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Interlocking Directorships among Companies in Ringkøbing Amt: A case of Social Capital?

This paper describes a small research project into board memberships and directorships interlock in a particular rural county in Denmark. This research also looks at other counties in Denmark as well as a group of the largest companies, in terms of revenue, within the country. The paper describes how UCINET and PAJEK software was used. The findings indicate that the companies in Ringkøbing Amt are interlocked by board and directorships, but much less so than the largest companies in Denmark. This leads us to attempting to relate the concept of interlocking directorships with more resent research into social capital, individual as well as corporate social capital. We conclude by discussing these findings as well as suggest areas for further research in this area.

The question

Interlocking directorships i.e. situations where a particular person sits on the board or is in the top management of two or more companies (Scott 2000 p.43), have been investigated many times using network analysis tools such as UCINET. The aim of this paper is to analyse the companies within the county of Ringkøbing Amt in Jutland, Denmark (For a map of the Danish counties, please refer to the appendix, Figure 5).

When interviewing company managers in the region one will hear stories about how the companies were founded and how they have evolved. Often such stories include references to prominent business personalities within the region whose company have spawned a number of new ventures throughout its history. In some cases the owner of a company will support an employee who wants to start a new business with advice, guaranteed orders or money. In the windmill sector a number of small companies have made it big through the close relationships with main actors sharing their expertise helping to build up the sub-suppliers.

In this region, by many considered to be built on perseverance over hardship due to the meagre opportunities for farming, raising sheep or cattle, one could expect to see that the companies were somehow linked together through interlocking directorships. Interlocking directorships within the

region would not be surprising in this light. On the other hand the experiences of hardship could have made the environment even more competitive to the degree of deliberately excluding other managers from your own company relying more perhaps more on family members.

Using the computer-based tools available for analysing social network structures, we might be able to find such interlocking directorships among the companies. If companies are related to each other by sharing key people at the top management and board level, then there could also be groups or cliques of people that it would be interesting to identify.

Knowing more about the structure of companies and people will be an important part of working within this the region.

So the questions we are asking (initially) are:

> *Are the companies in Ringkøbing Amt related by interlocking directorships?*
>
> *Can we identify groups or cliques of companies and/or people with particular affinity to each other by analysing the available data?*
>
> *What does that tell us about the social capital of companies and directors in Ringkøbing Amt?*

Interlocking directorships

Interlocking directorships is a concept often referred to in the literature. The context in which the concept is used is quite varied and some have even claimed that it must be considered a cornerstone of capitalism in the western companies (Orrù, Hamilton, & Suzuki 1989). Studies of interlocking directorships go as far back as the Pujo Report (U.S. Congress, 1913), a congressional investigation into corporate concentration. Control through interlocking directorships was a practice widely recognised by historians of the early 1900s. Investment bankers often put representatives on the boards of corporations they controlled (Mizruchi & Bunting 1981).

Control vs. Influence

Mizruchi and Bunting, (1981) make the point that since boards are often represented by many different interests each of which has influence but not necessarily control, influence rather than control should be the focus when investigating interlocking directorships. They use Hopkins definition of influence as leadership ability in situations of collective activity and as the ability to affect the outcome of events. This is in contrast to control, which can be viewed as the ability to determine the long-run policies of a firm.

In their study they find that studies of network influence will be strengthened by accounting for the direction of network ties as well as for the strengths of those ties. This is in line with common sense: the influence depends on who is providing the director to the board (direction) and also on the strengths of this person's ties. The more ties the more influence. When the investment bankers put directors on the board of the companies they controlled like J. P. Morgan did with U. S. Steel (Mizruchi & Bunting 1981), J. P. Morgan gained influence on U. S. Steel not vice versa.

Collaboration and Knowledge Exchange

Grant & Baden-Fuller (1995) saw interlocking directorships as one of many forms or techniques in which firms can collaborate and exchange knowledge. They do not state this directly, but probably interlocking directorships are a way of transferring tacit knowledge from one firm to another. Recent studies on interorganisational imitation have shown that interlocking directorships play an important role in the diffusion of innovative practices. A study specifically aimed at investigating corporate acquisitions, found strong links between a focal company's acquisitions and prior acquisitions performed by tied-to companies (Haunschild 1993). It was further found that even between very dissimilar types of companies, interlocks and imitation acquisitions are correlated. Interlocks can be viewed as a source of models to be imitated and as a source of information.

