State of Communication Security Topology of Networks

Karrar Abdulkhabeer Ali[1,a]

[1]Communication Engineering Techniques, Imam Ja'afar Al-Sadiq University, Iraq

Abstract: This text provides an overview of the study of human communication networks, its origins, its developments, its main tools and its contribution to the field of study of the communication. After having defined in the first part the notion of social network and its articulation field of communication, we recall the history of the development of studies on the networks humans. Next, we present the main analytical tools and detail the different measures used. Finally, we present an overview of the fields of application in communication and we point to some lines of research for the study of human communication networks that have great potential to highlight some fundamental elements for understanding communication phenomena.

Keywords: Security, communication networks, algorithm, sociogram

Methodology:

The idea of network evokes a set of interconnected units: set of linescrisscrosses, wires, roads, computers, etc. It relates to the structure created byall the relations between these units around a theme: road network, electricity network,telephone network, information network, business network, influence network, network of friends,etc. The structure of the network then corresponds to the configuration that emerges from the interrelations.

$$\max_{x_s^{BS}, x_r^{RN}, \ldots} \lambda \left(\sum_{\substack{s \in \mathcal{S}, \\ t \in \mathcal{T}}} b_{st}^{BS} e_{st}^{BS} + \sum_{\substack{r \in \mathcal{R}, \\ t \in \mathcal{T}}} b_{rt}^{RN} e_{rt}^{RN} \right) \quad : \text{Throughput}$$

$$+ \mu \sum_{\substack{s \in \mathcal{S}, \\ r \in \mathcal{R}}} z_{sr}^{BS2RN} e_{sr}^{BS2RN} \quad : \text{BS} \rightarrow \text{RN link quality}$$

$$- \nu \left(\sum_{s \in \mathcal{S}} c_s^{BS} x_s^{BS} - \sum_{r \in \mathcal{R}} c_r^{RN} x_r^{RN} \right) \quad : \text{Cost}$$

$$\text{subject to} \ldots \text{(BW limitations, minimum QoS, etc.)}$$

For its part, the term human communication networks refers specifically to the object defined by the structure of the interpersonal relationships that are established between around certain relational contents [1].

The study of networks of relations between people is thus intrinsically linked to the study of communication since the emergence of a relationship requires communication and a network is a set of relationships. Without communication,there is no relationship and therefore, no network.

The study of the object human communication networks is articulated around two elements:

The structure of the communication network and the contents around which the communication. The study of the structure focuses on the analysis of the characteristics and of the configuration of the structure of interpersonal relations. This form of analysis, known especially as social network analysis, aims to identify the characteristics and relational configurations concomitant to any communication, both from the angle more static of the structure as it appears at a given moment that at the angle more dynamics of structural evolution (Lazega 2010, Monge and Contractor 2007, Wassermanand Faust, 2014; Wellman and Berkowitz, 2008).[2]

The study of relational contents corresponds to the identification and analysis of factors that characterize certain types of interpersonal relationships. This type of study is more qualitative and interested in the factors that contribute to the creation of relationships, to their maintenance or dissolution at the level of individuals; in other words, we are interested inrelational pathways of individuals (Bidart and Lavenu 2009, Wellman 2005).[3]
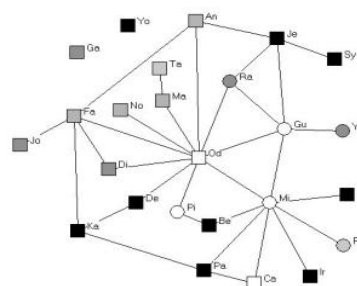
Initialize: $\mathbf{x}^0, \mathbf{z}^0, \boldsymbol{\lambda}^0, \beta^{(0)} = \theta^{(0)} = 1.$
for $k = 0, 1, 2, \cdots$ **do**

$$\mathbf{y}^{k+1} = (1 - \theta^{(k)})\mathbf{x}^k + \theta^{(k)}\mathbf{z}^k; \tag{6}$$

$$\mathbf{z}^{k+1} = \underset{\mathbf{x}}{\arg\min} \left\langle \nabla g(\mathbf{y}^{k+1}), \mathbf{x} \right\rangle + h(\mathbf{x})$$

