Journal of Social Structure

JoSS Article: Volume 12

# Inter-Firm Social Networks Created by Mobile Laborers: A Case Study on Siteler in Ankara

**Burak Beyhan, burakbeyhan@mersin.edu.tr**
Mersin University, Faculty of Architecture, Department of City and Regional Planning

*Address* Mersin Universitesi, Mimarlik Fakultesi, Sehir ve Bolge Planlama Bolumu, Ciftlikkoy Kampusu, 33343, Yenisehir/Mersin, Turkey

## Abstract

Labor mobility, both as a mechanism of knowledge diffusion and as a kind of social glue that holds together small production communities operative within a given territory, deserves serious consideration. In this context, focusing on a specific industrial cluster in Ankara, this paper reveals the extent and characteristics of the social networks created by the mobile laborers in order to understand the interconnections between social context, knowledge spillovers, innovation and labor mobility. For this purpose a step-wise algorithm is employed in order to identify social sub-groups by employing social network analysis and by drawing on the flow data constructed for this study. What is evident from this study is that the social network created by the mobility of laborers in Siteler, an industrial cluster specialized in furniture production, reveals a topography of social relations that cannot be split into equally large blocks but eventually parceled out to micro parts consisting of generally 2 or 3 firms. Interestingly, the contexts of innovation also unveil that innovative firms tend to be located at an intermediate position, not an upper and central position, within the topography of the network.

## Key Words

Labor mobility, industrial clusters, innovation, social network analysis

## Acknowledgements

The author would like to thank Çetin Küçüker of SSI for his help in providing the database without which this study would not be possible. He also would like to thank the anonymous referees for their constructive suggestions and comments. All standard component, bicomponent and clique analyses were carried out using UCINET software (Borgatti et al. 2002), while the network visualization in the figures was realized through the NetDraw visualization tool (Borgatti, 2002).

*When a man changes jobs, he is not only moving from one network of ties to another, but also establishing a link between these. Such a link is often of the same kind which facilitated his own movement.*

Granovetter (1973: 1373)

## 1. Introduction

Being part of a broader research program, the basic motivation behind this paper is to capture the cognitive processes that prevail within an industrial cluster through the buzz of labor mobility. The extent of circulation and regional codification of the tacit knowledge residing with labor is primarily determined by the degree of the mobility of the respective labor in and around an industrial cluster. A kind of social network is constructed around the mobile laborers. One of the critical tasks of this study is to unveil the extent of this network in Siteler in order to map the interconnections between innovation, knowledge spillovers, and labor mobility in the emerging social structures. Within this context, the primary concern of this paper is to determine the boundaries of communities internally implicated within a large network of small firms connected to each other by way of labor mobility and to observe the context of innovation in terms of available characteristics that can be assigned to both the firms themselves and the relations established between them through mobile laborers.

For this purpose, a simple algorithm has been employed to reveal the social groupings which can be made visible by mapping the flow of labor in the larger community over time. Actually this mapping practice also provides us with the approximate extent of the tacit knowledge transfer. Within this context, some of the basic questions addressed in this paper can be listed as following: Are there different *communities of production* exclusive of each other and framed by the contexts of the labor mobility? Do they exhibit specific sectoral, cultural and other *cohesive characteristics*? In other words, are these communities internally homogenous in terms of some specific characteristics? The basic expectation from these questions is to show that any social structure can survive only by creating islands of social groups weakly connected to each other within it. Although the respective social structure as a social network is characterized by some common attributes, internally it accommodates social groups differentiated from each other in terms of some cohesive characteristics.

Another set of questions is related to the innovativeness of the respective communities of production in relation to their position in the network: Do the innovative firms or group of firms concentrate in certain parts of the network? Do they exhibit identifiable and meaningful patterns of coexistence within the parts of the network of which they are member? In this study it is claimed that the relationship between innovativeness and network can not be explicated by only illustrating the fact that the firms subject to high amount of labor traffic tend to be more innovative. Instead, parallel to Granovetter (1973) and Burt (1992), it is argued that innovative firms do not necessarily occupy the most central positions in the network in terms of their degree centrality. Those members and parts of the network placed along the paths connecting different parts of the network with each other can be expected to be more innovative because of their information rich and strategic position in the network.

In order to answer these questions and to test the propositions given above, standard tools available in social network analysis (SNA) will be employed by following a simple algorithm mainly composed of component, bicomponent and clique analyses to divulge the *social structures* embedded in the network. In spite of simplifying the effort made in this study as if it is solely an explanatory attempt revolving around a set of questions, it should be stressed that this study is equally an exploratory scientific endeavor that is equipped and forced to overlap with the explanatory efforts. A form of dialectic between *exploration* and *explanation* constitutes the backbone of this study. In this paper,

SNA is used for mainly exploratory purposes, in order to detect whether or not there are exclusive social sub-groups and, in turn, to observe whether there are some cohesive characteristics that can be used to explain the innovativeness of the emerging inter-firm social networks created by mobile laborers.

The rationale behind the identification of the sub-communities of production framed by the contexts of the labor mobility is to illustrate the fact that innovation does require not only the existence of social sub-groups but also the proper connections between the respective groups. In other words, it is argued that cultivation of innovation can only be realized by overlapping the different social and cognitive domains. As some members of the components or blocks are connected to the other components or blocks owing to their position in the network as brokers (cut-points), they facilitate the flow of information between different parts of the network. In fact, in some respects, sub groups also function in the same fashion as cut-points within large social networks. That's why in this study it is hypothesized that innovative firms and sub-communities do not necessarily occupy the most central positions in the network in terms of their degree centrality.

Under these considerations, this paper is organized as follows: First, labor mobility studies will be elaborated by focusing on their emphasis on social networks and innovation. Later, the network coverage of the study will be presented by focusing on the characteristics of the main database and drawing on the methodological aspects of SNA and labor mobility studies. This will be followed by the application of SNA to the inter-firm labor mobility network at two different levels of view. Finally, the merits of applying SNA to the mapping of the *cognitive architecture of a region* will be discussed by drawing on the results of the SNA algorithm employed in this study.

## 2. Labor Mobility Studies in Connection with Social Networks and Innovation

The earliest studies in labor mobility can be traced back to the 1930s. Although they lack the specific analytical focus employed in this paper, one can be surprised with their strong methodological foundation and relatively comprehensive outlook which is not even available in most of the studies conducted to analyze labor mobility today. All of these early studies were conducted in the USA. Especially three books deserve attention as they reflect the culmination of the efforts made to analyze mobility of laborers in the USA. The driving force behind the books evaluating the labor mobility experience in the USA between 1930 and 1950 was the 'Inter-industry Economics Sections of the U.S. Air Force', which supported the labor mobility survey in the major cities of the USA. The first book, written by Palmer and Brainerd (1954), is devoted to the analysis of the labor mobility in six American cities. The second book is a compilation of the previous studies conducted on labor mobility with a special focus on the economic opportunities tied to labor mobility (see Bakke (1954), Kerr (1954), Myers (1954), Palmer (1954) and Yoder (1954)). The last book is an appraisal of these labor mobility studies by Parnes (1954).

These early studies devoted strong consideration to the interconnections between social networks and labor mobility in terms of the tendency of the laborers to move within the geographical boundaries of the clusters which were characterized by specialization in certain sectors and strong ties to a particular community. Yet, they did not formally employ SNA (sociometrics at that time) for the analysis of these interconnections. One of the major characteristics of these studies is their refusal of the formal methods employed by mainstream economics characterized by 'ceteris paribus'. All of the contributors have a strong commitment to the institutional considerations in relation to the analysis and conceptualization of labor mobility.

Labor mobility studies continued during the 1960s and 1970s (see for example Bunting (1961), Lansing and Mueller (1967), Zarka (1967), Greenberg and McCall (1974)). Yet, except for the groundbreaking study of Granovetter (1973), one can not observe a simultaneous thread of labor

mobility and social networks in terms of employment of SNA as a tool for the analysis of social contexts of labor mobility.[1] Nevertheless, recent labor mobility studies are more promising in this respect. In recent years, there has been an increasing interest in SNA in terms of its applicability to the analysis of knowledge spillovers, innovation and labor mobility. Yet, most of them again fail to discover the potential of SNA in the exploration of the interconnections between labor mobility and social networks. Besides, those studies employing SNA for the analysis of labor mobility and social structure have certain biases.

One of the biases of the literature is the exclusive focus on modern high-tech sectors at the expense of *low-tech* and *traditional sectors*. There are a number of studies employing SNA and concerning labor mobility in connection with innovation especially for scientists (see for example Breschi and Lissoni (2003), Cantner and Graf (2006), Graf and Henning (2006), and Casper (2007)). Indeed, such studies dealing with the application of SNA in labor mobility and innovation mostly do it by tracking the career paths of scientists. But, there is no doubt that learning and innovation are activities going on in all parts of the economy including traditional sectors such as manufacture of furniture. Some of the new studies seem to overcome this problem by focusing on relatively more traditional sectors of the economy (see for example Møen (2000), Lam and Lundval (2004), and Frederiksen and Sedita (2005)). Yet, this time they fail to employ SNA for the exploration of the social contexts exposed by the mobile laborers.

One of the remarkable characteristics of Siteler[2] as a case study area, compared with the other labor mobility studies' cases, is its reliance on a traditional sector, manufacture of furniture products. So-called low-tech and traditional sectors, as noted above, have also attracted the interest of researchers studying labor mobility. In this regard, it should be noted that innovativeness in traditional sectors is particularly design intensive and mostly based on small improvements. This is also the case for Siteler where one can observe a high degree of variation in industrial design but a large single community in terms of circulation of (tacit) knowledge among the members of the respective community.

Another bias of the labor mobility studies having a concern both in SNA and in innovation and knowledge spillover is the employment of relatively small databases. Indeed, in spite of the availability of *large databases* and the computational capabilities provided by modern computer technology, bulk of the labor mobility studies applying SNA still concentrates on small networks. Fortunately, and interestingly, in recent years the role of labor mobility in knowledge dissemination has been seriously investigated by drawing on remarkably large databases (see for example Møen (2000); Dahl (2002 and 2004), Power and Lundmark (2003), Aslesen, Isaksen and Stambøl (2004), de Blasio and Di Addario (2002), and Castillo, Novick, Rojo and Yoguel (2006)). Yet, these studies do not develop a concern for the application of SNA to the study of relationships between labor mobility and innovation.

In this respect, another distinction of this study is the employment of a large database compiled from Social Security Institution (SSI) of Turkey. This study draws on the complete set of economic actors working in Siteler and registered in the databases of SSI. However, employment of the large databases creates some burdens on the part of the researchers digging into the respective databases. One of the major problems is the fact that the construction of the respective databases is a very time consuming activity and it necessitates a good knowledge of database management.

What is evident from this short review of the recent labor mobility studies focusing on social networks and innovation is that, in spite of the prophesy of Granovetter (1973), a proper application of SNA to the study of interconnections between labor mobility, innovation and knowledge spillover in terms of employment of relatively large databases constructed for traditional sectors could not be observed, and those digging into large databases and traditional sectors fail to develop a concern for the application of SNA to the problem under scrutiny.

The review of labor mobility studies dealing with the social networks and innovation will be concluded by re-drawing on the pioneering study of Granovetter (1973). In his seminal study, *The Strength of Weak Ties*, Granovetter tries to establish a link between *micro* and *macro* levels of sociological theory by proposing the employment of SNA in order to come up with a *mezzo* level theoretical and analytical framework.[3] Laying foundation to this, Granovetter explains his exclusive focus on the strength of weak ties as follows:

> Unlike most models of interpersonal networks, the one presented here is not meant primarily for application to small, face-to-face groups or to groups in confined institutional or organizational settings. Rather, it is meant for linkage of such small-scale levels with one another and with larger, more amorphous ones. This is why emphasis here has been placed more on weak ties than on strong. Weak ties are more likely to link members of different small groups than are strong ones, which tend to be concentrated within particular groups. (Granovetter, 1973: 1376)

What is exclusively crucial to us in his study is that Granovetter (1973) has a deep vision about the employment of SNA in the conceptualization of labor mobility as a kind of *social glue*. Indeed, his wisdom and insightful ideas, not only on the relationship between labor mobility and knowledge spillovers but also on the role of mobile laborers in the achievement of social cohesion and harmony, deserve stern consideration:

> From the individual's point of view, then, weak ties are an important resource in making possible mobility opportunity. Seen from a more *macroscopic* vantage, *weak ties play a role in effecting social cohesion*. When a man changes jobs, he is not only moving from one network of ties to another, but also establishing a link between these. Such a link is often of the same kind which facilitated his own movement. Especially within professional and technical specialties which are well defined and limited in size, this mobility sets up elaborate structures of bridging weak ties between the more coherent clusters that constitute operative networks in particular locations. Information and ideas thus flow more easily through the specialty, giving it some "sense of community," activated at meetings and conventions. Maintenance of weak ties may well be the most important consequence of such meetings. (Granovetter, 1973: 1373) [*emphasis* added]

The research guideline suggested by Granovetter (1973) is instructive in many respects, especially in terms of analytical apparatus that can be employed to understand the social networks operational in the socio-economic life processes. His emphasis on labor mobility as a kind of social glue facilitating the establishment of weak ties especially deserves attention. Nonetheless, as discussed above, researchers seem to fail in successfully following the outline of the research program formulated by Granovetter (1973), both with respect to the employment of the analytical tools of the social network theory he proposed in his pioneering study, and with respect to the role of labor mobility in the diffusion of (tacit) knowledge.

In fact, weak ties are generally built by (and around) the agency of mobile laborers. In this respect, following the research program defined by Granovetter (1973), in this paper it is claimed that labor mobility under the light of SNA can be used in order to unveil the boundaries of small production communities operative over a given territory such as Siteler in Ankara. Following Granovetter (1973), in the following sections, not exactly macroscopic but mainly a mesoscopic view of the social networks created by mobile laborers will be developed by employing the standard tools of SNA.

## 3. Extent of the Labor Mobility: Network Coverage of the Study

On the main axes of the databases employed in this study, there lies a two-mode dataset compiled from the 'Social Security Institution'[4] (SSI) (formerly 'Social Insurance Institution'[5] (SII)). This main dataset reveals information about the mobility of employees registered in the databases of SSI from one firm to another. It basically involves both career paths of workers and at the same time information about the number of staff employed by each firm in Siteler (see Figure 1 for the location of the cluster in Ankara and Figure 2 for the geographical extent of the cluster). In other words, it mainly involves affiliation information about the workers and their respective employers. In order to define the extent of labor mobility and to construct the original two-mode database required for this study, a series of SQL queries are employed.