Other references to interlocking directorships can be found where people are looking into board compositions (Rhoades, Rechner, & Sundaramurthy 2000; Scott & Rosa 1996). The financial indications of outside directors have been studied as well as the effects on CEO selection (Borokhovich, Parrino, & Trapani 1996). Having very prominent board members will undoubtedly have an impact on the companies' ability to attract financing.

Who Accumulates Directorships

Then who is it that gains directorships? In a study of directorships in Israeli big business firms, Maman (2000) finds that it is a combination of the structure of the national economy and human and social capital which determine who will join additional boards.

The structure of the economy will have an influence on board membership in different ways. In some economies directors from companies who do not have any ownership ties with the focal company will be invited to join the board. This is very much the tradition in the Anglo-American type of corporate governance. Other types of economies can have very large business groups like the Keritzu in Japan and the Chaebol in Korea. These large business groups often have strong ownership links between the companies, which increases the likelihood of directors, who serve on boards within the business group, being invited to join additional boards within the group (Maman 2000).

The human capital covers the skills and abilities of the individual. This has often been the focus when investigating the careers of directors. Maman (2000) finds that directors who accumulate directorships often have a professional background such as lawyers and accountants. He also finds unsurprisingly that directors who accumulate directorships have longer tenure than those that do not accumulate directorships.

Social capital in contrast to human capital is not a property of the individual but refers to opportunities enabled by the social structure the individual is embedded in (Burt 1992; Coleman 1990). Maman (2000) distinguishes between three components of social capital. One is the part that is associated with the individual's position and standing. Holding top positions in large companies are likely to lead to accumulating further directorships. Another is social capital as elite positions. In many countries it is common to have politicians or retired government officials on the boards. However, Maman (2000) did not find this to be the case in his study. The third part is the social network or the "who do you know" aspect. Granovetter (1973; 1995) has shown the importance of what he terms weak ties: the benefit of knowing someone sufficiently well to contact them but at the same time someone sufficiently far away from your self so as to provide important new insights

compared to those of your closer relationships or own competencies. In this case the issue is getting a job through such ties.

Maman (2000) found support for the following having a positive correlation with accumulating directorships:

- Affiliation with business groups
- Professional background
- Long tenure
- High positions in organisations such as CEO
- Inside directors (in some governance situations like in Israel)
- Member of more boards (Matthew effect (Merton, 1968))
- Central positions on the boards
- More direct contacts with other directors (degree centrality)
- Closer to other directors (closeness centrality)
- Located between other directors (betweenness centrality)

And he found no support for the assumption that political or government officials should be more likely to accumulate directorships.

Network Structure and Social Capital

Burt (2000) discusses the network structure of social capital. He points to two major mechanisms that contribute to social capital: *protection* within closed networks and *brokerage* across structural holes. His point is that the source of social capital stems from brokerage but that closure is a significant contingency factor for the value of brokerage.

According to Burt (2000) the social capital metaphor can be said to have a number of underlying network mechanisms each of which make sometimes contradictory predictions about the effect of social capital. The metaphor itself is a metaphor of advantage in the sense that it signals a net positive value (assets – liabilities). Those that have more social capital are somehow in a more advantageous position. As far as the social capital metaphor is concerned, Burt is in agreement with both Bourdieu and Coleman (Burt 2000; Coleman 1990).

In neo-classical economical theory the buyers and sellers are assumed to have full and complete market information at their disposal. Under this assumption, the network structure of today will not have any influence on the performance of the actors tomorrow. Actors will always act completely rationally and any network structures will be by-products of the interaction of buyers and sellers in the market. In a sense the network can be said to be an emergent phenomena of the interactions of the buyer-seller actors.

In less than perfect markets, the information available might very well not be complete and in some cases it could even be impossible to obtain all relevant information due to the complexity of the environment. In such cases information can be substituted or affected by what is known as *contagion*. Contagion is doing what other actors are observed to be doing. A special form of contagion is called *prominence* in which actors imitate what prominent other actors are observed doing.

Contagion and prominence can be an important source of social capital because it allows rapid transmission of beliefs and practices between people and organisations. On the other hand it can also prevent innovation by holding on to established ways of thinking and doing things for too long in a changing environment.

Other network mechanisms like closure and brokerage, have more to do with the flow of information rather than how to replace it. Both mechanisms begin with the assumption that information takes time to propagate through a network. Research has generally found that information circulates more within than between groups, more within organisations than between organisations, more within industries than between industries etc. (Burt 2000).