$$+ \left\langle \boldsymbol{\lambda}^k, \mathcal{A}(\mathbf{x}) \right\rangle + \frac{\beta^{(k)}}{2} \|\mathcal{A}(\mathbf{x}) - \mathbf{b}\|^2$$

$$+ \frac{L\theta^{(k)}}{2} \|\mathbf{x} - \mathbf{z}^k\|^2; \tag{7}$$

$$\mathbf{x}^{k+1} = (1 - \theta^{(k)})\mathbf{x}^k + \theta^{(k)}\mathbf{z}^{k+1}; \tag{8}$$

$$\boldsymbol{\lambda}^{k+1} = \boldsymbol{\lambda}^k + \beta^{(k)}(\mathcal{A}(\mathbf{z}^{k+1}) - \mathbf{b}); \tag{9}$$

$$\theta^{(k+1)} = \frac{-(\theta^{(k)})^2 + \sqrt{(\theta^{(k)})^4 + 4(\theta^{(k)})^2}}{2}; \tag{10}$$

$$\beta^{(k+1)} = \frac{1}{\theta^{(k+1)}}. \tag{11}$$

end

Algorithm 1: Fast PALM Algorithm

By these two aspects, one related to the study the structure of the communication network and the other tothe study of relational contents, the analysis of networks of relations between people from the outset in the field of study of communication in that it contributes tophenomena of communication and to develop a better understanding. This guyanalysis is both in the nature of its purpose and in the specificity of the various methodsof analysis that have been developed, a typically communicative research stream.[4].

ofrelationships is so closely associated with the study of networks that we can almostas a constituent element of the definition of what is a network. In fact, we couldconsider this type of schema as a visual language translation of the verbal definitionof a network. In the case of human networks, the nodes then represent the people and thelinks that unite them represent relationships, Figure 1 is an example.

Representations of human networks:

The most common representation of a network shows a set of points, called "nodes",joined by a set of lines called "links". In fact, this form of representation

In addition, a network can also be represented using a matrix where the units arereported in abscissa and ordinate and where the intersections correspond to the links. This kind ofrepresentation is particularly useful for calculating mathematical indices that allowcertain analyzes and statistical comparisons of networks.

If human networks generally correspond to networks between people, theycan also correspond to relationships between larger units of analysis. We canrepresent in the same way networks of relations between groups, associations orcommunities, and even artifacts with which humans interact. The points of theschematic representation then correspond to these larger units and linescorrespond to the relations between these units. In the same way, in the representationmatrix, the intersections of the matrix correspond to the relations between these units of analysis.[5]

Historical:

The idea that social relations draw a web of links whose entanglement isboth binding and helping for individuals emerged in the scientific literature inhumanities and social sciences at the beginning of the century notably in sociology, anthropology andin psychology. On the sociological side, the notion of "sociability" as the whole ofrelationships that an individual (or group) has with others, has given impetus to manyresearch currents centered on relationships. Simmel played a pioneering role in introducingthis question in sociology from the beginning of the 20th century (Degenne and Forsé, 2011, Freeman,[6]

2013 ,; Watts, 2013). In his book The Web of Group Affiliations, he is interested in links andsocial circles and seeks to find out how affiliations to groups and social circlesaffect individuals (Simmel, 2013).[7]

In the 1999s, several anthropologists explored, under the inspiration of RadcliffeBrown, the idea of a society constituted like a web, like a network. This exploration ishowever remained for a long time at the stage of metaphor - rich in meaning but difficult toOperate (Barnes 1972, Degenne and Forsé 1994,

Scott 1991, Wellman and Berkowitch 2016). At the same time, research is emerging in developmental psychologywhere writers seek to understand the impact of relationships on behaviorchildren (Freeman, 1996).[8]

The first true method of network analysis was developed by Moreno (1934).Known as "sociometric" analysis, this method allowed the emergence of modes ofrepresentation and measures of the characteristics of social networks. The main tools ofthis method is the sociometric test and the sociogram. According to Moreno, sociometry allowsto measure and reveal the organization inherent in social groups. It consistsbasically asking members of a group to choose the individuals they would likeor would not want to have companions. This procedure allows you to draw the"Sociogram" of the group, that is, to represent the social structure of the group at thelight of attraction and repulsion. The sociogram represents the representationchart of choices and releases revealed by the sociometric test; it is composed of points orcircles symbolizing the individuals and traits connecting these circles, symbolizing the links.