In an attempt to outline the extent of the network created by mobile laborers, firstly the firms located within the geographical extent of Siteler were determined. Consequently, it was identified that 19484 out of 53397 'initial sector firms'[6] operating in Altındağ and Mamak (municipal districts (of Ankara) along which it is known that Siteler is located) have been located within the geographical extent of Siteler since 1965. After obtaining the exact list of such firms, the next step was to obtain the list of workers who have been employed by those firms during the last four decades. The initial quests for this purpose revealed that not all firms could be included in this search because of the chaotic structure of the information system employed by SSI. Fortunately, a great deal of the firms (17975 (92.26%) out of 19484) could be included in the quest to obtain the list of workers. The total number of workers employed by those firms is calculated as 112760. The registry of workers in SSI showed that 106437 workers (94.39%) out of 112760 had a proper registry and attribute-based information.

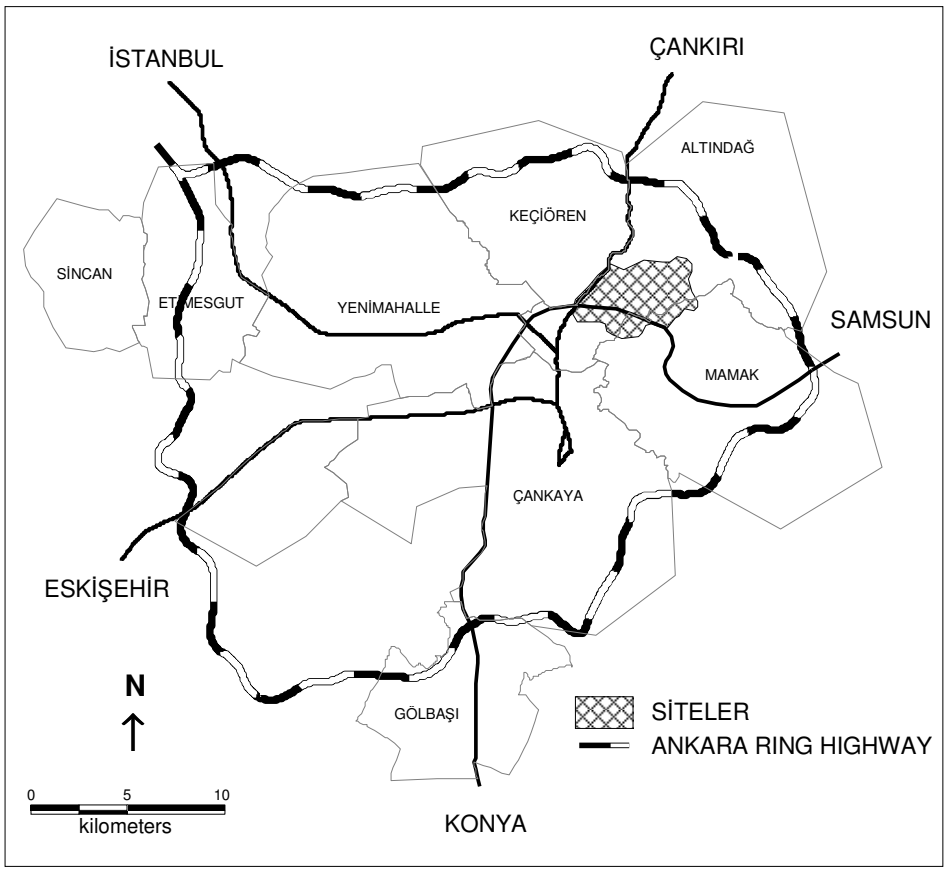


Figure 1 – Location of Siteler within the Metropolitan Area of Ankara.

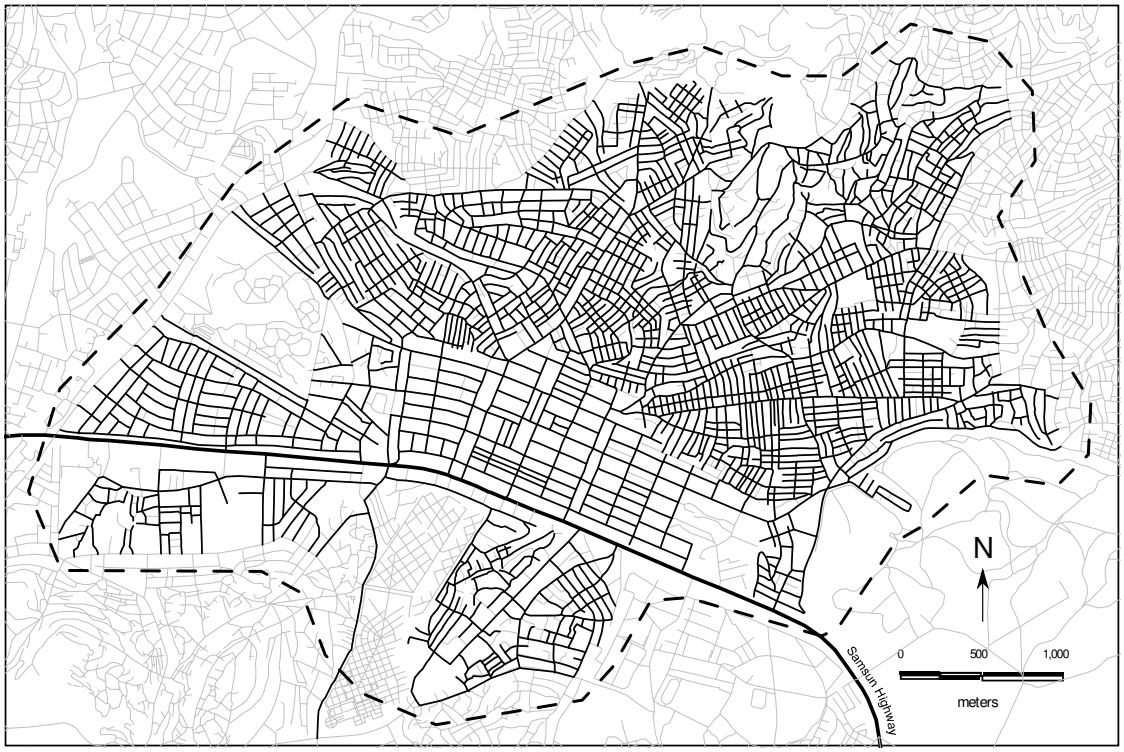


Figure 2 – Streets involved within the geographical extent of Siteler.

The last step in the construction of labor mobility databases involved derivation of the career path of these workers in order to frame exact network coverage of this study. The SQL queries designed for this purpose revealed that 17975 firms which have been located in Siteler have been directly or indirectly linked to 165074 firms located all over Turkey via labor mobility since 1965. However, as it is experienced in the case of the registry of workers, the total number of the firms for which there is a proper registry in SSI information system is slightly smaller than the actual figure. 150787 firms (91.35%) out of 165074 have a proper registry and attribute-based information.

Based on this information, the total number of movements realized by the laborers who had been employed by the firms located in Siteler at any point in time during the four decades is calculated as 441452. It should be strongly emphasized that this figure involves the incidences of labor mobility not only among the firms located in Siteler, but also between the firms both outside and inside Siteler. Following an example helps us to understand the extent of the total number of movements. Assume that a worker is employed in Siteler only for a month and then he moves to another firm located in Konya (a province in Turkey). He works there for two years and then he moves to yet another firm located in Bursa where he works for four years. All these kinds of movements are included in the total figure. Thus, total number of the movements realized by any worker who historically has an employment connection to Siteler is included within this total figure.

But this paper only takes into account the cases of labor mobility that have occurred between Siteler and (mathematically) the universe. Within this context, the total number of movements realized during the last forty years, either from Siteler to universe or from universe to Siteler, is calculated as 188493. It should be noted again that this figure involves the incidences of labor mobility that occurred not only among the firms producing furniture and furniture-related products, but also between the firms both outside and inside the sectors producing furniture and furniture-related products. Due to the problems stemming from the large size of the databases and additionally from the irrelevance of some of the sectors that were initially included in the database, some reductions are made on the database for the sake of subsequent analysis. If the sectors other than the core ones

(Table 1) are omitted from the original database, the last forty years' total number of movements from Siteler to universe and from universe to Siteler drops to 45333 (Figure 3).

The total figure of 45333 movements also decreases to 28211 if the movements are restricted to only those occurring among the firms located in Siteler (see Figure 4). The total number of movements between Siteler and provinces other than Ankara is 2385. The movements that have occurred between the firms located in Siteler and the ones located outside Siteler but inside Ankara mounts to 14737.

Table 1 – The core sectors that have been included in SNA.

| code | Explanation for the Corresponding Sector |
|---|---|
| 2511 | Manufacture of Wood and Cork Product (Except Furniture) |
| 2512 | Manufacture of Lumber, Plywood, Pressed Paper, Particle Board and the Like Materials |
| 2513 | Carpentry and Joinery |
| 2521 | Manufacture of Wooden and Cane Containers and Small Cane Ware |
| 2590 | Engraving and Manufacture of Cage, Shelf and the Like Materials |
| 2601 | Manufacture of Furniture Primarily of Wood |
| 2602 | Manufacture of Furniture Primarily of Cane and Rush |
| 2603 | Manufacture of Furniture Primarily of Metal |
| 2609 | Manufacture of Fixtures Primarily of Wood |
| 6113 | Timber and Construction Material Wholesaling |
| 6116 | Office and House Furniture, Carpet, Rug and Blanket Wholesaling |
| 6124 | Furniture, Flooring and Housewares Retail Trade |
| 6128 | Big Stores (all Kinds of Retailing) |

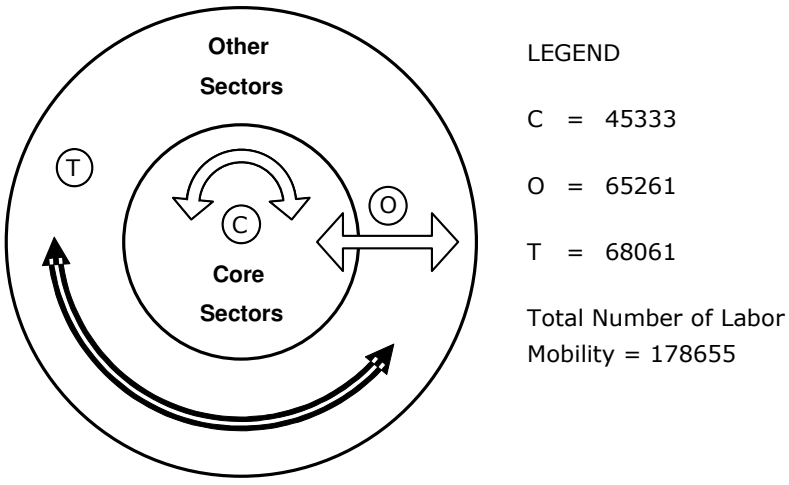


Figure 3 – Representation of extraction of the database that has been employed in SNA from the original database.[7]

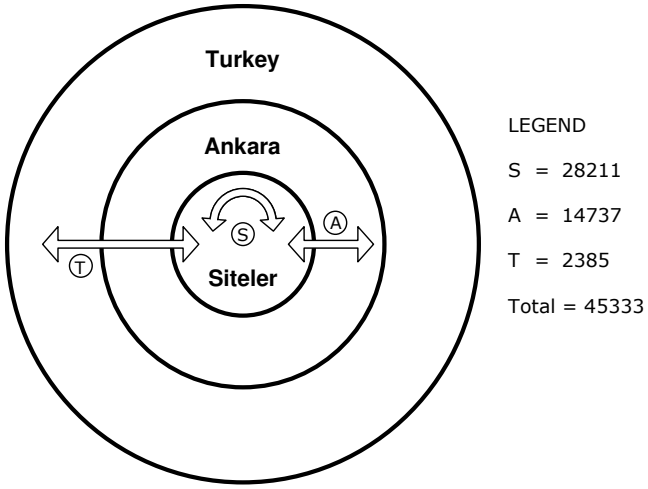


Figure 4 – Representation of labor mobility that has occurred both within Siteler and between either Siteler and Ankara or Siteler and Turkey.

Some other basic statistics about the workers and firms involved in the movements among the *core sectors* helps us to understand the general context of social network created by the mobile laborers in connection with the cluster. The total number of workers that have moved between the firms since 1965 is 23961. These workers have moved between 14832 different firms, 11188 of which have been located in Siteler. 2161 firms are located outside Siteler but inside Ankara. The remaining 1483 firms have been located outside Ankara in other provinces (see Table 2). Based on this set of actors, in the next section a *topography* of the labor mobility network has been created by employing the standard tools of SNA.

Table 2 – The number and location of the firms that have been involved in the labor mobility database with respect to the core sectors.

| TC | Province | Total | TC | Province | Total | TC | Province | Total | TC | Province | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Adana | 24 | 22 | Edirne | 6 | 43 | Kütahya | 5 | 64 | Uşak | 4 |
| 2 | Adıyaman | 0 | 23 | Elazığ | 0 | 44 | Malatya | 10 | 65 | Van | 1 |
| 3 | Afyon | 5 | 24 | Erzincan | 1 | 45 | Manisa | 3 | 66 | Yozgat | 26 |
| 4 | Ağrı | 0 | 25 | Erzurum | 8 | 46 | Kahramanmaraş | 4 | 67 | Zonguldak | 22 |
| 5 | Amasya | 7 | 26 | Eskişehir | 35 | 47 | Mardin | 0 | 68 | Aksaray | 4 |
| 6 | Ankara[8] | 2161 | 27 | Gaziantep | 17 | 48 | Muğla | 39 | 69 | Bayburt | 2 |
| 7 | Antalya | 132 | 28 | Giresun | 4 | 49 | Muş | 2 | 70 | Karaman | 5 |
| 8 | Artvin | 2 | 29 | Gümüşhane | 0 | 50 | Nevşehir | 3 | 71 | Kırıkkale | 27 |
| 9 | Aydın | 31 | 30 | Hakkari | 0 | 51 | Niğde | 8 | 72 | Batman | 0 |
| 10 | Balıkesir | 23 | 31 | Hatay | 11 | 52 | Ordu | 3 | 73 | Şırnak | 0 |
| 11 | Bilecik | 1 | 32 | Isparta | 6 | 53 | Rize | 5 | 74 | Bartın | 2 |
| 12 | Bingöl | 1 | 33 | İçel | 41 | 54 | Sakarya | 22 | 75 | Ardahan | 0 |
| 13 | Bitlis | 0 | 34 | İstanbul | 355 | 55 | Samsun | 26 | 76 | Iğdır | 0 |
| 14 | Bolu | 41 | 35 | İzmir | 127 | 56 | Siirt | 0 | 77 | Yalova | 0 |
| 15 | Burdur | 2 | 36 | Kars | 5 | 57 | Sinop | 4 | 78 | Karabük | 5 |
| 16 | Bursa | 87 | 37 | Kastamonu | 12 | 58 | Sivas | 8 | 79 | Kilis | 0 |
| 17 | Çanakkale | 6 | 38 | Kayseri | 67 | 59 | Tekirdağ | 9 | 80 | Osmaniye | 0 |
| 18 | Çankırı | 7 | 39 | Kırklareli | 1 | 60 | Tokat | 18 | 81 | Düzce | 0 |
| 19 | Çorum | 30 | 40 | Kırşehir | 19 | 61 | Trabzon | 15 | | | |
| 20 | Denizli | 9 | 41 | Kocaeli | 39 | 62 | Tunceli | 0 | | | |
| 21 | Diyarbakır | 4 | 42 | Konya | 34 | 63 | Şanlıurfa | 1 | | | |

Note: TC: Traffic Code and for Ankara see endnote 8.