Coleman's view of social capital is that it is linked to closure of networks (1990) -the closer relationships the more social capital. He distinguishes between two types of effects of social capital: One, the potential for obtaining information through a relationship. Since obtaining information can be very costly and time consuming, the benefit of social capital in this connection is obvious. Two, social capital provides norms and sanctions. Having norms and sanctions within a society facilitates some actions while at the same time constraining others. Coleman uses the example of the norm that allows women to walk the streets alone at night at the same time constrain the activities of criminals.

Corporate Social Capital

Social capital can be regarded as belonging to individuals as well as to organisations or companies. Building on the work of Coleman (1990) and Burt (1992) Leenders & Gabbay (Leenders & Gabbay 1990) propose a framework for studying social capital and a theory behind it. They distinguish between corporate social capital as "*the set of resources, tangible or virtual, that accrue to a corporate player through the player's social relationships, facilitating the attainment of goals*" (ibid. p.3.), and social liability, which concerns how social structure and negative ties constrain action in a way that impede goal attainment. This means that organisations, as well as individuals, can possess social capital.

They suggest a clear distinction between network structure and social capital assets and liabilities in order to turn from a "descriptive set of findings to a theoretically-based orientation with practical implications" (ibid. p.11). This separation between capital as the positive side of social relationships in contrast to the liabilities or the dark side is in line with Håkansson & Waluzewski's (2001) view on network relationships in general having this dual characteristic.

Network paradoxes

Interlocking directorships can be seen as relationships between companies. When we combine this with what Håkansson & Waluzewski refers to as *network paradoxes* (2001) we see what could be termed *interlocking directorship paradoxes*. What Håkansson & Waluzewski say with three paradoxes is that: One, network relationships can be both an asset and a liability; they can facilitate some actions while at the same time prevent or exclude others. Two, a company's relationships are the outcome of its strategy, but at the same time strategy is the outcome of the company's relationships. Three, the more successful the company is at controlling its network, the less innovative it will be.

Actually these can only be considered paradoxes if they really are surprising and counter-intuitive. Only if you start out implicitly or explicitly with a normative assumption about the relationships can it come as a surprise that they exhibit this dual characteristic. Relationships can and will at the same time provide both positive as well as negative aspects and opportunities. In this sense what Håkansson & Waluzewski is describing can hardly be considered paradoxes, but rather a property of social capital as the difference between assets and liabilities.

They do however, direct out attention to the fact that since interlocking directorships are a special kind of relationships between companies, the same set of "paradoxes" or dual characteristics must also apply to this type of relationships.

Drawing on all of these perspectives on social capital we can illustrate the dualistic characteristics by the following table:

	Adding to social capital	**Destroying social capital**
(Burt 1992; Burt 2000)	Structural Holes, Brokerage	Closure
(Coleman 1990)	Closure	Lack of ties, affluence, self reliance
(Granovetter 1973)	Weak-ties	(Strong-ties)
(Putnam 1993)	Bridging/Bonding	

Table 1: Dual aspects of Social Capital

While Burt (2000) does try to reconcile these different perspectives on what is good for social capital and what is bad for social capital his heart still favours the structural holes as the primary source of social capital. He does however recognise certain contingency factors among them the network closure.

Looking at the contributions presented here it would seem that there is a conflict between them in what is viewed as contributing and as destroying factors of social capital. If we look a little bit closer however, maybe the research contributions actually complement each other, illustrating different situations or contexts. If we assume that what is good and what is bad depend on the specific context of the research, all of these perspectives can be true. The following table attempts to illustrate in which contextual situations the two perspectives have been found to add to social capital:

Brokerage	**Closure**
Change	Stasis
Learning	Doing
Developing	Maintaining
Exploring	Exploiting
New venture	Existing business
Changing context	Stable context
Opportunities	Limitations, problems, sanctions
Prospecting	Defending
Source of value	Realising value
Risk embracing	Uncertainty avoidance

Table 2: Contextual link with Social Capital

A simple structural analysis like the one described here cannot tell us if what we find is positive or negative to the companies and people of a particular region. What is to be considered positive or negative depends on the largely unknown, idiosyncratic objective functions of the stakeholders. The analysis can merely identify and measure key characteristics of the network defined by the sample we look at. It does however indicate that interlocking directorships may be important to the individual companies potentially influencing its future options of action, its innovative capabilities and opportunities and its strategy.