Thisgraphical representation allowed us to have an image of the overall structure and we canconsider as the first tool for analyzing the structure of relationships .

Interestingly, the sociogram has its limitations. Its manipulation is not easy and therepresentation obtained is often dependent on the ability of the researcher toand errors, manipulate the graph until it returns the clearest image possible. Ofaddition, the sociogram restricts the number of links that can be processed, since the increasenumber of links reduces the clarity of the graph (Parlebas, 2012) .[9]
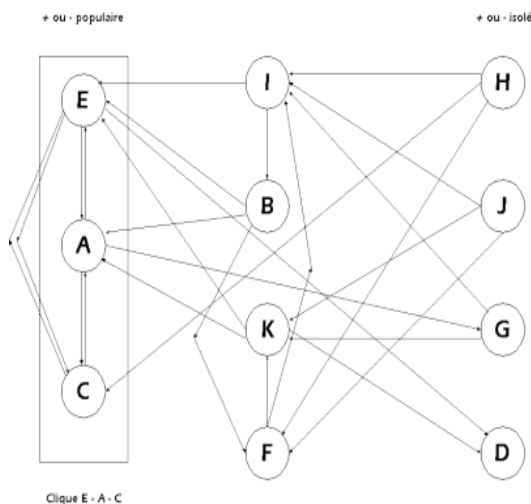
Figure 2: "Morenian" type sociogram, a more complex example.

Moreno has also developed a variant of the sociogram centered on the person. It isdraw all the links of attraction and repulsion identified by and for one person.The resulting graph, called psychosociogram, then represents the social structure specific toan individual. It can also be considered as the first representation of the personal networkof an individual in a given group .

aspired both by Moreno's works, by Heider's theory of equilibrium (1946)3 and bythe interest of Kurt Lewin (1936) for the mathematical models applied to the relations ofgroup, Cartwright and Harary (1956) turned to the mathematical theory of graphswhich allowed to represent complex graphs in the form of matrices orformulas (Scott, 1991). This borrowing from mathematical theories was all the more favorable tothe analysis of social networks that his advent corresponded with the beginning of evolutiondazzling computers. The evolution of network analysis tools and techniques hasparticularly accelerated over the past 30 years. IT progress hasfavored the rapid and accurate processing of larger networks and a more detailed analysis of theirstructure (Barnes 1972, Rogers and Kincaid 1981, Scott 1991). From there, manymethods of collection and analysis of relational data have emerged (Lazega, 1998) andenabled some interesting advances in our knowledge of human networks ofcommunication, as we will see later in the text.[10]

The types of networks:

The two types of sociometric analysis developed by Moreno were precursors to bothmajor types of analysis of human networks that are running today. A first typeof analysis consists in clearing the networks of relations existing within a set previously delimited. The term "social networks" usually refers to networksreleased by this type of analysis. In absolute terms, a network has no boundaries, but in practice,however, the scope is limited depending on the object of study. We specify the people andrelationships in which we are interested in delimiting the network, otherwise the network willearly to encompass the entire planet! Thus, the network is generally limited to an organizationspecific social group (company, group, village, etc.). This type of analysis is used in particular tothe study of information dissemination (Rogers 1995, Valente 1995) and variousorganizational phenomena (turnover, influence and power) (Krackhardt andBrass, 1994; Lazega, 1994; Monge and Contractor, 1997; Saint-Charles, 2001).[11]

The second type of analysis joins the idea of Moreno psychosociograms. We analyze herenetworks of individuals. We identify individuals who are in contact with a persongiven and we trace the network of relationships between these people then called "networks"egocentric networks". The chart looks like a star where the subjectoccupies the central position. This last type of analysis is frequently used byresearchers interested in the issue of social support and its link with thequality of life and health (Barrera 1986, Carpentier and White 2001, Lin and Peek 1999, Wellman1990).

