks now sometimes strengthen existing structures and also weaken the same structures, leading social changes.



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Toward a Sociology of the Network Society

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Purpose of reading This article

The Call to Sociology

The twenty-first century of the Common Era did not necessarily have to usher in a new society. But it did. People around the world feel the winds of multidimensional social change without truly understanding it, let alone feeling a grasp upon the process of change. Thus the challenge to sociology, as the science of study of society. More than ever society needs sociology, but not just any kind of sociology. The sociology that people need is not a normative meta-discipline instructing them, from the authoritative towers of academia, about what is to be done. It is even less a pseudo-sociology made up of empty word games and intellectual narcissism, expressed in terms deliberately incomprehensible for anyone without access to a French-Greek dictionary.

Because we need to know, and because people need to know, more than ever we need a sociology rooted in its scientific endeavor. Of course, it must have the specificity of its object of study, and thus of its theories and methods, without mimicking the natural sciences in a futile search for respectability. And it must have a clear purpose of producing objective knowledge (yes! there is such a thing, always in relative terms), brought about by empirical observation, rigorous theorizing, and unequivocal communication. Then we can argue—and we will!—about the best way to proceed with observation, theory building, and formal expression of findings, depending on subject matter and methodological traditions. But without a consensus on sociology as science—indeed, as a specific social science—we sociologists will fail in our professional and intellectual duty at a time when we are needed most. We are needed because, individually and collectively, most people in the world are lost about the meaning of the whirlwind we are going through. So they need to know which kind of society we are in, which kind of social processes are emerging, what is structural, and what can be changed through purposive social action. And we are needed because without understanding, people, rightly, will block change, and we may lose the extraordinary potential of creativity embedded in the values and technologies of the

Information Age. We are needed because as would-be scientists of society we are positioned better than anyone else to produce knowledge about the new society, and to be credible—or at least more credible than the futurologists and ideologues that litter the interpretation of current historical changes, let alone politicians always jumping on the latest trendy word.

So, we are needed, but to do what? Well, to study the processes of constitution, organization, and change of a new society, probably starting with its social structure—what I provisionally call the network society.

A New Society

Except for a few stubborn academic economists, there is widespread consensus that we have entered a new economy. I contend we are also living in a new society, of which the new economy is only one component. Since this society will unfold, throughout the world, during the twenty-first century, the survival of sociology as a meaningful activity depends on its renewal, in accordance with the new phenomena to be studied and the new analytical issues to be tackled. But what is this new society? Since the focus of this article is on sociology, not society, I have no option but to be schematic and declarative, rather than analytical, taking the liberty to refer the reader to my trilogy on the matter (Castells [1996] 2000a). Here are, in my view, the main dimensions of social change that, together and in their interaction, constitute a new social structure, underlying the “new society.”

First is a new technological paradigm, based on the deployment of new information technologies and including genetic engineering as the information technology of living matter. I understand technology, following Claude Fischer (1992), as material culture—that is, as a socially embedded process, not as an exogenous factor affecting society. Yet we must take seriously the material transformation of our social fabric, as new information technologies allow the formation of new forms of social organization and social interaction along electronically based information networks. In the same way that the industrial revolution, based upon generation and distribution of energy, could not be

separated from the industrial society that characterized the last two centuries, the information technology revolution, still in its early stages, is a powerful component of multidimensional social change. While new information technologies are not causal factors of this social change, they are indispensable means for the actual manifestation of many current processes of social change, such as the emergence of new forms of production and management, of new communication media, or of the globalization of economy and culture.

The second dimension of social change is, precisely, globalization, understood as the technological, organizational, and institutional capacity of the core components of a given system (e.g., the economy) to work as a unit in real or chosen time on a planetary scale. This is historically new, in contrast with past forms of advanced internationalization, which could not benefit from information and communication technologies able to handle the current size, complexity, and speed, of the global system, as it has been documented by David Held et al. (1999).

The third dimension is the enclosing of dominant cultural manifestations in an interactive, electronic hypertext, which becomes the common frame of reference for symbolic processing from all sources and all messages. The Internet (248 million users currently, in 2000; 700 million projected by the end of 2001; 2 billion by 2007) will link individuals and groups among themselves and to the shared multimedia hypertext. This hypertext constitutes the backbone of a new culture, the culture of real virtuality, in which virtuality becomes a fundamental component of our symbolic environment, and thus of our experience as communicating beings.