One of the major problems experienced in this study with respect to the employment of SNA was the large size of the database that prevented the implementation of any sophisticated mathematical analysis. In order to overcome this problem, after conducting some experiments with two-mode data representing the affiliation information between workers and firms, it is preferred to convert it into one-mode data representing labor flows between firms by making use of the same affiliation information. Periodization of the database into five-year periods also facilitated the analysis of the network and additionally provided the study with a historical outlook.

Since the conversion of the two-mode data into one-mode data also involves a radical shift from the employee to the social context of the firm as the basic *unit of analysis*, some information was inevitably lost. In order to make this shift costless with regard to the knowledge involved in two-mode data format, attributes of employees were generalized to the firm level by employing simple techniques such as location quotient and chi-sqr indices (see Beyhan (2005) for a list of macro scripts employed in this study). This generalization process made it possible to imprint the firms with the most basic characteristics of their employees, and in turn, to test whether the mobility of employees between origin and destination firms exhibits some traceable patterns of sub-community formations. Nonetheless, social sub-groups corresponding to possible communities of production are primarily identified by employing a well-defined but simple algorithm (see Figure 4) developed for the analysis of network data compiled from SSI.

## 4. Revealing the Topography of the Labor Mobility Network: A Combination of Component, Bicomponent and Clique Analyses

In the representation of the networks, there were initially two options available to this study as discussed above. Two-mode characteristics of the database employed in SNA are formative and influential in many respects. However, as it demands more space than one-mode data and requires more exhaustive computer technology, in this paper two-mode data is converted into one-mode data representing the labor flows between firms. This representation is superior to two-mode representation not only because of its occupation of fewer amounts of computer memory and processing power but also because of its reduction of the complexity involved in the network to a manageable level. Nevertheless, at the earlier stages of this study, some experiments had also been done for the representation of two-mode data. Inspired from Granovetter (1973) these experiments were named as microscopic view of the labor mobility network. Parallel to this, firm-to-firm network is labeled as mesoscopic view, not macroscopic, as it is believed that macroscopic view necessitates a comparison between different industrial clusters.

### 4.1. Microscopic View of the Labor Mobility Network: An Example from a Sub-network of Siteler

Microscopic view of the labor mobility network that is based on the two-mode data representing the affiliation of the laborers with the firms is realized only for illustrative purposes by taking a real sample from the compiled database for the period between 1995 and 1999, and it does not entail a complete assessment of the network which is achieved at the level of mesoscopic view of the network. The difference between microscopic and mesoscopic view becomes apparent when Figure 5 and Figure 6 are compared with each other.[9] Figure 5 shows a network of firms that are connected to each other by way of mobile laborers who are not visible in the respective graph. Yet, in Figure 6 one can see the mobile laborers moving between the firms shown in Figure 5. By producing a series of thematic graphs for the respective network and carefully examining these graphs, one can easily create real life stories about the possible relationships between labor mobility, social contexts, innovation and creation of spin-offs. Thus, it will be instructive to take a number of snapshots from the network data in its two-mode data format before proceeding to the mesoscopic view of the one-mode firm-to-firm network data.

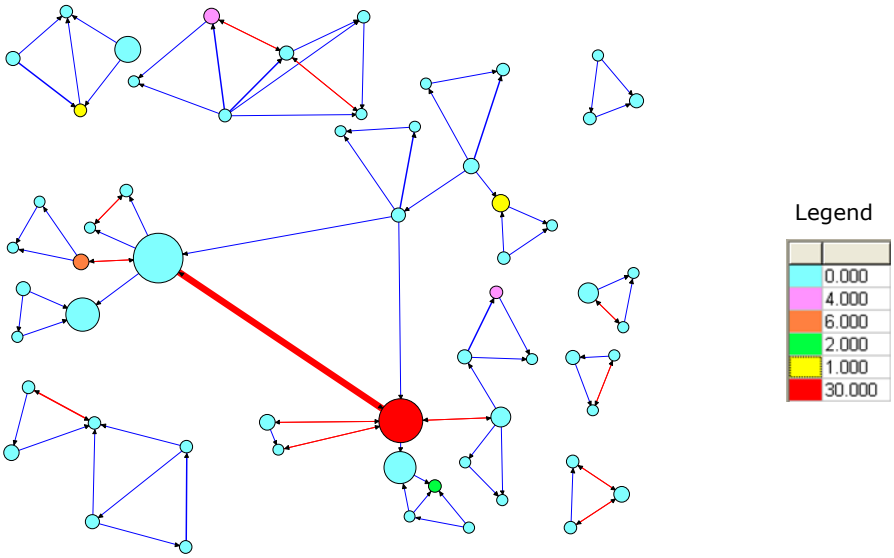


Figure 5 – The firms which have applied for at least one industrial design certificate during the current and subsequent periods and the respective size of the firms.[10]

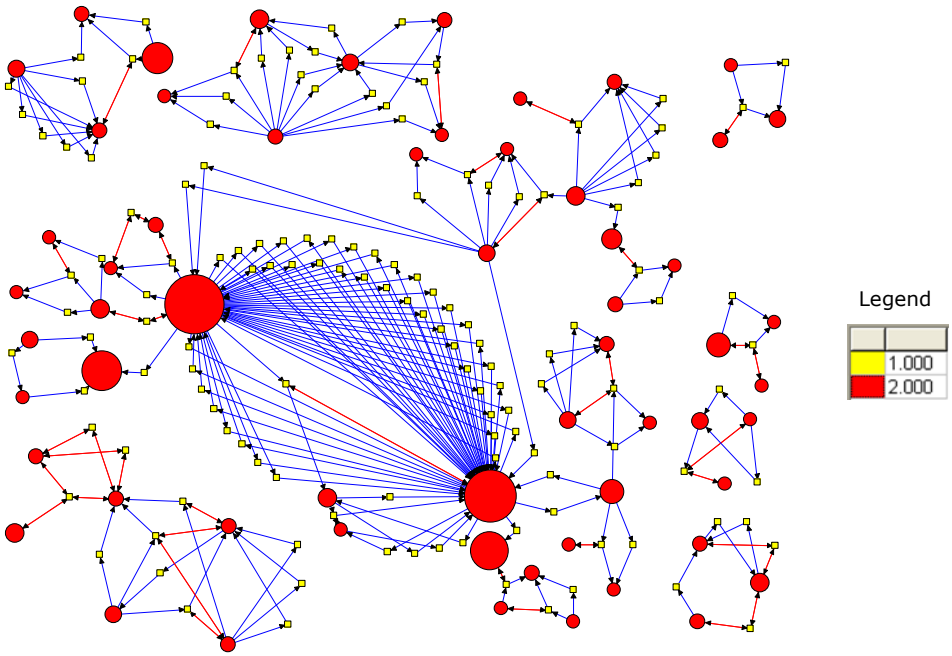


Figure 6 – The firms and the workers represented together.[11]

On the graphs presented in Figure 6 and Figure 8, one can observe the formation of a spin-off[12] during the period between 1995 and 1999. The red color stands for the same person who was previously a worker and later became an employer. As it is seen from the graph, while he was working for a firm that is manufacturing wooden furniture (see Figure 7), he moved to another firm where he became an entrepreneur (Figure 8). He was probably a talented worker and he was recruited as a shareholder (partner) for the new firm after a short period of time. It is notable that he was supported by a social atmosphere in which majority of the workers, compared with the average of Siteler, have the same birthplace as him, whom was born in Artvin (province code of Artvin is 08) (see Figure 9). One of his friends, he met while he was working for the firm before his move to the current one, also moved to another firm that has recently applied for an 'industrial design certificate' (Figure 5).[13] The

story revolving around this spin-off can be extended in order to include a number of other real life terms.

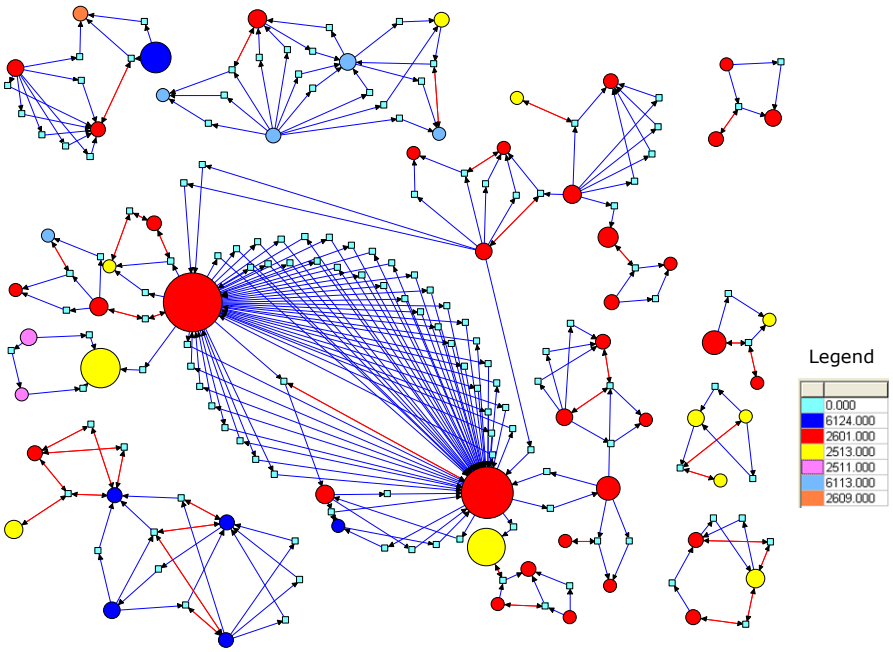


Figure 7 – The distribution of firms according to the core sectors.[14]

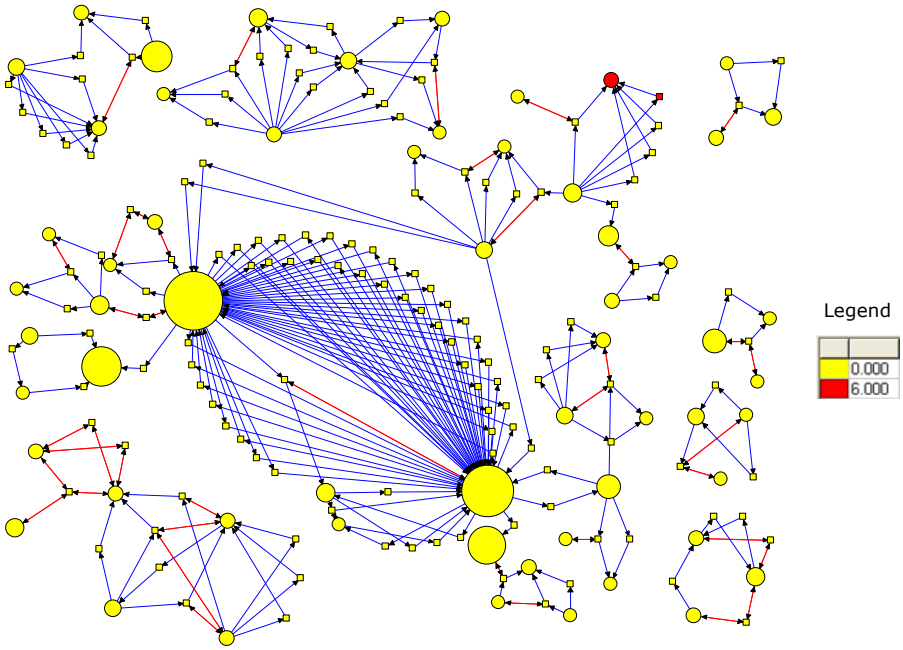


Figure 8 – The formation of a spin-off.

Note: This thematic network graph has been produced in order to detect the formation of a spin-off in relation to his or her involvement in the same graph as an entrepreneur. For this purpose, nodes standing for mobile laborers and owners of the firms have been colored according to the possible match between them. If there is a match, you can see them with the same identification number on the graph. Within this context, for the example presented above, you can observe that there is a spin-off formation associated with the mobility of a labor from one firm to another where he or she becomes an entrepreneur (identification number 6).

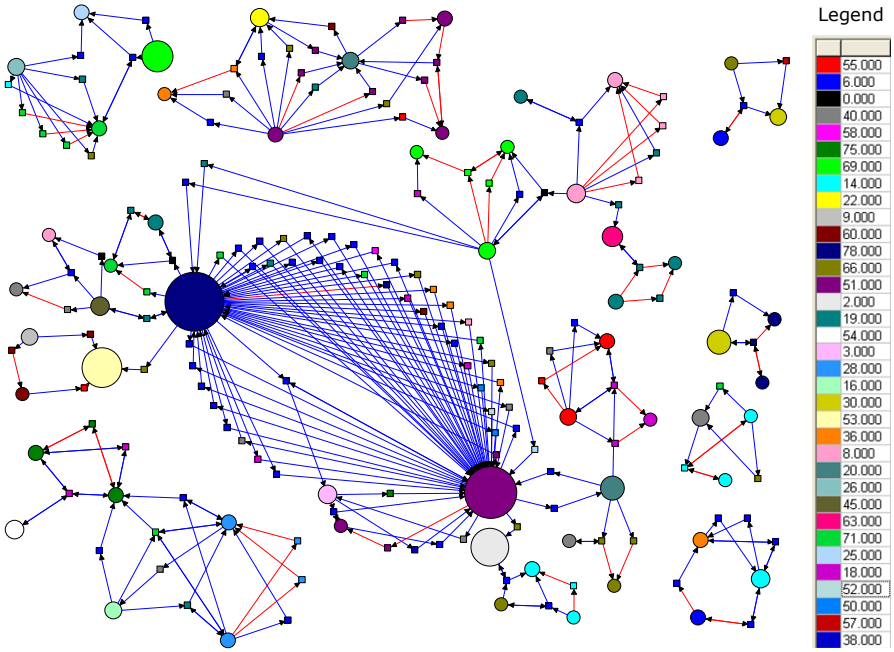


Figure 9 – The context of the birthplaces of workers.[15]

Note: The graph presented above is highly informative about the relationship between the labor mobility and the fellowmen context (i.e. workers' birth places). The red lines represent the cases of labor mobility in which a laborer moves between two firms both of which employ a number of workers having the same place of birth with him or her above the average of Siteler.[16] The colors of the nodes stand for the provinces where these workers were born (see legend of the graph – provinces are represented according to their traffic codes).