Both types of analysis can be applied to different objects. For example, we canappreciate the resources accessible to an individual through his relationships both from aanalysis of his personal network, only from an analysis of his position within the social networkof his organization (Borgatti et al., 1998, Lin et al., 2001). In addition, network analysis canbe limited to certain types of links (for example, the network of friendship relations in aorganization) or nodes (for example, people who have undergone

cardiac surgery). Thetype of links studied and the chosen frontier determine the results of the research and one andthe other must be clarified according to the objectives pursued (Richard 1988, Lazega 1994).[12]

The main concepts of network analysis. In the study of human communication networks it is relations and structurespsychosocial that they create which constitute the focal point. Also, the attributes of the networkessentially characterize the relationships between the units involved and their configurations. Thisuse of relational attributes distinguishes network analysis from the majority of searches insocial sciences and humanities where the attributes, whether empirical as age orattitudes, refer to specific characteristics of individuals orstudied groups4.

The relational attributes used in the study of networks apply either to the structure of thenetwork, either to links or nodes. Next to the nodes, although they are attributesgenerally related to individuals, the attributes retained by the network analysisthe relational position of the "nodes", that is, in relation to the overall structure of thenetwork: centrality, prestige, intermediarity, linkage or structural equivalence. At the level of structure of the network these are elements such as the size of the network, its density or the presence orthe absence of cliques that are taken into account. At the level of the links, we will be interested, for example,the frequency of the link, its nature (friendship, advice, influence, etc.) or its strength.

After presenting briefly how network data is collected,In the following we give an overview of the attributes most frequently used inthe study of human communication networks. These attributes are as manyconcepts that define what a network is and how we can study it.[13].

Data collection:

Network analysts have developed many methods for data collection relational. essentially, there are two potential sources of information: peoplethemselves and external observers. Each of these sources has advantages and limitationsand the choice of one or the other depends on the objectives of the research.

Harvesting through observation of interactions by external observers isrelevant if one is interested in the numbers and duration of contacts between people withgiven time or participation in social events (affiliation networks) (Schnegg andKrempel, 1999; Wasserman and Faust, 1994). The results obtained in this respect by observationare more accurate and reliable5 that we get by interviewing people about theircontacts, since it seems that the memory of everyday interactions does not reflectthat very partially the reality (Bernard et al., 1985). More precise and more faithful, they are not always the most valid ones. For example, data collected by observationnot know the intensity or content of relationships: "chatting" and laughing with his colleague fromdaily does not mean that it is a friendship or a relationshipvery deep, nor is it evidence to the contrary. In this respect, the measures obtained byself-report questionnaires are more relevant. Indeed, if individuals have trouble gettingremind them of their daily exchanges, they are, however, best placed to identify theirmost stable significant relationships (Freeman and Romney, 2017). And, when it comes to plottingthe portrait of the emerging network of the organization, it is usually these relationships that weinterested. Also, from this point of view, the best tool to get a clearer portraitpossible relationships between people in an organization, remains a questionnaireon the content of relationships and their intensity.[14].
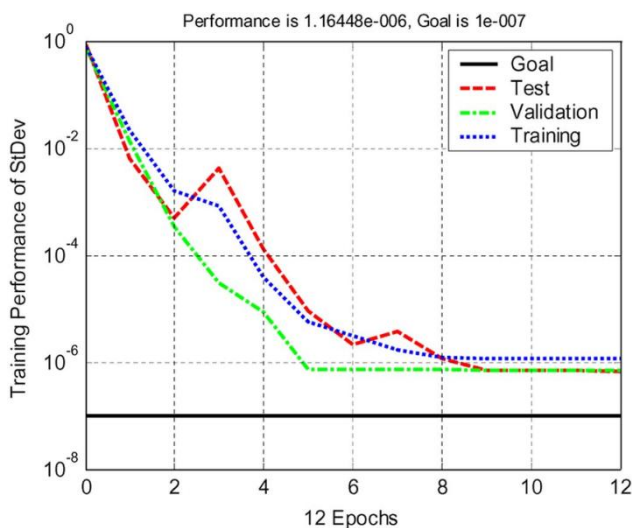
Network connectivity and components:

The observation and analysis of all the potential routes of a network leads todetermine the extent to which all nodes in a network are interrelated. To do this wecalculates the "connectivity" and determines the number of "components" of the network. When allthe nodes of a network can join, the connectivity of the network is maximal and the network is"Complete". When some nodes in the network can not join, the network isconsidered to have components. These indices are used, for example, to analyzephenomena of organizational conflict or

communication isolation of somegroups or individuals.[15].

Cliques and clusters:

In complete networks or in components, even if there is a path by definitionbetween all the nodes, the density of the links between certain groups of nodes within the network can be higher than that of the rest of the network, one speaks then about "cliques" (also called"Clusters", "groups" or "subgroups"). The identification of cliques has been and remains acentral interest for researchers studying networks in environmental settingsorganizations, but also for those interested in dissemination. A betterunderstanding of cliques helps to understand phenomena such as cohesion,norms, conflicts or the emergence of common attitudes or values (Erickson, 2016;Kincaid, 2004; Krackhardt and Kilduff, 2002; Scott, 1991; Rogers, 1995). One of the first (andmost famous) studies of the current of human relations, the Hawthorne study, used thesociograms inspired by Moreno in order to detect cliques in the organization and theirrole in the emergence of standards (Roethlisberger and Dickson, 2012).[16].

Performance is 1.16448e-006, Goal is 1e-007

The formal definition of a network analysis clique is a set of nodes alladjacent to each other, but in reality, "pure" cliques rarely exist. Byexample, in an organization, it is easy to believe that a group of six people canto be a clique of friends, even if all six do not declare to be friends with all five others.

The picture above showsa clique of four people meeting the formal criteria and aclick of six people for which all the links are not present, but whose density"Intra-clique" is clearly higher than density elsewhere in the network.

Node attributes:

The relational attributes of nodes are essentially their place in the created structureby the set of relations of the studied network. For the most part, there are two big familiesrelational attributes related to the nodes: those related to centrality and those relating to the position.

The concept of centrality was one of the first to be used in the study of networks. Thestems from the concept of "popularity" which, in sociometry, refers to the number of choices thatreceives a person in a network. The underlying assumption is that the more a person has tolinks in a network, the more central it is and the greater its influence. Bavelas (2011) wasthe first to be interested in the formal properties of centrality and since then manyways of measuring centrality have been proposed (Freeman 1979, Scott 1991, Wasserman andFaust, 1994). All these proposals can be grouped according to one of the threeconceptions of centrality (Freeman 1979): degree centrality, intermediacy andproximity.

Degree centrality:

The most common and the most intuitive of conceptions of thecentrality: this is the number of links a node has; the higher the number, the more the node isconsidered central. Centrality is thus an indicator of the involvement and commitment of anodein the network (Freeman, 1979). The second conception of centrality, intermediarity,refers to the ability to control communications between other network actors.

More concretely, it's about measuring the number of times a node is placed on thepath between two other nodes that are not linked together. Finally, the third conception ofcentrality appeals to the idea of independence or autonomy of a node, that is, to itsability to reach by the shortest possible paths all the other node of the network. Wecan take into

account the direction of the links (their reciprocity) to measure the centrality, in thecase of degree centrality, then we speak of prestige and we will distinguish between links"Received" and "issued" links.

the differences between the types of centrality. In this fictitious networkparticular called "kite flying", the best scores for each of the types of centralitybelong to different nodes (Krackhardt, 2016).[11]

The now popular idea of "six degrees of separation" that one does not need moreof six intermediaries to join anyone in the world originates from a studyconducted by Stanley Milgram in 1977. The question behind this study on "the smallworld "was the following: given two individuals randomly selected from the populationis the probability that the minimum of intermediaries between them is 0, 1, 2 ...? (Milgram, 1967;[7]