The fourth axis of change, largely a consequence of the global networks of the economy, communication, and knowledge and information, is the demise of the sovereign nation-state. Not that current nation-states will disappear in their institutional existence, but their existence as power apparatuses is profoundly transformed, as they are either bypassed or rearranged in networks of shared sovereignty formed by national governments, supranational institutions, conational institutions (such as the European Union, NATO, or NAFTA), regional governments, local governments, and NGOs, all interacting in a negotiated process of decision making. As a result, the issue of political repre-

sentation is redefined as well, since democracy was constituted in the national enclosure. The more key decisions have a global frame of reference, and the more people care about their local experience, the more political representation through the nation-state becomes devoid of meaning other than as a defensive device, a resource of last resort against would-be tyrants or blatantly corrupt politicians. In another axis of structural change, there is a fundamental crisis of patriarchy, brought about by women's insurgency and amplified by gay and lesbian social movements, challenging heterosexuality as a foundation of family. There will be other forms of family, as egalitarian values diffuse by the day, not without struggle and setbacks. But it is difficult to imagine, at least in industrialized societies, the persistence of patriarchal families as the norm. The real issue is how, at which speed, and with which human cost, the crisis of patriarchy will extend, with its own specific forms, into other areas around the world. The crisis of patriarchy, of course, redefines sexuality, socialization, and ultimately personality formation. Because the crisis of the state and of the family, in a world dominated by markets and networks is creating an institutional void, there are (and increasingly will be) collective affirmations of primary identity around the key themes of religion, nation, ethnicity, locality, which will tend to break up societies based on negotiated institutions, in favor of value-founded communes.

Last, but not least, progress in scientific knowledge, and the use of science to correct its own one-sided development, are redefining the relationship between culture and nature that characterized the industrial era. A deep ecological consciousness is permeating the human mind and affecting the way we live, produce, consume, and perceive ourselves. We are just at the beginning of a most extraordinary cultural transformation that is reversing the course of thought that has prevailed among the world's dominant groups since the Enlightenment.

This new society was produced during the last quarter of the twentieth century, through the interaction among three independent processes that happened to coincide in time: the revolution in information technology; the socioeconomic restructuring of both capitalism and statism (with different fates for these antagonistic modes of production); and the cultural social movements that emerged in the 1960s in the United States and Western Europe. While

this multidimensional social change induces a variety of social and cultural expressions in each specific institutional context, I propose the notion that there is some commonality in the outcome, if not in the process, at the level where new social forms are constituted—that is, in the social structure. At the roots of the new society, in all its diversity, is a new social structure, the network society.

The Network Society: The Social Structure of the Information Age

The new society is made up of networks. Global financial markets are built on electronic networks that process financial transactions in real time. The Internet is a network of computer networks. The electronic hypertext, linking different media in global/local connection, is made up of networks of communication—production studios, newsrooms, computerized information systems, mobile transmission units, and increasingly interactive senders and receivers. The global economy is a network of financial transactions, production sites, markets, and labor pools, powered by money, information, and business organization. The network enterprise, as a new form of business organization, is made of networks of firms or subunits of firms organized around the performance of a business project. Governance relies on the articulation among different levels of institutional decision making linked by information networks. And the most dynamic social movements are connected via the Internet across the city, the country, and the world.

Networks are, however, a very old form of social organization. But throughout history, networks had major advantages and a major problem. Their advantages are flexibility and adaptability, characteristics essential for managing tasks in a world as volatile and mutable as ours. The problem was the embedded inability of networks to manage complexity beyond a critical size. Networks were historically useful for personal interaction, for solidarity, for reciprocal support. But they were bad performers in mobilizing resources and focusing these resources on the execution of a given task. Large, centralized apparatuses usually outperformed networks in the conduct of war, in the exercise of power, in symbolic domination, and in the organization of standardized, mass production. Yet this substantial limitation of networks' competitive capacity was overcome with the development of new information/communication technologies, epit-

omized by the Internet. Electronic communication systems give networks the capacity to decentralize and adapt the execution of tasks, while coordinating purpose and decision making. Therefore, flexibility can be achieved without sacrificing performance. Because of their superior performing capacity, networks, through competition, are gradually eliminating centered, hierarchical forms of organization in their specific realm of activity.