Within this context, it should also be noticed that it is very difficult to measure the creation and transfer of tacit knowledge without making certain assumptions. Indeed, it is well documented in the literature that the transfer of tacit knowledge from one social context to the other is actually very difficult and restricted. For example, for Nelson and Winter (1982), transmission of firm specific routines through time from one person to the other is only possible within the boundaries of individual firms because the fact that the know-how embodied in routines is tacit prevents their transmission to the other firms. However, in this study, it is argued that trust-based relations and tacit knowledge as sources of routines are not only operative through time within the boundaries of individuals firms but also over the space and network between the firms. Within this context, Beyhan (2009) shows that workers tend to move between the firms characterized by the same fellowmen contexts. He argues that this is because of the fact that mobile laborers trust their fellowmen more than the others and feel themselves more comfortable in working with their fellowmen than in working with others. Nevertheless, parallel to Wirth (1938), Beyhan (2009) also illustrates that any urban cluster rather functions as a melting-pot and the number of labor mobility occurring between similar contexts defined according to the fellowmen relationship in terms of the rural origin of the people decreases over time.

Lastly, it should be reminded that circulation of habits and routines through tacit conducts of knowledge is not limited to formal labor mobility as part of an economic point of view. Word of mouth, informal networks and imitation are also very important in economic development. This form of circulation of habits and routines is also well documented within the studies relating to learning regions and innovative milieu. For example, within this context, Camagni (1991) argues that a successful regional innovative milieu embodies imitation processes and informal 'cafeteria' effects. As

illustrated above, another important mechanism by way of which (tacit) knowledge is transmitted from one firm or institution to the other is the spin-off formation. Spin-offs actually correspond to offspring mechanism in biology (Beyhan, 2007: 416-419). The literature especially on technological clusters is full of this kind of evidence. Although spin-off formation can be treated as a special case of labor mobility, it actually refers to more in terms of its effect in the economic system.

## 4.2. Mesoscopic View of Labor Mobility Network

The examination of the topography of the social network created by the mobile laborers having connection with Siteler on mesoscopic level has been realized by employing a dual assessment framework: systemic and spotlight assessments. The systemic assessment follows the outline embedded in the algorithm (see Figure 10) employed in order to analyze the labor mobility network. Spotlight examination is constructed upon the outcomes of the network algorithm, but it does not necessarily follow the algorithm. Instead, it makes arbitrary selections from the elements involved in the thematic outcomes of the algorithm.[17] Thus, spotlight examination refers to the selective assessments of the outcomes of the network algorithm. Instead of focusing on the general pattern of social relations available in a graph, similar to the function performed by projected spot light in theaters, during the examination of the thematic graphs focus of attention is directed to a single component or group of components. Thus, in essence spotlight examination is an idiographic experience. Yet, it is directed towards a nomothetic outcome.

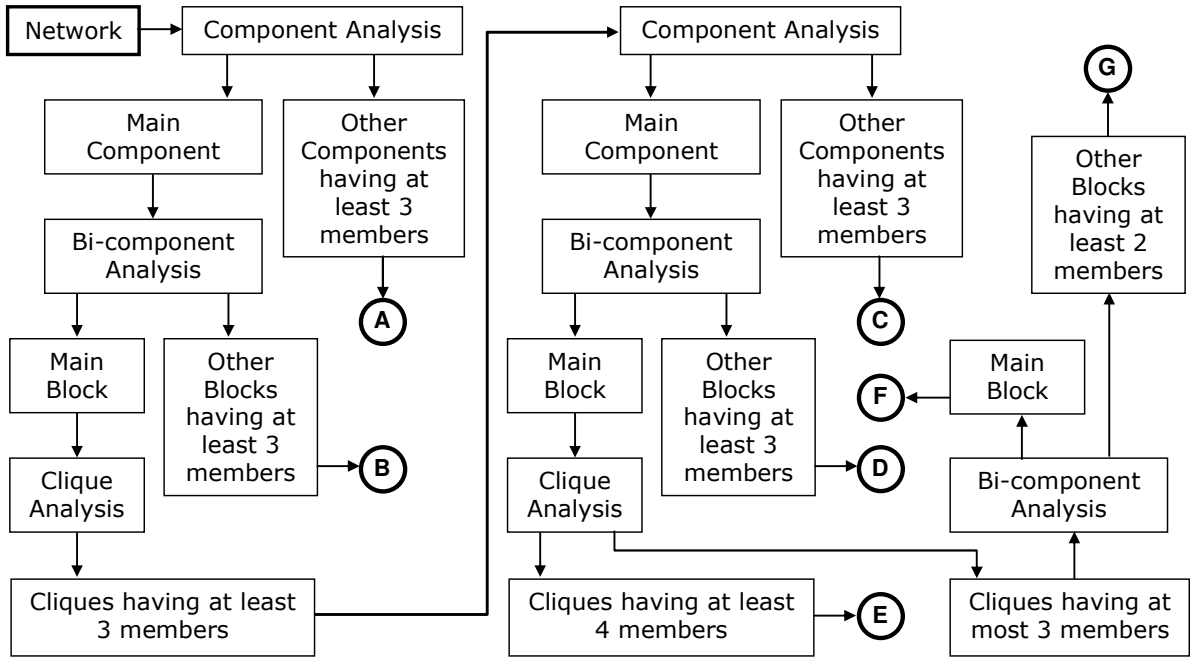


Figure 10 – The basic algorithm employed in the analysis of the labor mobility network.

### *Systemic Assessment of the Labor Mobility Network*

In the analysis of firm-to-firm labor mobility networks, a simple algorithm designed to detect social sub-groups in the network was followed. In building this algorithm, "deterministic definitions of cohesive sub-graphs" were followed. Deterministic definitions of cohesive sub-graphs especially include component, bicomponent, clique and n-clique (Everett and Borgatti, 1998). As n-clique is not a suitable measure for the detection of the sub-groups in the networks created by labor mobility

because of the fact that these networks are already constructed upon indirect relations[18], the algorithm employed in this study makes use of only component, bicomponent and clique analyses.

The algorithm employed to split the network into mutually exclusive sub-groups processes the network data at several stages. In the first stage, components[19] of the network are identified and, except for the main component, all other components having at least three members are plotted over time (for a thematic example see Figure 11).[20] In both component and clique analyses, the minimum size of the groups to be identified is set to 3. In other words, only triadic relations are taken into account. As Faust (2006: 207) notes, triads, in fact, constitute the lowest level at which one may observe the formation of interesting social structures.

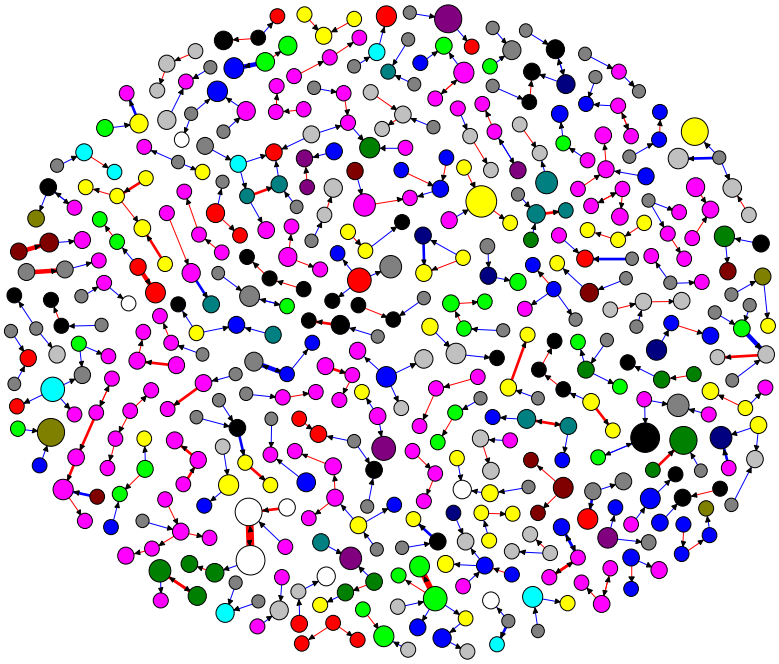

Figure 11 - The association of firms with the birthplaces of workers (1995-1999-A).

Note: Main component is not included in this figure. Nodes on the figure are colored according to predominant birth place of the employees. Association of the firms with the predominant place of birth is realized by assigning the birth place with maximum location quotient value to the respective firms. Direction of the lines on the graph shows the direction of labor mobility between the firms. Color of the lines shows whether the laborers move between the same or different contexts defined according to the birth place of the laborers (red lines show the labor mobility between the firms characterized by the same place of birth).

What is distinctively evident from this stage is that the social network created by mobile laborers having connection to Siteler could not be split into equally large (main) components for any of the periods examined, except for the first period (1965-1969). It should be stressed that main component in each period accommodates the bulk of the network (see Table 3 and Table 4 reporting some descriptive statistics for the resulting one-mode network of firms over time). Although this is actually in line with the characteristics of the functional regions characterized by the formation of a single community out of a wider framework of social relations, it is remarkable for the identification of the cluster itself.[21] Nevertheless, one can also claim that bifurcated clusters may exist, which can be proved by the existence of equally large (main) components prevailing at the same level of the network.

Table 3 – Evolution of one-mode network of firms created by mobile laborers over time.

| | 1965-1969 | 1970-1974 | 1975-1979 | 1980-1984 | 1985-1989 | 1990-1994 | 1995-1999 | 2000-2005 |
|---|---|---|---|---|---|---|---|---|
| **(a)** size of the largest (main) component | 9 | 257 | 629 | 1211 | 3030 | 5191 | 5508 | 4056 |
| **(b)** size of the second largest component | 8 | 5 | 8 | 9 | 7 | 11 | 13 | 11 |
| **(c)** average size of the remaining components | 2.56 | 2.38 | 2.32 | 2.43 | 2.3 | 2.35 | 2.31 | 2.32 |
| **(d)** remaining components with 3 or more members | 9 | 12 | 19 | 47 | 63 | 107 | 127 | 102 |
| **(e)** components with only 2 members | 18 | 27 | 66 | 131 | 231 | 375 | 503 | 373 |
| **(g)** total number of components | 29 | 41 | 87 | 180 | 297 | 484 | 632 | 477 |
| **(s)** total number of the firms involved in the network | 86 | 355 | 834 | 1653 | 3719 | 6334 | 6979 | 5170 |
| **a** as percent of **s** | 10.47 | 72.39 | 75.42 | 73.26 | 81.47 | 81.95 | 78.92 | 78.45 |
| **b** as percent of **s** | 9.30 | 1.41 | 0.96 | 0.54 | 0.19 | 0.17 | 0.19 | 0.21 |
| **d** as percent of **g** | 31.03 | 29.27 | 21.84 | 26.11 | 21.21 | 22.11 | 20.09 | 21.38 |
| **e** as percent of **g** | 62.07 | 65.85 | 75.86 | 72.78 | 77.78 | 77.48 | 79.59 | 78.20 |
| **s** / **g** (average size of the components) | 2.97 | 8.66 | 9.59 | 9.18 | 12.52 | 13.09 | 11.04 | 10.84 |

In the second stage, bicomponents (blocks) of the main component are identified. Parallel to the component analysis, only blocks having at least three members are examined and plotted over time (for a thematic example see Figure 12). It is remarkable that the main component could not again be split into equally large blocks. The main block derived from the bicomponent analysis covers the bulk of the network. Parallel to the component analysis, in order to increase the visibility of the blocks, the main block is not included in the figures representing the blocks harvested in the second stage.

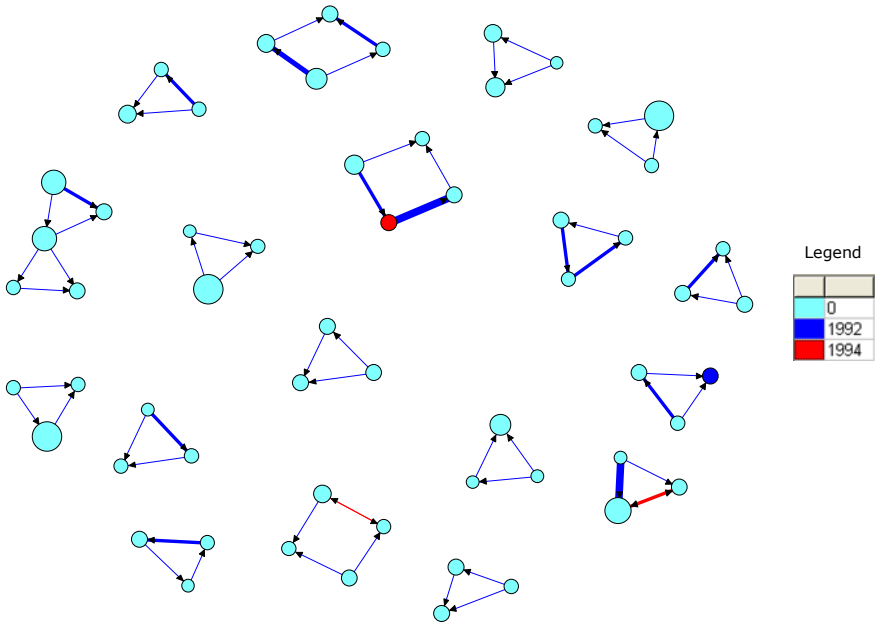


Figure 12 – The employers who had been previously employed by others and their date of spin-off (1990-1994-B).[22]

It is important to note that Table 3 and Table 4 reporting about the results of the network analysis conducted according to the procedure defined in the algorithm outlined in Figure 10 inform us about the characteristics of the network over time (Table 3) and according to the stages (Table 4) coded with the capital letters in Figure 10. On the one hand, Table 3 reports about the size and number of components and the number of firms involved in the labor mobility network over time. On the other hand, Table 4 gives more detailed information about the number of firms and (bi)components (components and bicomponents) harvested in each stage of the algorithm outlined in Figure 10 according to the periods. The capital letters attached to the periods in Table 4 shows the stage of the algorithm employed in order to detect social sub-groups in the labor mobility network of Siteler. Accordingly, A, B, C, D, E and F-G denote the first, second, third, fourth, fifth and sixth stages respectively. As some members of the blocks may be connected to the other blocks owing to their position in the network as cut-points, the actual graphs produced for the stages involving bicomponent analysis contain more amount of components. Hence, for the respective stages the numbers of (bi)components are shown according to both the results of the bicomponent analysis (excluding cut-points) and the emerging components harvested after re-including the cut-points in the graphs. In Table 4 the results of the bicomponent analysis (excluding cut-points) is shown in parenthesis. The reduction in the number of components harvested after the re-inclusion of the cut-points in the graphs is actually one of the positive aspects of the algorithm employed in order to identify social sub-groups.

The first two stages presented above are rather characterized by the employment of a bottom up approach directed towards the splitting of the network into sub-groups beginning from the fringes of the respective network. What is evident from the analyses conducted in the first two stages is that the network resists to splitting into equally large sub-groups and rather scatters out into very small parts composed of on average 3 or 4 members. The network persistently preserves the bulk of its core. Because of this resistance, a reverse approach has been employed in the algorithm in order to unveil the social sub-groups embedded in the network. The reverse approach, firstly, identifies the clique formations having at least three members and involved in the main body of the network which cannot be split into sub-groups throughout component and bicomponent analysis. It subsequently repeats the procedure employed in the first two stages, but this time for actor-by-actor clique co-membership matrix created according to the overlapping pattern of the cliques.