At the regional level the complexities of many companies' relationships and interactions will generate outcomes that are either positive or negative for the region. However this very complexity will make it difficult if not impossible to detect direct causal links, although the Israeli study can be seen as an attempt in the sense that it focuses on who *accumulates* board memberships not just on who *possesses* them, thus potentially capturing more of the dynamics and possibly also providing an indication about the causal direction.

The process

The raw data for the analysis of the company relationships was exported from Købmandsstandens Oplysningsbureaus CDDIRECT (Købmandsstandens Oplysningsbureau 2001). Companies were selected based on the following criteria:

- Companies registered with a home address in the county of Ringkøbing Amt.
- Companies with 10 or more employees
- Companies that are privately own, excluding public institutions

The data in CDDIRECT contains listings on companies in Denmark identified by a unique number assigned by Købmandsstanden. For each company a number of key people can be listed. What people are actually listed depends on the type and size of the company and on how much information the company is willing to disclose. Large companies have more directors and a larger board of directors and managers listed and will in total tend to have more people listed.

Because the people listed in CDDIRECT are not uniquely identified, but listed only with their names, using this data also introduce a systematic error: two persons with the same name will be registered as one person possibly implying a relationship between two companies not related in fact. This means that the analysis will potentially show more relationships between companies than there really are. Relationships between people will not have this error since a number in the data uniquely identifies every company. Even companies with identical names will not produce errors in the relationships measured between people because the companies are uniquely identified.

Comparing data across different regions or segments in Denmark is considered to alleviate this problem since we must expect the name resemblance to be the same throughout Denmark.

Choice of boundary can also have an effect on what the network analysis will show. Probably the data on the county of Frederiksborg Amt below is an example of this because of its close proximity to the metropolis of Copenhagen.

Searching CDDIRECT using the criteria mentioned resulted in 1798 companies. From these companies all directors and registered functional managers i.e. CEO, sales director, finance director, logistics director as well as all board members were selected and exported to a plain text file. This resulted in 1798 companies and 5248 people indicating that each company listed in average 2.9 people in the database.

Analysing the Ringkøbing Amt data first

The .txt file from CDDIRECT was edited, adding the necessary DL codes to be loaded into UCINET (UCINET 1999 section 3.3). In this case the following text was inserted prior to the data: Since some companies do not list names for all positions, the double quotes that are not inclosing

```
DL
NC=5248
NR=1798
FORMAT=NODELIST2
LABLES EMBEDDED
data:
0000002171,"Poul Vester Pedersen","Jan Jensen","Kim Skov".....
0000004640,"Erik Børge Heller",.....
0000009050,"Lilian Jensen","Ib Gadekær Jensen",.....
0000009135,"Anker Sørensen",.....
0000009204…..
(data truncated for illustration only)
```

Figure 1: Input to UCINET

names must be deleted –in this case this was done using WORDPAD. Then the text file was saved and imported into UCINET using the following command: **Data>Import>DL..** The resulting dataset was named **ringamt1.##h**. Since we are only interested in knowing if a person is associated with a given company or not and since people can (and does indeed often) occupy more than one position within a company the data is dichotomised. This means that each company-person relation will be registered as a '1' in the data matrix of UCINET. Using the command: **Transform>Dichotomise** provide us with the new, dichotomised dataset: **ringamt1GT0.##h**. Because of the size of this dataset it is not shown here.

The **ringamt1GT0** dataset is an incidence dataset with companies as the rows and the people as columns. To get the corresponding company-company and person-person adjacency matrices we need to do some matrix algebra (Scott2000 p.45):

ringcomp=**ringamt1GT0** x **ringamt1GT0**^{T} i.e. 1798 x 1798 companies by companies matrix
ringpeople=**ringamt1GT0**^{T} x **ringamt1GT0** i.e. 5248 x 5248 people by people matrix

where **ringamt1GT0**^{T} is the **ringamt1GT0** matrix transposed (rows and columns interchanged).

In UCINET this is done through the following command: **Data>Transpose**, which provides us with the transposed matrix **ringamt1GT0**^{T}. Using the **Tools>Matrix Algebra**, we can now multiply the two matrices as indicated above. Now we have 2 new matrices **ringcomp** and **ringpeople**.