A network is a set of interconnected nodes. Networks are flexible, adaptive structures that, powered by information technology, can perform any task that has been programmed in the network. They can expand indefinitely, incorporating any new node by simply reconfiguring themselves, on the condition that these new nodes do not represent an obstacle to fulfilling key instructions in their program. For instance, all regions in the world may be linked into the global economy, but only to the point where they add value to the value-making function of this economy, by their contribution in human resources, markets, raw materials, or other components of production and distribution. If a region is not valuable to such a network, it will not be linked up; or if it ceases to be valuable, it will be switched off, without the network as a whole suffering major inconvenience. Naturally, networks based on alternative values also exist, and their social morphology is similar to that of dominant networks, so that social conflicts take the shape of network-based struggles to reprogram opposite networks from the outside. How? By scripting new codes (new values, for instance) in the goals organizing the performance of the network. This is why the main social struggles of the information age lie in the redefinition of cultural codes in the human mind.

The prevalence of networks in organizing social practice redefines social structure in our societies. By *social structure* I mean the organizational arrangements of humans in relationships of production/consumption, experience, and power, as expressed in meaningful interaction framed by culture. In the Information Age, these specific organizational arrangements are based on information networks powered by microelectronics-based information technologies (and in the near future by biologically based information technologies). Under the conditions of this new, emerging social structure, sociology must address several conceptual and methodological issues in

Civilization and power



Decentralized by electronic networks

order to be equipped to analyze core processes of social organization and social practice.

Theorizing Social Structure as Interactive Information Networks

The study of social networks is well established in sociological research, spearheaded in contemporary American sociology by Wellman (e.g., 1999), Fischer (e.g., 1992), and Granovetter (e.g., 1985). There is also an international association for the study of social networks, which constitutes a fruitful milieu of research. It can provide concepts and methods that will foster understanding of social networks as specific forms of organization and relationship, including electronic communication networks. Yet, while building on this tradition, I advance the notion that twenty-first-century sociology will have to expand the network-based perspective to the analysis of the entire social structure, in accordance with current trends of social evolution. This implies more than analyzing social networks. It will require reconceptualizing many social processes and institutions as expressions of networks, moving away from conceptual frameworks organized around the notion of centers and hierarchies.

For the sake of communication, I will use two illustrations to make my case, taking them from two different and very traditional sociological fields: industrial sociology and urban sociology. I will then draw some general theoretical implications from this change of perspective.

The prevailing form of business organization emerging in advanced societies and diffusing throughout the global economy is the network enterprise, which I define, in sociological terms, as the specific form of enterprise whose system of means is constituted by the intersection of segments of autonomous systems of goals. It follows a complete transformation of relationships of production and management, and thus of the occupational structure on which social structure is largely based. How can we conceptualize the role of producers of information in their differential position along an interactive network? How can we conceptualize the variable geometry of new industrial organizations, based on firms' permeable boundaries, bringing together workers, capital, and knowledge in specific projects that form, dissolve, and reform under a different configuration? Yes, work, workers, exploitation, cooperation, conflict, and negotiation do not disappear, but the ensuing individualization of the relationship between

management and labor and the ephemeral character of project-based, industrial organizations require a new conceptual apparatus, focusing on networked relationships rather than on vertical hierarchies. In this perspective, I propose to conceptualize the new occupational structure around the interaction among three dimensions of production relationships: value making, relation making, and decision making.

For value making, in an information-based production process, we may differentiate various structural positions: the commanders (or strategists), the researchers, the designers, the integrators, the operators, and the human terminals. Relation making defines another set of positions: the networkers, the networked, and the switched-off. And the relative positioning in decision making differentiates among the deciders, the participants, and the executors. The three dimensions are analytically independent. Thus, the empirical observation of the various arrangements among different positions in the three dimensions built around the performance of a given project may yield some clues on the emergence of new social relationships of production, at the source of new social structure.

A second example: the transformation of spatial structure, a classic theme of urban sociology. With the diffusion of electronically based communication technologies, territorial contiguity ceases to be a precondition for the simultaneity of interactive social practices. But "the death of distance" is not the end of the spatial dimension of society. First, the "space of places," based in meaningful physical proximity, continues to be a major source of experience and function for many people and in many circumstances. And second, distant, interactive communication does not eliminate space; it transforms it. A new form of space emerges—"the space of flows." It is made of electronic circuits and information systems, but it is also made of territories, physical places, whose functional or symbolic meaning depends on their connection to a network, rather than on its specific characteristics as localities.