A similar approach can also be observed in a recent study by Jonsson, Cavanna, Zicha and Bates (2006: 10), who try to identify key protein communities involved in cancer metastasis by using clustering methods on the networks.[23] They identify key protein communities by carrying out component analysis of the clique-clique overlap. Within this context, in the third stage of the algorithm, components of the clique co-membership matrix are identified and those components having at least three members are plotted over time (for some thematic examples see Figure 13, 14 and 15).[24] It is noticeable that at this stage, the network can be split into relatively and equally larger components compared with the first two stages (Table 4). However, compared with the core of the network (the main component), the size of these components are again relatively small. One can easily observe that the large components unveiled at the third stage are characterized by the predominance of specific sectors (Figures 13, 14 and 15). Until 1990s, the dominant sector in the largest component observed at the third stage is 'Manufacture of Wood and Cork Products' (sector code 2511). Beginning from the 1990s onwards, the dominant sector in the largest component identified in the third stage is 'Furniture, Flooring and Housewares Retail Trade' (sector code 6124). These findings emerging out of the analysis of the social network created by the mobility of labor between firms are completely in line with the changing sectoral mosaic of Siteler in the last two decades.

Table 4 – The number of the (bi)components and the firms involved in each stage of the algorithm employed in order to analyze the contexts of labor mobility (1965-2005).

| Stages of Algorithm (tag of the graphs) | Number of the firms shown in graphs | size of the main (bi) component | size of the second largest (bi)component | remaining (bi)components with 3 or more members | (bi)components with only 2 members | total number of (bi)components |
|---|---|---|---|---|---|---|
| 1965-1969-A-B-C-D-E-F-G | 86 | 9 | 8 | 9 | 18 | 29 |
| 1970-1974-A | 44 | 257 | 5 | 12 | 27 | 41 |
| 1970-1974-B | 9 | 72 | 4 (6) | 2 | 173 | 177 |
| 1970-1974-C-D-E-F-G | 72 | 72 | - | 1 | - | 1 |
| 1975-1979-A | 73 | 629 | 8 | 19 | 66 | 87 |
| 1975-1979-B | 7 | 239 | 4 | 1 | 384 | 387 |
| 1975-1979-C | 13 | 66 | 7 | 1 | - | 3 |
| 1975-1979-D | 6 | 59 | 3 | 1 | - | 3 |
| 1975-1979-E | 12 | 12 | - | - | - | 1 |
| 1975-1979-F-G | 45 | 43 | 2 | - | 1 | 2 |
| 1980-1984-A | 180 | 1211 | 9 | 47 | 131 | 180 |
| 1980-1984-B | 22 | 445 | 5 (13) | 5 (3) | 748 | 755 |
| 1980-1984-C | 28 | 93 | **21** | 2 | - | 4 |
| 1980-1984-D | 17 | 83 | **3 (11)** | 5 (3) | - | 7 (3) |
| 1980-1984-E | 16 | 16 | - | - | - | 1 |
| 1980-1984-F-G | 55 | 21 | 5 | 8 | - | 10 |
| 1985-1989-A | 227 | 3030 | 7 | 64 | 231 | 297 |
| 1985-1989-B | 34 | 1361 | 4 | 10 | 1646 | 1658 |
| 1985-1989-C | 63 | 543 | **10 (18)** | 17 (13) | - | 19 (15) |
| 1985-1989-D | 25 | 332 | **4 (22)** | 8 (1) | - | 10 (3) |
| 1985-1989-E | 68 | 68 | - | - | - | 1 |
| 1985-1989-F | 83 | 83 | - | - | - | 1 |
| 1985-1989-G | 97 | 16 | 4 | 8 | 26 | 36 |
| 1990-1994-A | 393 | 5191 | 11 | 107 | 375 | 484 |
| 1990-1994-B | 59 | 2455 | 4 (5) | 18 (17) | 2695 | 2714 |
| 1990-1994-C | 208 | 650 | **12 (63)** | 53 (41) | - | 55 (43) |
| 1990-1994-D | 26 | 458 | **3 (8)** | 8 (6) | - | 10 (8) |
| 1990-1994-E | 78 | 78 | - | - | - | 1 |
| 1990-1994-F | 175 | 175 | - | - | - | 1 |
| 1990-1994-G | 122 | 31 | 8 | 12 | 20 | 34 |
| 1995-1999-A | 465 | 5508 | 13 | 127 | 503 | **632** |
| 1995-1999-B | 65 | 2526 | 4 (6) | 20 (19) | 2938 | 2960 |
| 1995-1999-C | 206 | 559 | **3 (35)** | 58 (44) | - | 60 (46) |
| 1995-1999-D | 47 | 437 | **6 (22)** | 13 (6) | - | 15 (8) |
| 1995-1999-E | 80 | 75 | 5 | - | - | 2 |
| 1995-1999-F | 237 | 237 | - | - | - | 1 |
| 1995-1999-G | 52 | 5 | 4 | 4 | 15 | 21 |
| 2000-2005-A | 368 | 4056 | 11 | 102 | 373 | 477 |
| 2000-2005-B | 33 | 1727 | 3 | 10 | 2307 | 2319 |
| 2000-2005-C | 132 | 442 | **4 (37)** | 35 (23) | - | 37 (25) |
| 2000-2005-D | 15 | 400 | 3 | 4 | - | 6 |
| 2000-2005-E | 47 | 47 | - | - | - | 1 |
| 2000-2005-F | 274 | 274 | - | - | - | 1 |
| 2000-2005-G | 31 | 6 | 5 | 2 | 7 | 11 |
| Total | 4395 | | | 864 | | |

It should be kept in mind that the majority of the graphs given in this paper and produced by employing the algorithm illustrated in Figure 10 show only the labor mobility network excluding the main component or bicomponent (block). In fact, one of the primary purposes of the algorithm presented in Figure 10 is to map the social sub-groups revealed by the labor mobility network in such a way that one can easily grasp both the topography of the network and the interesting social groupings at different level of the respective topography. As the database employed in this study is actually a two-mode data representing the affiliation information between the firms and laborers, the results of the component analysis of clique overlap matrix conducted for one-mode data representing the labor mobility traffic between the firms are presented in the third and subsequent stages by eliminating the clique restrictions imposed before the analysis. Thus, the clique components or bicomponents identified in the third and subsequent stages are mapped by adding the labor mobility traffic which is omitted before the component analysis of clique overlap matrix, which revealed the weak ties between the respective components. Although the respective ties actually do not lead to any clique formation, the re-inclusion of them in the harvested social groups reveals interesting components that are previously invisible. Hence, in Table 4 the number of social sub-groups (shown in parenthesis) revealed by the component and bicomponent analysis of the clique overlap matrix is presented together with the number of social sub-groups made visible by re-including the labor traffic which does not actually give rise to the formation of cliques into the network. In this context, for the third and subsequent stages, the numbers outside the parenthesis in Table 4 show the number of (bi)components identifiable in the network after the re-inclusion of the previously omitted labor traffic between the firms.

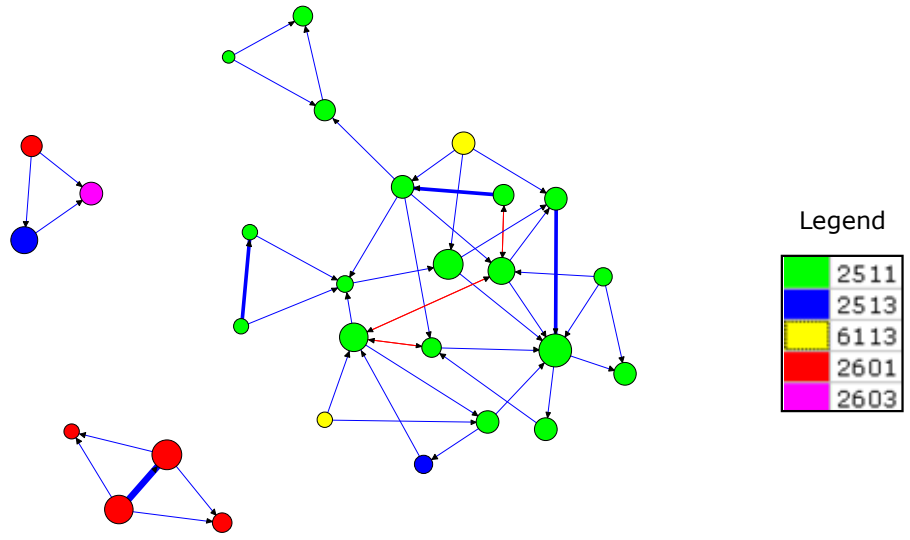


Figure 13 – The distribution of firms according to the core sectors (1980-1984-C).

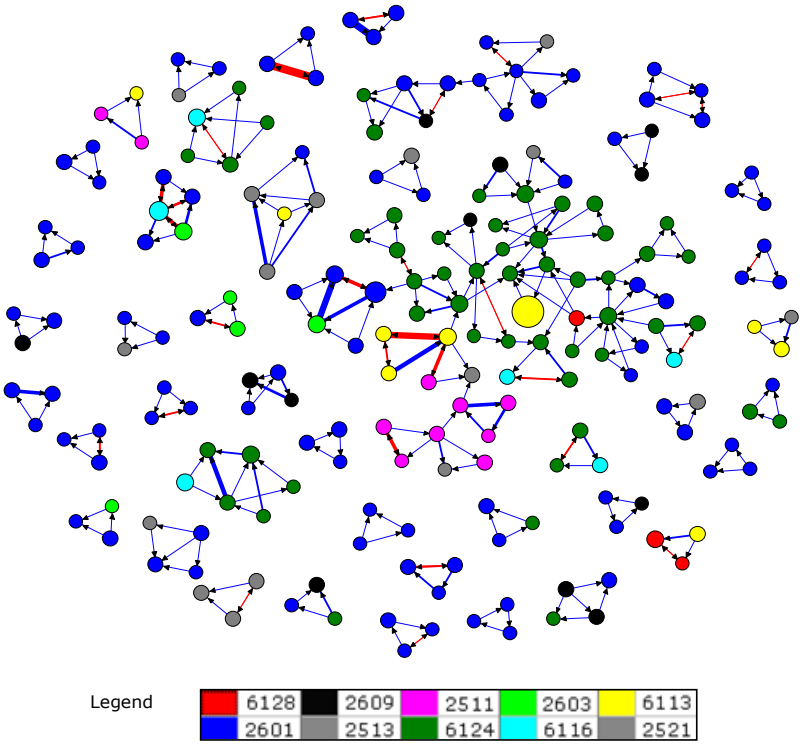


Figure 14 – The distribution of firms according to the core sectors (1990-1994-C).

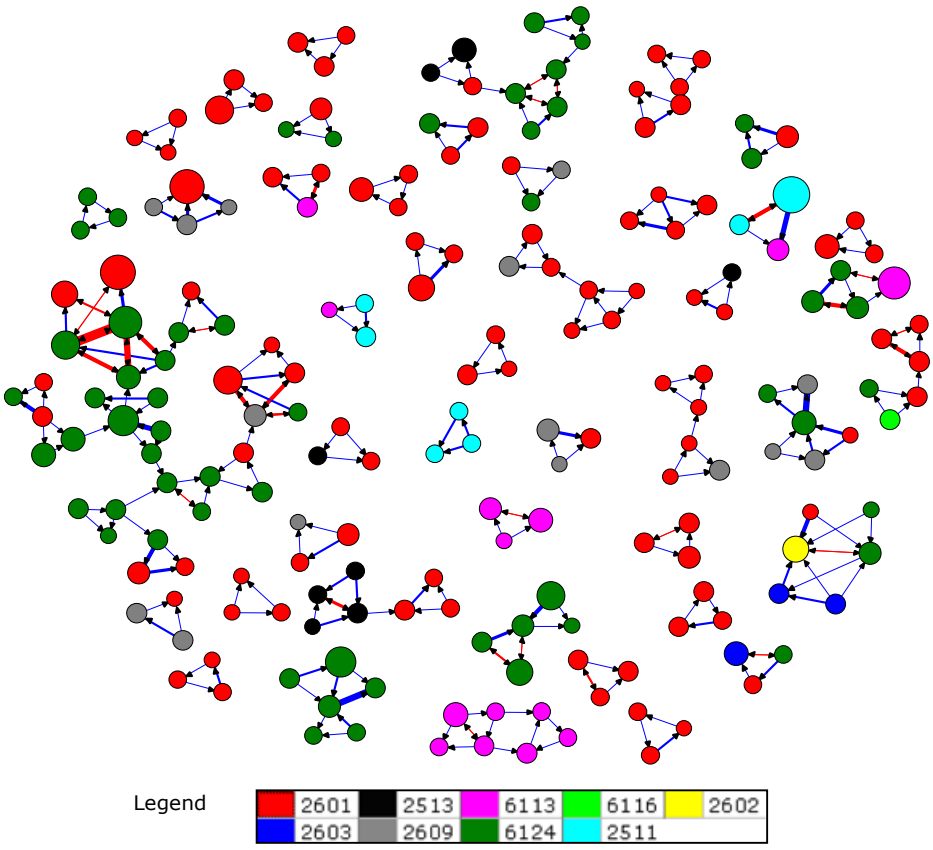


Figure 15 – The distribution of firms according to the core sectors (1995-1999-C).

For the early periods up to 1980, the second and the third stages are treated together with other stages because of the relatively easier splitting out of the core of the network (for an example see Figure 16). However, for these early periods, one could not observe the trend identified for the subsequent periods beginning from 1980s onwards. In general, 'Manufacture of Furniture Primarily of Wood' and 'Carpentry and Joinery' dominates the large components in these early periods (see Figure 16).

In the fourth stage of the algorithm employed in the network analysis, the bicomponents in the main component that survive out of the third stage are identified (for an example see Figure 17). Parallel to the second stage which is also based on bicomponent analysis, the size of the blocks identified in the fourth stage was relatively small, especially for the periods beginning from 1990s onwards. For the periods between 1980 and 1990, one can observe the dominance of a relatively large block over others compared with the periods between 1990 and 2005. However, compared with the core of the network (main component), the size of the largest block detected in the fourth stage is relatively small (see Table 4) and, unlike the third stage, it is not dominated by a specific sector.

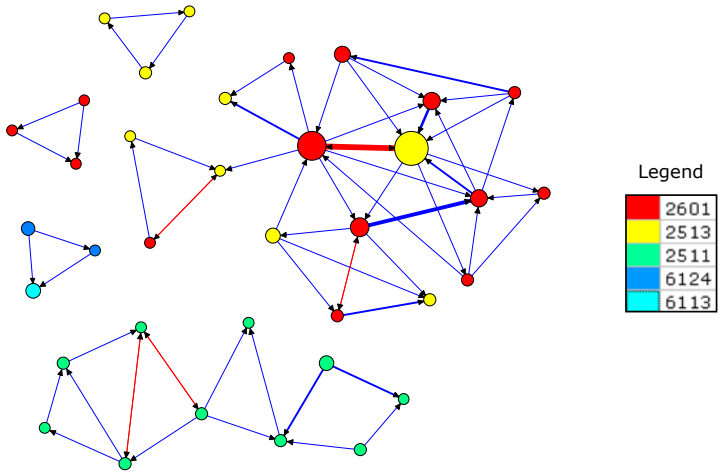


Figure 16 – The distribution of firms according to the core sectors (1975-1979-B-C-D-E).