With the **Data>Export>Pajek>Network** these two datasets are then exported for further analysis in the program PAJEK[1]. Looking at the graphical representation of the **ringcomp** network in PAJEK provides this picture shown in Figure 2 (the 78 components of size>=2 are indicated with colours other than cyan. Thickness of the lines indicates how many people the companies have in common):

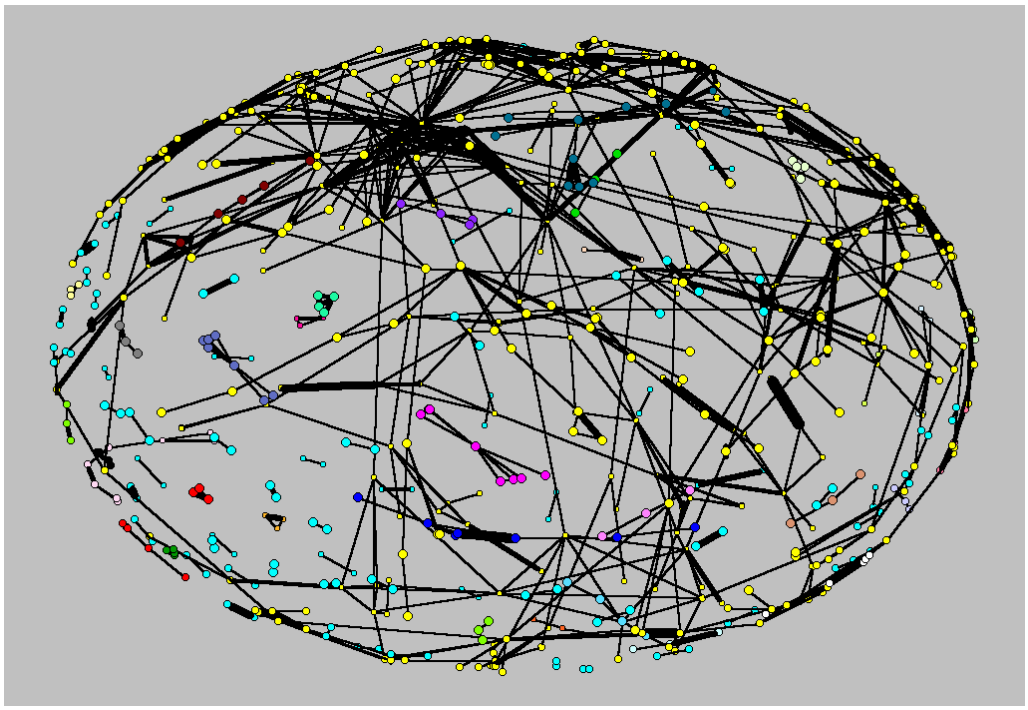

Figure 2: Ringkøbing Amt Companies

Because PAJEK can easily remove isolates it is possible to measure how many isolates there are in each dataset. On the basis of the number of isolates, inclusion and % of not connected nodes was calculated using an Excel spreadsheet. Also the maximum component size was counted using Excel on the UCINET output from the **network>region>components>simple graph** command.

In the following section we will go into more detail as to the specific findings of the analysis. But before this the results gave rise to additional data being analysed;

From Figure 2 it is evident that this is a very sparsely connected network (=low density) and the question of how this compared to other counties in Denmark quickly arose from looking at this picture. Subsequently the county of Frederiksborg Amt was investigated based on intuition or hunch as this county is located in a totally different region of Denmark but has a population of companies that is comparable to Ringkøbing Amt in terms of number of companies in the network.

The processing of the Frederiksborg Amt county followed exactly the same procedure as the one described for Ringkøbing Amt. The resulting graphical picture showed almost the same picture as the one shown for Ringkøbing Amt. Considering this result and a bit of speculation led to a hypothesis that maybe the "missing" relationships among companies in this network was due to

[1] PAJEK was chosen here over KRACKPLOT because it is better suited to handling networks with many nodes and it is a Windows application making it easier to use.

Frederiksborg Amt's close geographical location to Copenhagen. This could potentially sever many relationships if companies are connected so to speak across the county limits. And as a result of this hypothesis we decided to analyse a county comparable in the number of companies (to allow for comparisons between networks of different regions (Scott2000 p.74)) that could be considered isolated to the same degree as Ringkøbing Amt. The choice was Vestsjællands Amt although with slightly fewer companies (1354 compared to 1798 in Ringkøbing Amt). Finally we decided to look at the top 1700 companies in Denmark and their network (again to have a network of comparable size).

Using the analysis function of CDDIRECT shows that the size distributions of the three regional data samples are very similar. Clearly the Top1700 data contains the large companies only.