The space of flows is made of bits and pieces of places, connected by telecommunications, fast transportation, and information systems, and marked by symbols and spaces of intermediation (such as airports, international hotels, business centers, symbolized by de-localized architecture). For instance, in recent years there has been considerable debate about the emer-



No sense of place



gence of “the global city.” The global city is not just a major metropolitan center that ranks high in the worldwide geography of management of wealth and information. For such cities (New York, London, Tokyo, Paris, or São Paulo) we already had the descriptive notion of “world city,” proposed 20 years ago. The global city, in the strict analytical sense, is not any particular city. And empirically it extends to spaces located in many cities around the world, some extra-large, others large, and still others not so large. The global city is made of territories that in different cities ensure the management of the global economy and of global information networks.

Thus, a few blocks in Manhattan are part of the global city, but most of New York, in fact most of Manhattan, is very local, not global. These globalized segments of Manhattan are linked to other spaces around the world, which are connected in networks of global management, while being loosely connected to their territorial hinterlands.

So the global city is a network of noncontiguous territories, reunited around the task of managing globalism by networks that transcend locality (Graham and Simon 2000). From this theoretical perspective we can develop models to analyze the new spatial forms constituted around interterritorial networks, and then examine their differential relationship to their surrounding, local environments. Thus, it is the connection between local and global, rather than the “end of geography” in the age of globalization, that becomes the appropriate perspective for the new urban sociology (Borja and Castells 1997). Networks of discontinuous places in interaction with a diverse range of localities are the components of the new sociospatial structure. The central analytical question then becomes how shared social meaning is produced out of disjointed spatial units reunited in a purely instrumental, global logic (Castells 2000b). By redefining spatial structure on the basis of a networking logic, we open up a new frontier for one of the oldest sociological traditions, urban sociology.

The analysis of social structures as a multidimensional, evolving system of dynamic networks may help explain social evolution in the Information Age. Indeed, networks are dynamic, self-evolving structures, which, powered by information technology and communicating with the same digital language, can grow, and include all social expressions, compatible with

each network’s goals. Networks increase their value exponentially as they add nodes. In formal terms, as proposed years ago by computer scientist and Internet entrepreneur Bob Metcalfe, the value of a net increases as the square of the number of nodes on the net. (The precise formula is $V = n^{(n-1)}$, where V is the value of the network and n the number of nodes). Thus, a networked social structure is an open system than can expand indefinitely, as long as the networks included in the meta-network are compatible.

The issue arises, then, of the contradictions among networks, which lead to conflicts and social change. In fact, network theory could help solve one of the greatest difficulties in the explanation of social change. The history of sociology is dominated by the juxtaposition of and lack of integration between the analysis of social structure and the analysis of social change. Structuralism and subjectivism have rarely been integrated in the same theoretical framework. A perspective based on interactive networks as the common basis for social structure and social action may yield some theoretical results by ensuring the communication, within the same logic, between these two planes of human practice. A social structure made up of networks is an interactive system, constantly on the move. Social actors constituted as networks add and subtract components, which bring with them into the acting network new values and interests defined in terms of their matrix in the changing social structure. Structures make practices, and practices enact and change structures following the same networking logic and dealing in similar terms with the programming and reprogramming of networks’ goals, by setting up these goals on the basis of cultural codes.

A theory based on the concept of a social structure built on dynamic networks breaks with the two reductionist metaphors on which sociology was based historically: the mechanical view of society as a machine made up of institutions and organizations; and the organicist view of society as a body, integrated with organs with specific bodily functions. Instead, if we need a new metaphor, the sociology of the network society would be built on the self-generating processes discovered by molecular biology, as cells evolve and develop through their interaction in a network of networks, within the body and with their environment. Interactive networks are the components of social structure, as well as the agencies of social change. The soci-

Network forms a social structure and at the same time , causes a social change

ology of the network society may be able to bridge structure and practice in the same analytical grasp.

A New Methodology?

The renewal of the study of society cannot proceed just on theoretical grounds. Sociology is an empirical science, within all the limits inherent to the constraints of observation under non-experimental conditions. Thus, new issues, new concepts, new perspectives require new tools. The emergence of interactive information networks as the backbone of social structure makes even more acute the need to take up the greatest methodological challenge for empirical research in sociology. While most of our analytical tools are based on linear relationships, most social phenomena—even more so in the network society—are characterized by nonlinear dynamics. But in the last two decades, we have witnessed the development of numerous research tools able to deal with nonlinear relationships.

On one hand, we have an expanding field of the new mathematics of complexity based on notions such as fractals, emergent properties, autopoietic networks, and the like (Capra 1996). Most of these mathematical discoveries remain confined to formal exercises with slight relationship to empirical research. But they are tools ready to be used, transformed, and perfected by able researchers with both the knowledge of the tools and the substantive knowledge to make sense of this formal language.