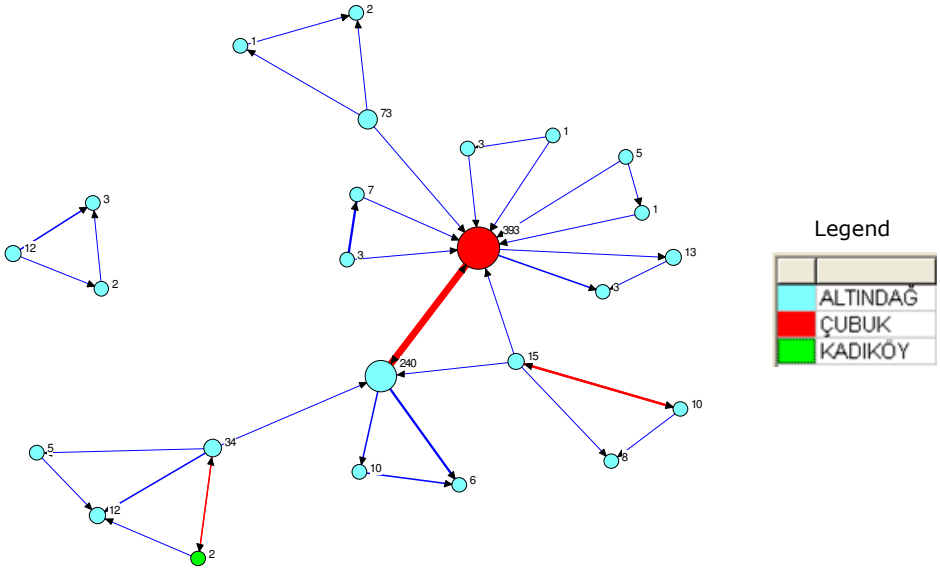


Figure 17 – The districts in which the firms are located (1985-1989-D).[25]

The efforts to dig into the most condense part of the network continue in the fifth stage by furthering the top-down approach initiated in the third stage. In the fifth stage, cliques having at least four members were identified and plotted over time in order to reveal the core of the network (for an example see Figure 18).[26] Those members of the network which could not form cliques having at least four members were separated from the rest of the network and further processed by employing bicomponent analysis in the sixth stage marked with tags 'F' and 'G' in Figure 10. The result of the bicomponent analysis employed in the sixth stage is plotted separately for the main block (for an example see Figure 19), on the one hand, and other blocks having at least 2 members (for an example see Figure 20), on the other hand.

For all of the time periods analyzed, the main component in the fifth stage is dominated collectively by 'Manufacture of Furniture Primarily of Wood' and 'Carpentry and Joinery'. In the case of the sixth stage, the main component marked with tag 'F' is again dominated collectively by 'Manufacture of Furniture Primarily of Wood' and 'Carpentry and Joinery'. However, in the rest of the network composed of components having at least two members, except for the period between 1990 and 1994, one could not observe any remarkably large component (see Figure 20). For the period between 1990 and 1994, the second largest block in the sixth stage is dominated by 'Manufacture of Wood and Cork Products'.

It is very clear from this section that SNA offers interesting insights for the exploration of the inter-firm social structures embedded in an industrial cluster through the agency of mobile laborers. It should be noted that for all components and bicomponents identified above, a series of attribute-based representations of the network were produced. Yet, because of the space available to us, only some of the illustrative examples are included in this paper. Nevertheless, for the last two periods (1995-1999 and 2000-2005), for which information about the application to the industrial design certificates were available, the attribute-based representation of the network was especially covered in order to reveal the contexts of innovation in the next section exploring the network in a spotlight fashion.

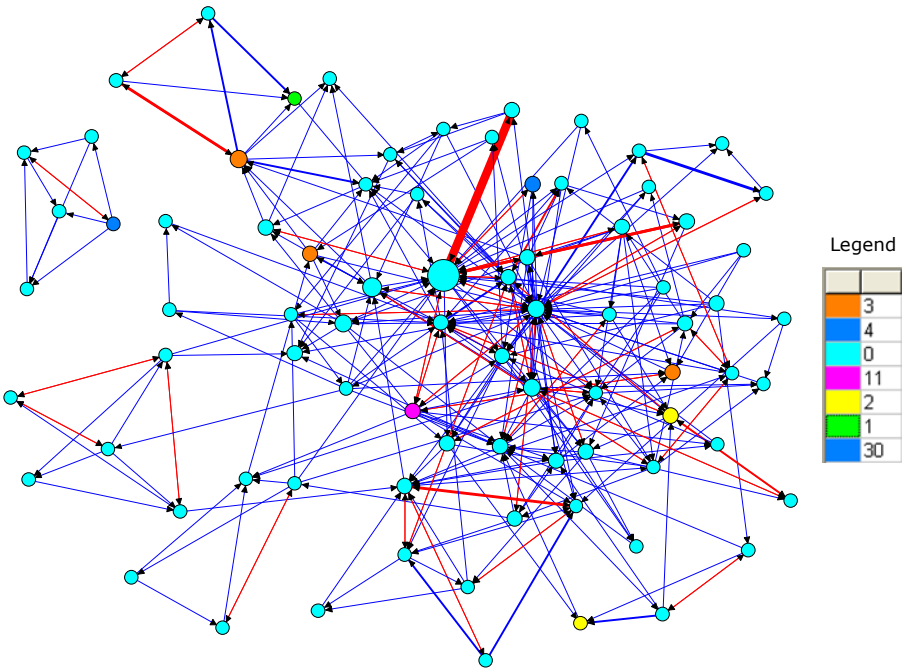


Figure 18 – The firms which have applied for at least one industrial design certificate during the current and subsequent periods, and the respective size of the firms (1995-1999-E).

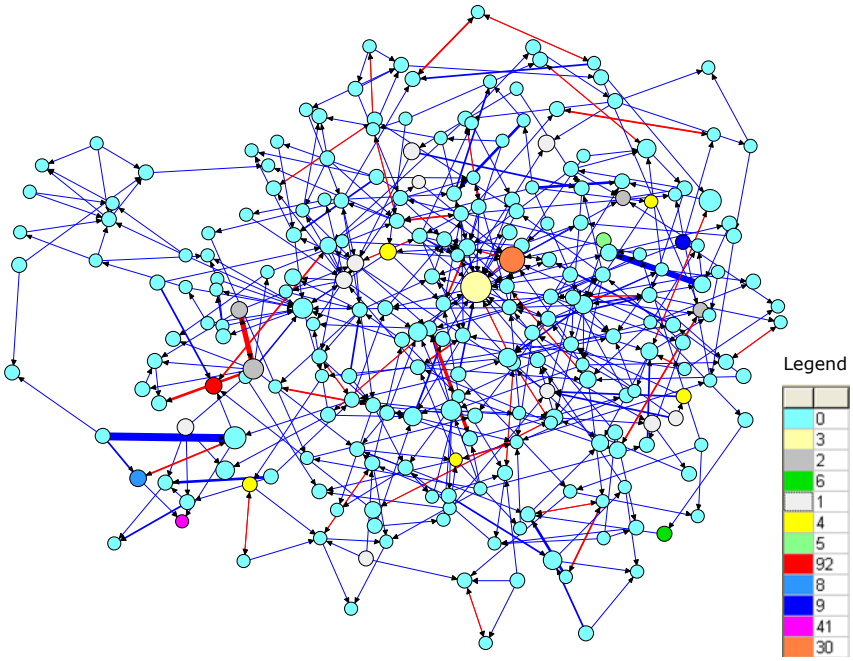


Figure 19 – The firms which have applied for at least one industrial design certificate during the subsequent and current periods, and the respective size of the firms (1995-1999-F).

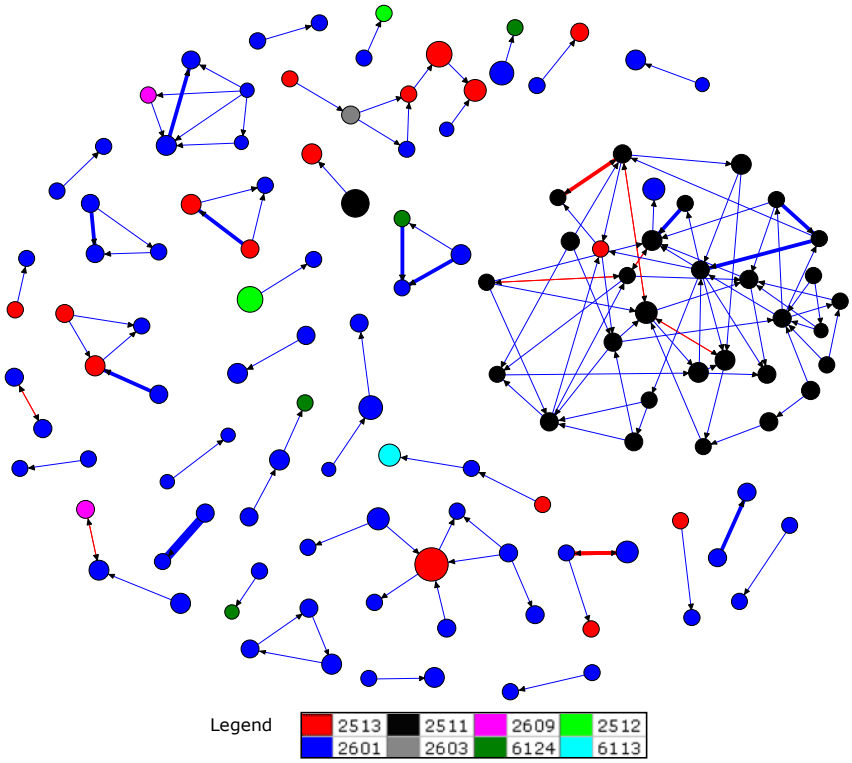


Figure 20 – The distribution of firms according to the core sectors (1990-1994-G).

Overall, what is evident from the systemic assessment conducted in this section following the algorithm outlined in Figure 10 is that there exists a kind of topography of the network created by the mobile laborers moving between the firms located both inside and outside the cluster. Topographic counter lines of this network can be summarized as below:

- tag 'E' – top of the network
- tag 'F' – above intermediate level of the network
- tag 'C' and tag 'G' – intermediate level of the network
- tag 'A' – bottom of the network

(B) and (D) cannot be properly located on this topography because of their relatively small size. However they can be considered as part of (C).[27] In spite of the efforts made in order to split the network into identifiable and equally large blocks co-existing at the same level of stage (see Table 3 and Table 4), the network created by labor mobility has resisted these efforts and rather exhibited a pattern of topography of the respective network.

### *Spotlight Examination of the Labor Mobility Network with a Special Focus on Innovativeness*

Other attributes of the components and the blocks cultivated throughout the basic algorithm developed for the analysis of the network of firms also deserve attention and necessitate a spotlight examination of the thematic graphs produced for each stage and period. Indeed, mapping of the social networks according to some thematic coverage alone provides us with valuable insights for grasping and understanding the inner logic of socio-economic processes.

In this respect, mapping of the social network for each stage explained above with respect to the number of industrial design certificates for which the firms apply provides us with one of the critical findings regarding the relationship between labor mobility and innovation. It is noticeable that the pattern of density of industrial design certificate applications exhibits remarkable topographical variation. Compared with other stages, the rate of innovativeness for the components and firms (defined respectively as 'b/a' and 'b/c' in Table 5) harvested throughout the first stage (bottom of the network in terms of capacity of the firms to establish relationships through labor mobility – tag 'A') is quite smaller than the rate of innovativeness harvested throughout the third (intermediate level of the network – tag 'C'), fifth (top – tag 'E') and sixth (tag 'F') stages.

Table 5 – The ratio of innovative firms at each level of the labor mobility network.

| | | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|---|
| 1995-1999 | firms (a) | 465 | 65 | 206 | 47 | 80 | 237 | 52 |
| | innovative firms (b) | 4 | 4 | 9 | 2 | 4 | 13 | 3 |
| | components (c) | 128 | 20 | 45 | 7 | 2 | 1 | 21 |
| | b / a | 0.009 | 0.062 | 0.044 | 0.043 | 0.050 | 0.055 | 0.058 |
| | b / c | 0.031 | 0.200 | 0.200 | 0.286 | 2.000 | 13.000 | 0.143 |
| 2000-2005 | firms (a) | 368 | 33 | 132 | 15 | 47 | 274 | 31 |
| | innovative firms (b) | 7 | 1 | 11 | 2 | 6 | 28 | 4 |
| | components (c) | 103 | 11 | 24 | 5 | 1 | 1 | 11 |
| | b / a | 0.019 | 0.030 | 0.083 | 0.133 | 0.128 | 0.102 | 0.129 |
| | b / c | 0.068 | 0.091 | 0.458 | 0.400 | 6.000 | 28.000 | 0.364 |

Additionally, the rate of innovativeness of some intermediate levels (tag 'B' and tag 'G' for the period between 1995 and 1999; tag 'D' and tag 'G' for the period between 2000 and 2005) of the network (see 'b/a' in Table 5) is relatively higher than the rate of innovativeness of both top and 'above

intermediate' levels of the network (see also Figure 18, 19 and 21 for the period between 1995 and1999). Overall, high level of innovativeness of intermediate levels of the network deserves serious attention when one considers its relatively small size and importance in the network compared with both top and 'above intermediate' levels of the network. Thus, it can be concluded that the most innovative part of the network is topographically concentrated at the intermediate levels of the network and the rates of innovativeness at both top and bottom of the network tend to be lower than the rates of innovativeness at the intermediate levels (Table 5).