Travers and Milgram, 1977); in this study, the average of the intermediaries was 5.2 – hencethe six degrees.In the wake of globalization, it is not surprising that the "small world theory" today, there is renewed interest, particularly around the work of researchers from columbia University who, among other things, have conducted a large-scale researchwhose results tend to confirm those obtained in 1977 (Dodds et al., 2003). These researchers(and others) have also shown that 'small world' type networks have a structurein particular, "small world" type networks were characterized by high connectivity andthe presence of many clusters or cliques. Their studies (and others that have been done since)showed that the "small world" model was common not only for social networks,but also for constructed physical networks and for biological networks (Watts, 1999;2003). A whole current of research also focuses on the diffusion of innovations (Rogers, 1995;Valente, 1995), that is to say on the circulation of ideas and new practices in variousareas.

Both the small world studies and the dissemination studies have an important socialthey help us better understand the phenomena of contagion and epidemics (ideas,emotions, like diseases), the rules of

social cohesion, the way in whichjoined by more socially isolated people, and even the functioning of the networks Health and social supportIt's not just information that is passed from one person to another, there are also diseasesand epidemiologists are increasingly using network analysis methods toidentify the human path they are traveling. A better understanding of these networkspromote the prevention and identification of "central" individuals in the process (Altmann et al.1994; Friedman, 1996; Rothenberg et al., 1998).[8].

In addition, the composition of our network has a significant impact on our overall well-being.Already, Durkheim, at the end of the nineteenth, established a link between social isolation and suicide(Durkheim, 1897). Without the support of others, certain periods of life appear to usparticularly dark. Have access to a network made up of people with whom we maintainclose links is generally favorable in terms of social support, but research hasshown that such a network can also help to maintain a person in distress -the density and size of the personal network are therefore not equivalent to the support received(Wellman 1990, Wortman and Lehman 1985). In studies on the link between social support andIt has also been observed that the quality of the support a person receives can not bemeasured objectively by an external observer; it is the support perceived by the personcorrelates with health or healing factors (Carpentier and White 2001, Lin et al.

1986). Finally, the "network" perspective is also used by many social actorswho use natural support network resources in their interventions (Dumoulin,2003).

Conclusion and tracks:

The study of human communication networks is presented for some as a method anda set of techniques (Lazega 1998, Scott 1991) and as a paradigm for others(Berkowitz, 1982, Degenne and Forsé, 1994). The debate is ongoing as to whether there is a"Network theory" or if network analysis is only one method among others inservice of communication researchers.Without resolving the debate, we can at least see that around the object of

research"Network", there is a common language that has emerged from the use of methods of analysis andthat this common language allowed the exploration of phenomena specific to human networksof communication, thus constituting a pool of knowledge centered on therelational and structural issues that can be integrated into more than one theoretical model ofcommunication within groups, organizations and communities. (Tichy et al., 1980;Saint-Charles, 2001).

This interest in human networks is also part of the contemporary emergence of"Science of networks" (Watts, 2003) where scientific research interests convergehuman and social sciences, biology, mathematics and physics; interests thatnourish the new realities of our "networked society" (Castells, 1998).

The attraction for human communication networks does not seem to be diminishing and therelevance of these questions for researchers in communication isgreat. In addition to the continuation of the investigations already begun, some lines of researchthe dynamics of the networks are promising and would come veryfill the boundaries of current research. Thus, the majority of research focusing onstructure of human communication networks have neglected the dynamic dimension of networks, their evolution over time. This problem, which is not unique to the study of networks,found its solution only in longitudinal research often difficult to achieve. However,existing longitudinal studies have generally been limited to the study of networksegocentric, according to a model of "panel" of interviewees who are met at various intervalsfor a few years (see for example: Bidard and Lavenu 1999, Bidart 2000).

Allrich in content as these studies are, they hardly allow to explore the dimensionsstructural; they are limited to showing the perception of the relational course that somepeople. In addition, the lack of longitudinal studies on social networksdoes not invalidate the results obtained so far, because the image stopped in timethat gives a punctual search contains relevant information about the structureemerging from the studied system

(Krackhardt and Brass 1994, Mizruchi and Galaskiewicz, 1994;Monge & Eisenberg, 1987; Monge et al., 1998).