On the other hand, enhanced power of computers, and new, flexible computer programming languages, enable us to handle the complexity of an interactive network structure in precise terms. Computer-based system analysis of dynamic networks may constitute a fruitful approach through which observation and theory can be reconciled without excessive social reductionism. Simulation models in the social sciences got off to a bad start in the 1960s because their underlying theories were utterly simplistic, and computer programs were technically constrained by their set of rigid assumptions. But new computing capacity, in dynamic interaction of alternative assumptions processed at high speed, may change everything—as is already happening in biological research. In this sense, computational literacy (that is, knowing how to interact with computers, rather than just run statistical programs) may be a fundamental learning requirement for the current generation

of young sociologists—those who will analyze the network society.

In doing so, they will be fortunate enough to have access to a huge pool of information via the Internet. Given knowledge of languages (or automated translation programs), access to global sources may liberate sociology from the embedded ethnocentrism of its observation. Each study may be comparative or cross-cultural in its approach, by contrasting observation generated *ex novo* in a particular study to the accumulated knowledge on the matter from global sources. Naturally, critique of sources as well as problems of methodological integration of diverse data will be necessary requisites for use of this wealth of information. The practice of meta-analysis, in full development in other sciences, particularly economics, may become a standard tool of sociological research. This would also require proper training and methodological guidance for sociologists to benefit from expanded possibilities of information without being overwhelmed by it.

Overall, sociology should, and will, overcome the sterile, artificial opposition between quantitative and qualitative research, and between theory and empirical study. In the perspective of computational literacy, and with the formal integration of observations in a theory that conceives social structure as a network of interactive networks, it does not really matter what comes from statistics or from ethnography. What matters is the accuracy of the observation, and its meaning. Thus, formal models scripted in the computer programs must be theoretically informed, yet able to be given information apt to answer the questions raised in the theory.

The sociology of the network society will develop through synergy among relevant theorizing, computational literacy, and sociological imagination.

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Age Structure and Social Structure

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As sociology continues to evolve in the twenty-first century, how will demographic structure be understood? Demographic structure is minimal basic knowledge about the members of a society. Yet it becomes interesting sociologically because it is connected so intimately with our understandings of global social change, with social organization, and with the everyday lives of people. Here we argue that the distinction between demographic structure and social structure is an arbitrary and artificial one. Actually, these structures are very difficult to differentiate. Population structure is a dynamic and changing phenomenon, one that is enacted in everyday life. Changes in population structure occur in shipping containers filled with illegal immigrants in North American ports. High population densities occur in food lines and in traffic jams. Change in the age structure occurs in the need for home care and in loss of the sense of self due to chronic illness.

In this essay we focus on age structure. As rapid societal change occurs, cohort differences become evident among age groups. Indeed, the development of age cohorts as important elements of social structure is a product of cultural and institutional change (Eisenstadt 1956). Discussing birth cohorts as part of social change, Ryder (1965) firmly wedded population structure and social structure. That conception is a matter of not just social theorizing but commercial practice. For example, age-based marketing is essentially a cohort-focused strategy. The segmenting of markets by age and gender categories is firmly fixed in business culture today.

Riley and her colleagues (1968, 1988) took Ryder's concept of birth cohort and moved a

step beyond it. They connected individual aging with historical time, so that those individuals are seen as aging within a cohort context. As the new century begins, Americans are aging within an aging America. Settersten (1999) recently asserted, in this context, that the age structure over time influences the number of people available to different roles in society, and thus population structure partially determines the amount of competition for those roles within and between age groups. The number of people in line ahead for social security, for example, affects the amount taken out of your paycheck.

In addition, the age structure of the society may be seen as an "intervening variable" affecting the relations among other social processes. For example, the place of home ownership is affected by the aging of those who do own property. Under normal circumstances, middle-aged and older people are more likely than younger people to be homeowners. The rapid increase in the construction of rental units when the baby boom cohort began establishing independent residence pinpoints the intersection of population and economic processes. The market pressure from the larger birth cohort inflated the cost of housing and postponed homeownership for this age cohort (Forrest and Leather 1998).

Furthermore, age structure is a useful tool in a world-systems perspective. Nations that have relatively young populations and are rapidly modernizing, such as several Asian nations, find their populations aging very rapidly. It may be difficult to shift national policy focus just as quickly from youthful to aging sectors. Consequently, nations with very young populations may tend to export young people as less