All in all this resulted in 4 initial datasets that were all processed and analysed in the same way.

Using UCINET, a number of network parameters were found for each of the initial datasets. Because the original question has to do with companies rather than people most attention has been given to the company-to-company adjacency matrices. The argument is further supported by a number of observations: The people-to-people matrices did not spawn any new research questions or ideas as they show very much the same type of structure as the company-to-company matrices. The density is higher than in the company network. An explanation for this is that each company typically lists a number of people in various positions so people will be linked to a large degree to other people within one company only. To find out if this is indeed the case, it is not directly possible to use UCINET's **Network>Subgroups>Cliques,** that shows the number of cliques as a measure of maximally complete components, because in larger components (size>3) there can be more than one clique invalidating this as a way of finding maximally completed components (Scott 2000 p.115).

The measure nWeakC in **Network>Ego networks>Density** will indicate the number of weak components in each actor's ego network. The more nodes that have more than one weak component in their ego network the less dense each of the components must be. However this is not directly applicable either since larger components will have more ego networks each of which can be more or less dense.

Information on the number of weak components and cliques within People ego networks can be found in Table 3and Table 4.

The same argument can be made for the Companies: companies that are in maximally connected components could be companies sharing a CEO or any other one person so we need to find out how many of the companies are connected in this way. Again this is done through the Clique measure. The results are shown in Table 5.

When it came to the Clique measures on People UCINET refused to show the entire output log. It was not determined whether this had anything to do with the size of the People datasets (each run took approximately ½ hour to complete), but the CliqueSets dataset was created. It was then possible to transpose this dataset and multiply it by itself to get a resulting matrix where the diagonal showed the number of actors in each clique.

This analysis is a very deductive type of approach. The initial research question is very broad so the inquiry itself will influence or even guide what direction the search goes. An example is the large 419 Company component we find in Ringkøbing Amt. The component is discovered using UCINET at the network level on all company data in the region. When we then see that 25% of the companies are in this one component curiosity is triggered; what is this component? What does it look like?

To answer some of these questions, the component is extracted with the **data>extract** using Component_Sets ROW 1 to extract only those actors that are in this component. This creates a new dataset that we named **company1.##h**. Using network>core/periphery>categorical reveals that this large component actually has a very dense core of 20 companies.

Size of datasets

Each set of data is approximately 210MB and e.g. the matrix multiplication takes about 2 hours on a powerful PC (Pentium III, 1.3 GHz, 256MB). In Top1700 there were more than 13 thousand people bringing the time for matrix multiplication up to 10 hours 26 minutes and the size of the dataset to 650MB! To speed thinks up, 3 PC were used simultaneously. In total, more than 2GB of disk capacity and more than 100 hours of CPU time was used in this last process alone. The clique measure on Top1700 People was actually cancelled after more than 72 hours of computing without completing.

Because of the large datasets the results of the analysis are shown in tabular form rather than presenting the voluminous outputs of UCINET directly. Even in the reduced form the datasets contain hundreds of rows and columns, which make them very difficult to print.

Findings

The following tables contain the findings of the analysis process described previously. Due to the size of the individual analysis, the data has been aggregated into the tables shown below.

In Table 3 we can see that the Top1700 datasets have a significantly higher density and inclusion compared to the regional data. The differences between the regional datasets are not very big and can be explained by the fact that the Vestsjællands Amt network is smaller thus showing a higher density (Scott 2000 p.74).

	Ringkøbing Amt	Frederiksborg Amt	Vestsjællands Amt	Top 1700
# of companies	1798	1731	1148	1700
# of people	5248	5596	3079	13121
Company density	0,0009	0,0005	0,0014	0,0039
Std.dev.	0,0382	0,0294	0,0485	0,0827
People density	0,0011	0,0010	0,0019	0,0010
Std.dev.	0,0342	0,0324	0,0448	0,0317
Company isolates	1113	1179	751	275
People isolates	308	273	255	25
Company inclusion	38.10%	31.89%	34.58%	83,82%
People inclusion	94.13%	95.12%	91.72%	99,81%
# of weak components in companies	1209	1320	807	301
# of weak components in people	938	1064	628	301
% of companies not connected	61.90%	68.11%	65.42%	16,11%
# of weak components >=2 in companies	96	141	56	26
# of weak components >=3 in companies	35	59	16	9
# of weak components >=4 in companies	16	30	8	1
Max. component size in companies	419	51	261	1367
Max. component size in people	93	206	1116	11030

Table 3: Summary of measures on datasets

Comparing the Ringkøbing Amt Companies in Figure 2 with Top1700 Companies in Figure 3 graphically illustrate the difference between the two. Note that isolate companies have been omitted from the graphics.