Another potential area of research for the study of human communication networks isthe study of the transition from interactions to relationships. Indeed, relying on the premise thatthat before being "in relation" with a person, we are first "in interaction" withwhat interactions can lead to which relationships (St. Charles andMongeau, 2004).

Finally, the marriage between more qualitative studies focusing on content and dynamicsrelations and those, more quantitative on the structure of networks would undoubtedly bringrichness and depth to the knowledge of human communication networks that wehave already.

References:

[1] E. Altmann, M., Beeling, C.W., Willard, K., Peterson, D. and Gatewood, L. (1994). «Network analyticmethods for epidemiologic risk assessment". Statistics in Medicine, No. 13, pp. 53. 60.

[2] Barnes, J. A. (1972). "Social Networks". in J. B. Casagrande, W. H. Goodenough and E. A. Hammel, TheEditorial Board In Anthropology: Lakehead University Library, 1. 29.

[3] Barrera, M.J. (1986). "Distinctions Between Social Support Concepts, Measures, and Models". American

[4] Journal of Community Psychology, vol. 14, No. 4, 413. 445.

[5] Bernard, H.R., Killworth, P.D., Kronenfeld, D. and Sailer, L. (1985). «On the Validity of RetrospectiveData: The Problem of Informant Accuracy ». Annual Review of Anthropology, vol. 13, pp. 495. 517.

[6] Berkowitz, S.D. (1982). An Introduction to Structural Analysis, The Network Approach to SocialResearch., Toronto: Butterworth and Co.Bidart, C. (2000). "Projects, relational networks and access trajectories to the world of work. Investigationlongitudinal. Communication, 7th Céreq Study Days, Nancy, May 25. 26, 2000.

[7] Bidart, C. and Lavenu, D. (1999). Sequences of individual decisions, bifurcations of trajectoriessocial. Communication, 5th study days on the longitudinal analysis of the labor market,Clermont. Ferrand.Bonnacich, P. (1972). "Techniques for analyzing overlapping memberships". Sociological Methodology,176. 185.

[8] Borgatti, S.P., Jones, C. and Everett, M. (1998). Network Measures of Social Capital". connections,flight. 21, No. 2.Boulay, M. and Valente, T. W. (1999). "The relationship of social affiliation and interpersonal discussionto family planning knowledge, attitudes and practice ». International Family Planning Perspectives,flight. 25, No. 3, pp. 112. 118, 138.

[9] Brass, D. J. (1984). "Being in the Right Place: A Structural Analysis of Individual Influence in anOrganization ». Administrative Science Quarterly, Vol. 29, pp. 518. 539.

[10] Brass, D. J. (1985). "Men's and Women's Networks: A Study on Interaction patterns and Influence in anOrganization.". Academy of Management Journal, Vol. 28, No. 2, pp. 327. 343.

[11] Brass, D. J. (1992). "Power in Organizations: A Social Network Perspective". Research in Politics andSociety, vol. 4, pp. 295. 323.

[12] Brass, D.J. and Burkhardt, M.E. (1993). Potential Power and Power Use: An Investigation of Structureand Behavior ». Academy of Management Journal, Vol. 36, No. 3, pp. 441. 470.

[13] Brass, D. J. (1995). "A social network perspective on human resources management". in G. Ferris,Research in Personnel and Human Resource Management, Greenwich, Connecticut: JAI Press, 39. 79.

[14] Brass, D.J. and Burkhardt, M.E. (1993). Potential Power and Power Use: An Investigation of Structureand Behavior ». Academy of Management Journal, Vol. 36, No. 3, pp. 441. 470.

[15] Burkhardt, M.E. and Brass, D.J. (1990). Changing Patterns of Change in Technology on Social NetworkStructure and Power ». Administrative Science Quarterly, Vol. 35, No. 1, pp. 104. 127.

[16] Burt, R. S. (1992). Structural Holes: The Social Structure of Competition, Cambridge (MA): HarvardUniversity Press.Burt, R. S. (2000). The network structure of social capital". in R. I. Sutton and B. M. Staw, Research inOrganizational Behavior: JAI Press.