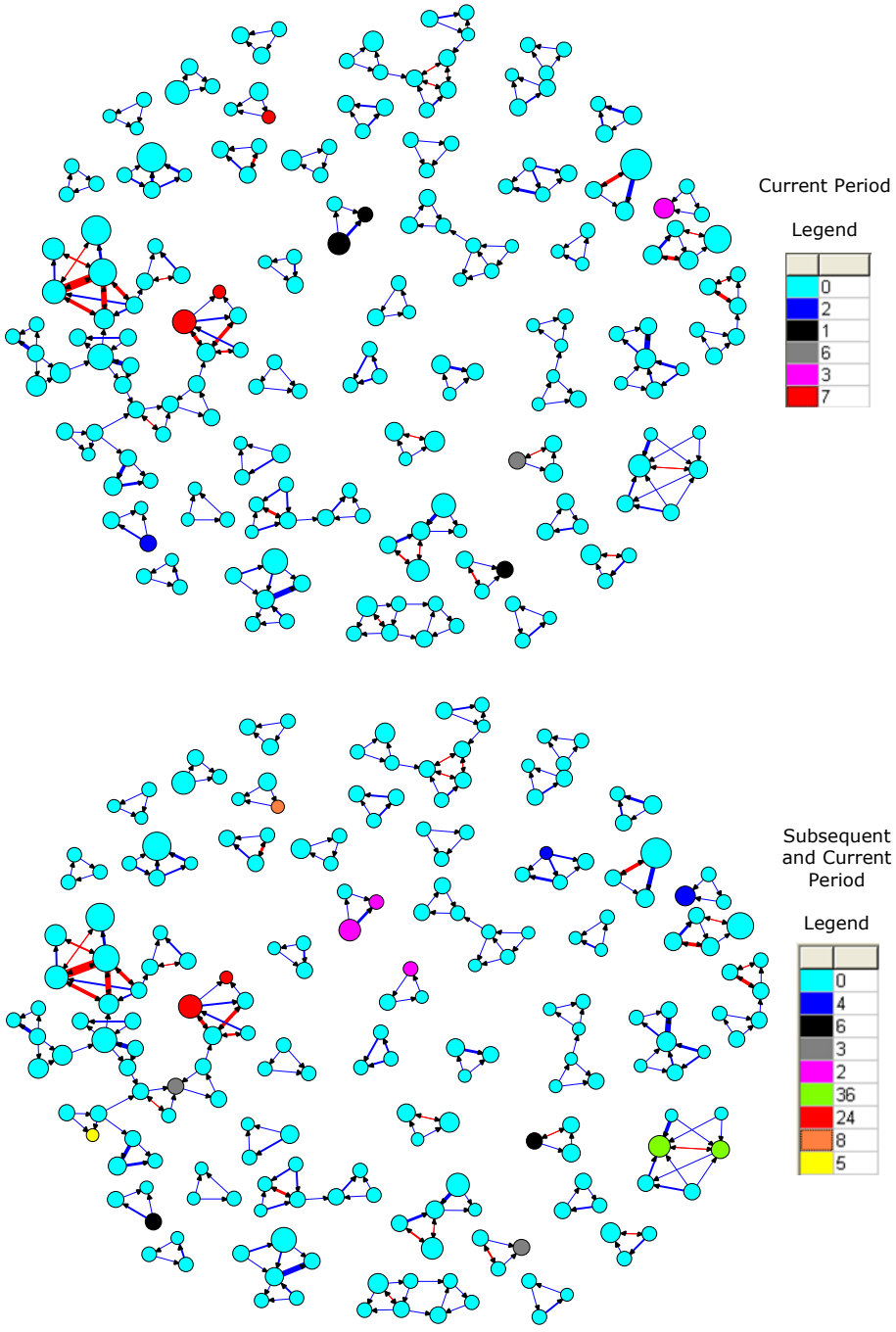


Figure 21 – The firms which have applied for at least one industrial design certificate during the subsequent and current periods, and the respective size of the firms (1995-1999-C).

Although the firms subject to more labor mobility and located at the top of the network are usually considered to have potential to be more innovative because of their ability to draw on a variety of ideas introduced by the mobile laborers, in reality it is observed that the firms characterized with relatively lower degree centrality and located at the intermediate levels of the network tend to be more innovative (Table 5). In terms of microscopic view of social networks composed of individuals, it is well documented that those people functioning as bridges (brokers) between different components have more potential to be innovative owing to their strategic position located along the information rich channels in the networks (Granovetter, 1973; Burt, 1992). What is evident from this study is that the same arguments also hold true for the mesoscopic level of the network composed of the firms connected to each other by mobile laborers. Thus, although the mobility of workers help the localized diffusion of knowledge spillovers, it is clear that this diffusion process is more concentrated at certain parts of the network characterized by the ability to connect the fringes and different parts of the network with the core of the network.

Not only the rate but also the pattern of innovativeness in intermediate levels of the network deserves stern consideration. One cannot help but notice that in the 'above intermediate' level of the network, innovative firms are often in pairs (for an example see the positions of the innovative firms in Figure 19).[28] In other words, in the intermediate levels of the network innovative firms are frequently and directly connected with each other by forming pairs. A similar kind of trend can also be observed for the intermediate level of the network (tag – 'C') (see Figure 21). However, it is not as powerful and noticeable as the one observed for 'above intermediate' level (tag – 'F'). Nevertheless, overall, the nature of couplings in the intermediate levels (both intermediate and 'above intermediate' level) of the network legitimately deserves a great deal of attention.

Overall, one of the most critical point that emerges out of the mapping of the inter-firm social network created by the mobility of laborers is that the innovative firms and social groups do not necessarily occupy the most central positions in the network in terms of the total amount of labor traffic they have experienced. Compared with the more isolated parts of the network, innovative firms and social groups have more proper channels to the rest of the network by means of labor mobility, but these channels are not as powerful as the ones established by the firms and social groups occupying the most degree central and higher positions in the network in terms of their capacity to connect to a more diverse group of firms. Actually, as it is noted above, this is in line with the very concept of 'strength of weak ties' (Granovetter, 1973) and 'structural holes' (Burt, 1992).[29]

In relation to the examples referred above, a small warning is in order here: It should kept in mind that the components unveiled in the third stage (tag 'C') are, in fact, by definition clique-like structures, not real components. In other words, each node (firm) in the graph is, though indirectly, connected to the other nodes in the actual network. Nevertheless, these connections are relatively weaker than the ones observed in the graphic outcomes of the third stage. For this reason a top-down approach is employed in the respective stage by combining certain aspects of the clique (clique-by-clique overlap matrix) and (bi)component analysis.

Occasionally, one can observe that the innovative firms may also occupy central positions in the inter-firm social network revealed by labor mobility (for example, see the positions of the innovative firms in Figure 19). Overall, in terms of strict generalizations, one cannot easily conclude for the exact relationship between the degree of centrality of a firm in the network and its innovativeness. However, this does not falsify the observations made above in relation to the overwhelming innovative characteristics of the (above) intermediate levels of the inter-firm social network created by mobile laborers. Indeed, it is observed that Pearson's correlation between the degree centrality and innovativeness of the firms in terms of application to industrial design certificates is very low for both of the time periods for which the respective information is available ($R = 0.0792$ for 1995-1999 and $R = 0.1183$ for 2000-2005).

If the correlation analysis is conducted by including only those firms that applied for industrial design certificates, the correlation values slowly increase (R = 0.2200 for 1995-1999 and R = 0.1941 for 2000-2005). Nevertheless, it should be noted that these values also are still low in order to conclude that there is a strong relationship between the innovativeness and degree centrality of a firm. Another important point is the fact that the degree of correlation between the centrality and innovativeness of the firms generally decrease if the innovativeness of the respective firms is measured in terms of total number of items for which the application is made instead of the count of each bundle of application according to the years (for the total number of items if the correlation analysis is realized for all the firms included in the network, R = 0.0610 for 1995-1999 and R = 0.1271 for 2000-2005; if the correlation analysis realized only for those firms characterized by innovativeness, R = 0.1597 for 1995-1999 and R = 0.1859 for 2000-2005).[30]

Another important attribute-based characteristic of the network which exhibits a pattern of change conditioned by the topography of the network is the tracks of spin-offs. In terms of spin-off formation, the inter-firm labor mobility network displays significant characteristics. Compared with other stages, the first stage (bottom of the network) accommodates much more spin-offs than the other stages, which seem to owe very much to the relatively settled nature of the other stages (for an example see Figure 12).

It is clear that the thematic graphs provide us with significant explanatory material that can be easily integrated to the exploratory dimension of SNA. Yet, because of the space available to us, only some illustrative examples from innovativeness and spin-off formation were given in this study. In terms of both systemic assessment and spotlight examination of the network, the method employed in this paper is rather an idiographic method. It also involves elements from nomothetic method but does not fully cover them in terms of, for example, density, cliquishness and transitivity of the network over time. These measures of social network analysis are intended to be covered in another paper by making use of the same one-mode data.

## 5. Conclusion

In many respects, tacit knowledge is part of the space and network within which firms and other institutions are located. By means of labor mobility, tacit conducts of knowledge is carried beyond the boundaries of the individual firms and institutions but within the availability of space and network over which there is a physical and relational proximity which facilitates both formal and informal contacts among actors who act as repositories of routines and habits in their tacit forms. Indeed, laborers moving from one firm to another not only carry valuable tacit knowledge with them, but also extend the social context within which knowledge circulates between the origin and the destination firms via friendships established through and by the respective laborer in both parties of the firms subject to the movement. In other words, respective laborer functions as a bridge between two firms in terms of establishment of new friendships between the employees of origin and destination firms.

In this context, following the research program proposed by Granovetter (1973), it has been shown that SNA offers interesting insights for both the exploration and explanation of the inter-firm social structures embedded in an industrial cluster through the agency of mobile laborers. Yet, it should be emphasized that the technical tools involved in the analytical repertoire of SNA and designed to handle the flow data do not only have an intrinsic capacity to represent and unveil the social structures embedded in the databases, but also meta-theoretically they serve well to the accomplishment of methodological realism characterized by the acceptance of the mutual causality between agency and structure (or system theoretically between parts and whole).

Being modest in its nature, one of the basic motivations of this paper was to explore possible topographical peaks and equally large social sub-groups in the inter-firm social network created by the mobile laborers having connection to Siteler. Consequently, it becomes apparent that in many

respects, Siteler exhibits the characteristics of a concrete and organic social whole which cannot be split into equally large components or bicomponents. One can identify large blocks in the network, but they do not coexist at the same level of the topographic counter lines of the respective network. Moreover, they have been rather characterized by sector specific divides. Overall, component analysis of clique-overlap matrix that lies at the core of the algorithm used in this study successfully reveals the fact that social sub-groups framed by the mobile laborers tend to be imprinted with some cohesive characteristics that actually differentiate one sub-group from the other.

Nonetheless, this study also shows that a spotlight examination of the network may provide us with a wide range of explanatory material to understand the nature of sub-groups. A series of thematic graphs may well reveal the basic motivation behind specific social sub-groups, whether it is motivated by sectoral proximity, spatial proximity or social proximity. For example, in this paper, it is shown that the density of industrial design certificate applications exhibits remarkable topographical variation and the most innovative part of the network is topographically concentrated at the intermediate levels of the network. Thus, it is clear that spotlight examination may provide us with both the symptoms and the sub-groups which, in turn, can be employed in the determination of sub-topics and sub-areas of the network for which more detailed studies are required especially in regional planning exercises. This study shows the potential of SNA in the identification of these sub-groups for which in-depth interviews and analysis are required to understand the inner mechanisms of the respective groups.

Future studies on labor mobility networks may be directed towards the development of more specific tools in SNA designed for the study of networks revealed by mobile laborers. Additionally, interaction between spatial and network dynamics in industrial clusters can be explored and explained by developing a co-evolving perspective between SNA and Geographic Information Systems (GIS). Recent developments in space syntax studies are interesting in this respect and there are rich avenues for future research in the application of SNA in spatial analysis. It should also be emphasized that the method of analysis employed in this paper does not exhaust all the opportunities offered by SNA. The issue of telescoping, overlapping and excluding social and cognitive domains will be more specifically addressed in another paper again by focusing on the social structures in Siteler.

---

[1] Although in some studies it is observed that graph theory is employed in order to identify functional regions by mainly drawing on the labor mobility between workplace and home (see for example Clayton's (1980) study), the concern on the application of SNA to the labor mobility between the firms is not theoretically well elaborated till the contribution of Granovetter (1973).

[2] Siteler was established by the relocation of the Cooperative of Manufacturers of Wood and Cork Products to its current location along Samsun highway in 1959 (see Figure 1 and Figure 2). In the subsequent years, other cooperatives followed the relocation trend and had settled down in Siteler. In fact, there are strong correlations between the rapid expansion and growth of Siteler and the spreading of squatter housing areas in Ankara especially around the cluster. The growth of the cluster is inherently associated with the growth of labor pool provided by the people who migrated to Ankara particularly after the Second World War. Those people working in Siteler had preferred to settle down in areas close the cluster and they formed squatter housing areas around it. In the early years of Siteler, the most dominant social group in the immigrant workforce was the group of people whose place of birth was Bolu.

On the provincial level, it is noticeable that in the early years up to the mid 1960s İstanbul was the most dominant place for the manufacture of furniture and related industries in Turkey. Nevertheless, beginning from 1960s onwards Ankara where Siteler is located, İzmir, Bursa, Kayseri and Adana have challenged the dominance of İstanbul in the core sectors involved in the manufacture of furniture. Yet, in absolute figures only Ankara, İzmir and Bursa have had a remarkable influence in this challenge beyond their geographical extent. And historically, the core sectors involved in the manufacture of furniture in Ankara are exclusively agglomerated within and around the geographical extent of Siteler.

[3] This quest of Granovetter (1973) is completely in line with many other pioneering studies conducted in urban and regional planning, geography and institutional economics (for a short review of these studies see Beyhan (2007: 413-416)).

[4] Social Security Institution (SSI) was established by the Social Security Institution Law No:5502 which was published in the Official Gazette No: 26173 dated 20.06.2006 and brings the Social Insurance Institution (former Workers' Insurance Institution), Social Insurance Institution for the Craftsmen and Artisans and Other Self Employers, and General Directorate of Retirement Fund under a single roof.

[5] Social Insurance Institution (SII) was responsible for the monitoring and controlling of the social insurance system for workers in Turkey. This institution kept the records for social insurance premium payments which have been used as the primary data source for the construction of the labor mobility databases that lies at the heart of this paper. SII data covers both public and private firms. Nevertheless, it does not cover the self-employed workers that are covered by Social Insurance Institution for the Craftsmen and Artisans and Other Self Employers (BAGKUR). BAGKUR data is also employed in the production of some graphs presented in this paper in order to trace the formation of spin-offs. Yet, it should be noted that both SSI and BAGKUR data cover those who are registered in the system.

There are some drawbacks to the data obtained from SII. It is a well known reality in Turkey that an important segment of the workforce is not registered in SII because of the unwillingness of the employers to pay for the social insurance premium payments. Social insurance premiums are paid mostly for the qualified portion of the actual workforce. The formal education in furniture sector is actually quite a new phenomenon in terms of both its widespread applicability and its historical development. Hence, most of the workforce is educated by way of learning-by-doing beginning from early ages (14 and sometimes below 14 especially at the early years of Siteler during 1970s and 1980s). In spite of these drawbacks, it should be noted that the data obtained from SII serves very well to the needs of this study in that it is well documented that only those having a certain amount of accumulation of technical knowledge is subject to the transfer of valuable (tacit) knowledge from one firm or institution to the other, and consequently some interviews held with the employers and also employees confirmed that any worker having this kind of technical knowledge is definitely paid social insurance premiums.

[6] Not all sectors are included in the initial phase of the study. Only furniture producers and sectors in close interaction with them are included in the initial sectors.

[7] The actual number of total labor mobility is 188493, but only for 178655 cases of mobility information about the sectors of the firms subject to the mobility of the laborers is available.

[8] This figure for Ankara does not include Siteler where 11188 firms have been located since 1965.

[9] These figures were created using the Spring Embedding Layout in NetDraw software (Borgatti, 2002). In some of the graphs, the layouts were modified by hand in order to increase the visibility of some nodes

[10] In this figure, the size of the nodes shows the total number of workers employed by the firms represented by the respective nodes. Color of the nodes indicates the number of industrial design certificate applications made by the respective firms during the period between 1995 and 2005 (although the current period for the graph is 1995-1999, the industrial design certificate applications made during the subsequent period (2000-2005) are also taken into consideration). Color of the lines shows whether or not the labor mobility between the firms is reciprocal (red color stands for the reciprocal moves). Direction of the lines shows the direction of the labor mobility (it reveals the origin and destination firms).

[11] In this figure, firms are represented by red circles and laborers are represented by yellow squares, the size of the node indicates the size of the firms in terms of number of their employees. Direction of the lines shows the direction of the mobile labor between the firms. Color of the lines shows whether or not the firm functions as an origin and destination place for the mobile labor employed by them (red color stands for the connection to the firms through which the mobile labor passed).

[12] It is assumed that any worker having a registry in SII is a case of spin-off if the respective worker also has a registry in the Chambers of Furniture Producers and Carpenters, Social Insurance Institution for the Craftsmen and Artisans and Other Self Employers (BAGKUR) or SSI (as the owner of the firm). Within this context, a total of 8716 spin-offs is identified by making use of the respective databases. In order to reveal the association between labor mobility and spin-off formation, each incidence of labor mobility is checked against whether the mobile laborer is in the list of spin-offs identified according to the overlapping between the databases of SSI, BAGKUR, and the Chambers of Furniture Producers and Carpenters.

[13] In a variety of studies it is assumed that innovation can be measured by the application to industrial design certificates, patents, utility models and trade marks. In the absence of these indicators, it is also generally assumed that discrete increases in output and productivity levels (such as electricity consumption) can also be employed as proxies of innovation. In this study, the dataset obtained from Turkish Patent Institute covers information about the applications to the industrial design certificates, patents, utility models and trade marks. Compared with industrial design certificates and patents (also utility models), trade marks are very poor in their capacity to represent the innovativeness in products because they are mainly used in order to distinguish products or services provided by an individual, business organization, or other legal entity from those of other entities. One can observe different trade marks placed on similar or even the same products. Moreover, it should be noted that for traditional sectors utility models and industrial designs are better indicators of innovativeness than patents because unlike high-tech sectors in most of the traditional sectors inventions rarely occur.

Indeed, in traditional sectors such as manufacture of furniture and related products, majority of the applications to the patent offices are for industrial designs that mainly deal with the appearance or look of the products. In manufacture of machine-parts and tools, utility model applications especially occupy a large share of the total applications made by the firms operating in the respective sector. Industrial designs are formally defined as the "compositions of lines or colors or any three-dimensional forms which give a special appearance to a product or handicraft" (see http://www.wipo.int/sme/en/ip_business/industrial_designs/index.htm). As it is explained on the website of World Intellectual Property Organization (WIPO), "[i]n most countries, protection of industrial designs can only be acquired through registration". Within this context, in Turkey, industrial design certificates are issued by Turkish Patent Institute.

[14] See Table 1 for the explanation of the sector codes.

[15] See Table 2 for the explanation of the traffic codes

[16] In association of the firms with a specific place of birth, a combination of location quotient index and find-maximum-assign-tag algorithm is employed (see Beyhan (2005)).

[17] The thematic graphs which are included in this paper are only for illustrative purposes. It should be reminded that the method of analysis proposed in this study actually draws on a larger number of figures. Thus, the figures included in this study represent only a small section of the thematic graphs produced by employing the algorithm developed in the paper.

[18] It should be kept in mind that the network under inspection is not a direct one, but one constructed from a two-mode data: labor traffic between firms.

[19] Component, bi-component and clique analyses were carried out using UCINET software (Borgatti et al. 2002).

[20] In fact, first stage in any SNA begins with the identification of components involved in the network data. It should be noted that all the components derived in this study are weak components, if not stated otherwise. In order to increase the visibility of the components, main component is not included in the figures representing the outcomes of the first stage. Set of figures for the first stage is marked with a common tag = 'A' (for example 1980-1984-A, 1990-1994-A …).

[21] Within this context, in recent years the interest in labor mobility as a tool of identification of true industrial clusters has increased owing to the fact that workers tend to move more within than between clusters (Power and Lundmark, 2003; Wolfe and Gertler, 2004). In other words, labor mobility between the firms in a country helps us reveal the islands of clusters in the respective country.

[22] Main block is not included in this figure. Nodes on the figure are colored according to date of spin-off formation. Set of figures for the second stage is marked with a common tag = 'B'.

[23] Employment of clique-by-clique co-membership matrix can be observed in various studies (for an example see Derudder and Taylor (2005: 81) who try "to illustrate how a conventional network-analytical framework can be used to analyze inter-city relations within contemporary globalization"). Yet, component analysis of the clique-by-clique co-membership matrix is not widespread and well-utilized.

[24] Main component is not included in this set of figures. Set of figures for the third stage is marked with a common tag = 'C'.

[25] Main block is not included in this figure. Set of figures for the fourth stage is marked with a common tag = 'D'.

[26] Set of figures for the fifth stage is marked with a common tag = 'E'.

[27] Nevertheless, it is notable that for certain time periods a series of stages are cultivated together as they involve relatively very small number of firms (or no firm).

[28] In assigning the applications made for industrial design certificates to the firms in the labor mobility database derived from the registries of SSI, some adjustment has been introduced in order to improve the representation capacity of the database obtained from Patent Institute of Turkey. These adjustments mostly stem from the fact that the firms involved in the manufacture of the furniture and having more than one workplace in Ankara tend to give the address of the administrative unit of the firm as the corresponding address in the application forms related to the industrial design certificates. There is no doubt that new designs are mostly developed at the workplace where manufacture of the furniture is realized, and the laborers employed in the workplace where the administrative and commercial departments of the firm is located have actually no direct contribution to the creation of the new design. However, considering the possibility of the employment of designers having no connection with shop floor, all workplaces of the respective firms that have applied for industrial design certificate are taken into account in the construction of the joint-database regarding the mobility of employers and the application to the industrial design certificates.

[29] Burt (1992) argues that economic actors embedded in structural holes can easily gain access to critical information required to be competitive. Granovetter (1973) also considers 'weak ties' as information-rich channels of knowledge flow.

[30] Application for industrial designs in Turkey is usually made by the firms for a bundle of products and each item in the bundle is listed as a separate industrial design. For example think of a dining room set including dining table, dining chair and dining accent furniture (such as buffets and sideboards), each item in the bundle is treated as a separate industrial design. Although this can be considered as a positive factor in the determination of the extent of innovation, it creates problems when one attempts to compare the innovativeness of the firms specialized in the manufacture of different furniture products. For example, a firm producing only rest chairs or office chairs applies each time for a limited number of items. Thus, in the first set of correlation analysis, not the number of items but the bundles defined according to the years is counted as the indicator of innovativeness.

## References


Aslesen, H.V., Isaksen, A. and Stambøl, L.S. (2004). "KIBS and Industrial Development of Cities: Labour Mobility, Innovation and Client Interaction." Paper prepared for the 44th Congress of the European Regional Science Association, Porto 25.-30.

Bakke, E.W. (1954). Introduction, in *Labor Mobility and Economic Opportunity: Essays*, Cambridge (Mass) M.I.T. Press, 1-7.

Beyhan, B. (2005). "Index Creator: A Set of Excel Macros for Calculation of LQ, Chi-Sqr and Dissimilarity Indices with additional support for Find-Maximum-Assign-tag." http://www.geocities.com/burakbeyhan/ (last accessed at 18.08.2006) (no longer available at the respective website).

Beyhan, B. (2007). Evrim Benzetisi, Kurumsal İktisat ve Çağdaş Bölge-Mekan Bilimi (Evolutionary Metaphor, Institutional Economics and Contemporary Regional-Spatial Science). In E. Özveren (ed.), Kurumsal İktisat, İmge: Ankara, 401-440.

Beyhan, B. (2009). Toplumsal-Bilişsel Yakınlık ve İşgücü Hareketliliği: Hemşehrilik İlişkileri Üzerinden Bir İrdeleme (Social-Cognitive Distance and Labor Mobility: An Examination Through the Fellowmen Relationships). In 21.Yüzyılda Türkiye'de Sosyal Bilimler ve Toplum Sorunları Sempozyumu Bildiri Kitabı, 271-303.

Borgatti, S.P. (2002). NetDraw: Graph Visualization Software. Harvard: Analytic Technologies.

Borgatti, S.P., Everett, M.G. and Freeman, L.C. (2002). Ucinet for Windows: Software for Social Network Analysis. Harvard, MA: Analytic Technologies.

Breschi, S. and Lissoni, F. (2003). Mobility and Social Networks: Localised Knowledge Spillovers Revisited. CESPRI Working Papers 142, CESPRI, Centre for Research on Innovation and Internationalisation, Universita' Bocconi, Milano, Italy.

Bunting, R.L. (1961). A Test of the Theory of Geographic Mobility. *Industrial and Labor Relations Review* 15, 1: 75-82.

Burt, R.S. (1992). *Structural Holes: The Social Structure of Competition*. Harvard University Press: Cambridge.

Camagni, R. (1991). “Local Milieu, Uncertainty and Innovation Networks: Towards a New Dynamic Theory of Economic Space.” In R. Camagni (ed.), *Innovation Networks: Spatial Perspectives*. Belhaven Press: New York, 121-144.

Cantner, U. and Graf, H. (2006). “The Network of Innovators in Jena: An Application of Social Network Analysis” *Research Policy* 35: 463–480.

Casper, S. (2007). “How Do Technology Clusters Emerge and Become Sustainable? Social Network Formation and Inter-Firm Mobility within The San Diego Biotechnology Cluster.” *Research Policy* 36: 438–455.

Castillo, V., Novick, M., Rojo, S. and Yoguel, G. (2006). “Employment Paths and Labor Mobility: Restrictions on the Development of Technical Competences” Globelics Africa Conference, South Africa.

Clayton, C. (1980). “Interdependence in Urban Systems and Its Application to Political Reorganization.” *Geografiska Annaler, Series B, Human Geography* 62, 1: 11-20.

Dahl, M.S. (2002). “Embedded Knowledge Flows Through Labor Mobility in Regional Clusters in Denmark.” Paper to be presented at the DRUID Summer Conference on Industrial Dynamics of the New and Old Economy: Who is Embracing Whom?, Copenhagen/Elsinore, Denmark.

Dahl, M.S. (2004). “Embodied Knowledge Diffusion, Labor Mobility and Regional Dynamics: Do Social Factors Limit the Development Potential of Regions?” Paper to be presented at the DRUID Summer Conference 2004 on Industrial Dynamics, Innovation and Development, Elsinore, Denmark.

de Blasio, G. and Di Addario, S. (2002). “Labor Market Pooling: Evidence from Italian Industrial Districts.” Paper presented in Temi di discussione series, number 453, October.

Derudder, B. and Taylor, P. (2005). “The Cliquishness of World Cities. *Global Networks* 5, 1: 71–91.

Everett, M.G. and Borgatti, S.P. (1998). “Analyzing Clique Overlap.” *Connections* 21, 1: 49-61.

Faust, K. (2006). “Comparing Social Networks: Size, Density, and Local Structure.” *Metodološki zvezki* 3, 2: 185-216.

Frederiksen, L. and Sedita, S.R. (2005). “Embodied Knowledge Transfer: Comparing Inter-firm Labor Mobility in the Music Industry and Manufacturing Industries.” DRUID Working Paper No. 05-14.

Graf, H. and Henning, T. (2006). “Public Research in Regional Networks of Innovators: A Comparative Study of Four East-German Regions.” Freiberg Working Papers, Faculty of Economics and Business Administration, Technical University Bergakademie Freiberg.

Granovetter, M. (1973). “The Strength of Weak Ties.” *American Journal of Sociology* 78, 6: 1360-1380.

Greenberg, D. and Mccall, J. (1974). “Teacher Mobility and Allocation.” *Journal of Human Resources* 9, 4: 480-502.

Jonsson, P.F., Cavanna, T., Zicha, D. and Bates, P.A. (2006). Cluster Analysis of Networks Generated through Homology: Automatic Identification of Important Protein Communities Involved in Cancer Metastasis. *BMC Bioinformatics* 7, 2: 1-13.

Kerr, C. (1954). “The Balkanization of Labor Markets.” In *Labor Mobility and Economic Opportunity: Essays*, Cambridge (Mass) M.I.T. Press, 92-110.

Lam, A. and Lundvall, B.A. (2004). “The Learning Organisation and National Systems of Competence Building and Innovation.” Working Paper No. 4, Brunel University, Brunel Research in Enterprise, Innovation, Sustainability, and Ethics (BRESE), Uxbridge, West London.

Lansing, J.B. and Mueller, E. (1967). *The Geographic Mobility of Labor*, Survey Research Center, Institute for Social Research, Ann Arbor, Michigan.

Møen, J. (2000). “Is Mobility of Technical Personnel a Source of R&D Spillovers?” Working Paper 7834, NBER Working Paper Series.

Myers, C.A. (1954). “Labor Mobility in Two Communities.” In *Labor Mobility and Economic Opportunity: Essays*, Cambridge (Mass) M.I.T. Press, 68-79.

Palmer, G.L. (1954). “Interpreting Patterns of Labor Mobility.” In *Labor Mobility and Economic Opportunity: Essays*, Cambridge (Mass) M.I.T. Press, 47-67.

Palmer, G.L. and Brainerd, C.P. (1954). *Labor Mobility in Six Cities: A Report on the Survey of Patterns and Factors in Labor Mobility, 1940-1950*. New York: Social Science Research Council.

Parnes, H.S. (1954). *Research on Labor Mobility: An Appraisal of Research Findings in the United States*. New York: Social Science Research Council.

Power, D. and Lundmark, M. (2003). “Working Through Knowledge Pools: The Effect of Labour Market Dynamics on the Transference of Knowledge and Ideas in Industrial Clusters.” DRUID Summer Conference 2003 on Creating, Sharing and Transferring Knowledge.

Wirth, L. (1938). “Urbanism as a Way of Life.” *The American Journal of Sociology* 44, 1: 1-24.

Wolfe, D.A. and Gertler, M.S. (2004). “Clusters from the Inside and Out: Local Dynamics and Global Linkages.” *Urban Studies* 41, 5/6: 1071-1093.

Yoder, D. (1954). “Manpower Mobility: Two Studies.” In *Labor Mobility and Economic Opportunity: Essays*, Cambridge (Mass) M.I.T. Press, 80-91.

Zarka, C. (1967). “Policies for Promoting Labor Mobility in Selected Western European Countries.” *International Labor Review*: 509-524.