In Ringkøbing Amt almost a quarter of the companies are linked in one component and more than 38% of the companies are linked to other companies. The same is true in the county of Vestsjællands Amt while Frederiksborg Amt is considerably lower in terms of density and in terms of component sizes. As mentioned previously this can be related to the regions close proximity to the metropolis of Copenhagen. A part of the explanation for the higher density in Vestsjællands Amt could also be linked to the smaller network size (Scott 2000 p.74). Companies in Top1700 are 83% linked and the network density is 3 times that of Vestsjællands Amt.

	Ringkøbing Amt	Frederiksborg Amt	Vestsjællands Amt	Top 1700
# cliques (size>=3)	979	987	526	Not completed. Cancelled after 72 hours.
# cliques (size>=4)	749	757	405	
Max. clique size	21	19	9	

Table 4: People network measures

People cliques in a size around the number of people named for each company could be expected. The maximum number of people that can be listed for each company is 23. This means that the maximum clique size in Ringkøbing Amt People of 21 could actually be just one company. Indeed this is the most likely explanation for the People cliques where everybody is connected to everybody. The data indicate that the cliques do not expand beyond a single company. So the much larger People component (maximum People component in Ringkøbing Amt is 93) is not as tightly coupled as a clique.

Companies form cliques as well. But for Companies there are no inherent cliques in the data. The number of cliques listed in Table 5 is therefore a good measure of how close the companies' relations are and how many participate in such cliques. Like it was in the People case, Companies are related to one another in much larger components. For Ringkøbing Amt companies the largest component is 419. This is almost 25% of all the companies in the region.

	Ringkøbing Amt	**Frederiksborg Amt**	**Vestsjællands Amt**	**Top 1700**
# cliques (size>=3)	118	77	75	594
# cliques (size>=4)	58	24	30	297
Max. clique size	8	8	16	14

Table 5: Company network measures

The graphical output from PAJEK for Ringkøbing Amt companies in Figure 4 illustrates the large 419 company large component which is clearly visible with its yellow nodes.

In the Top1700 the density is even more pronounced:

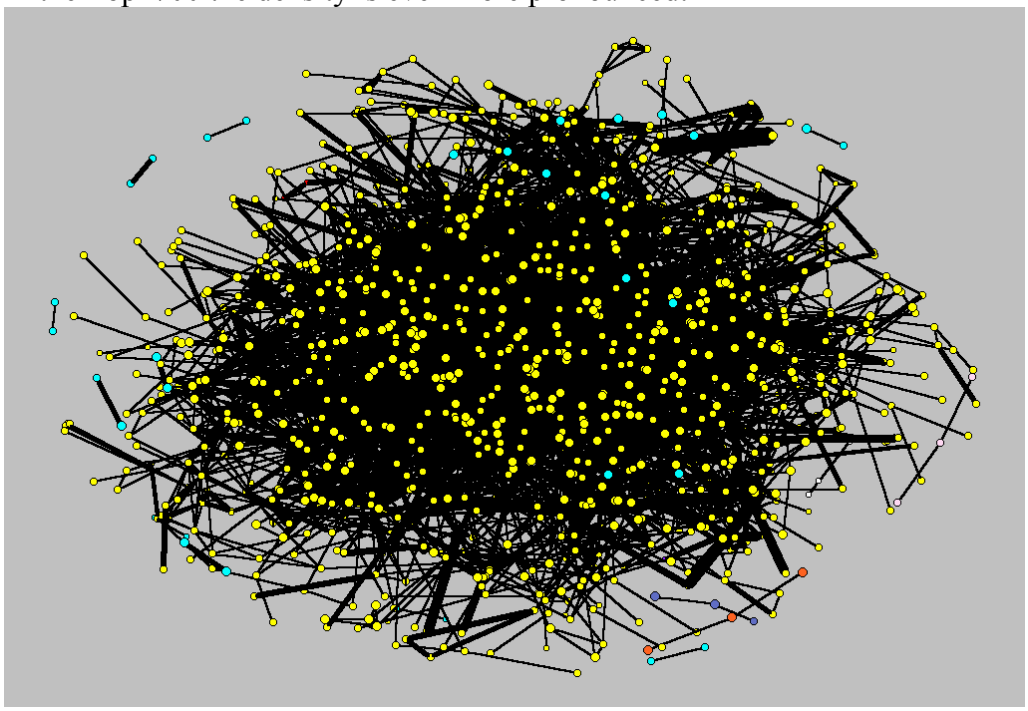

Figure 3: Top1700 Companies

In Top1700 the number of cliques among companies is much higher than in the other regions. Together with the higher density of this network, this strongly supports the idea that Top1700 companies are more likely to be related by interlocking directorships compared to the regional networks. However this could also simply be because the Top1700 are a more self-contained network with fewer outside relations that is severed in this analysis. Anyway it is important to note that there are no causal indications here. The Top1700 companies can be larger (more successful?) because they are more tightly related or they are tightly related because they are large. The data merely indicate a statistical correlation.

The 419 company large component in Ringkøbing Amt Companies was extracted to a new dataset, which was subsequently analysed for Core/Periphery. In Figure 6 in the Appendix part of the UCINIT listing is shown. 20 companies form a very dense core as indicated by the density matrix in Table 6

	Core	Periphery
Core	0,905	0,011
Periphery	0,011	0,012

Table 6: Density Matrix showing core/periphery

The table shows that the core companies have 90% of all possible relations between them and only 1,1% of possible connections to the periphery. As 18 of the companies also form a clique, one can hypothesise that the underlying cause could be that the companies share one (matrix shows mostly '1's) board member i.e. a professional board member.

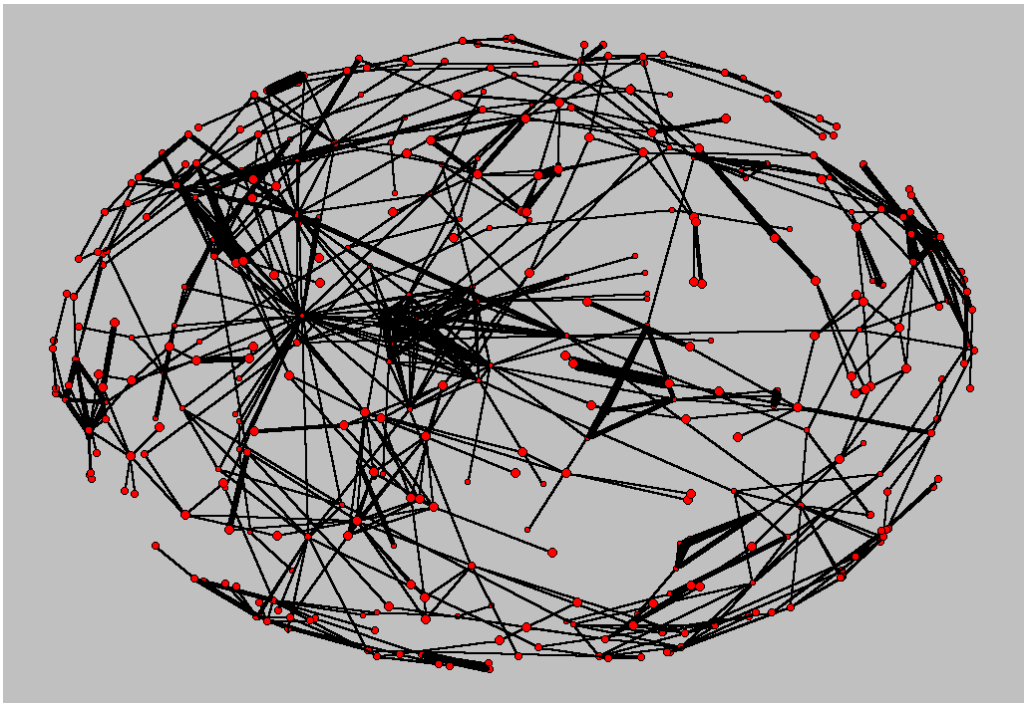

Figure 4: Ringkøbing 419 company component

Discussion of findings

The data clearly shows that interlocked directorships are indeed a widespread concept with regard to the companies we investigated. This applies to all the four sets of data analysed. Approximately 65% of the companies are connected to varying degree with other companies. However it is clear that the Top1700 companies have more relationships and that more companies are related to one another through this kind of connection than in e.g. Ringkøbing Amt. There are several possible explanations for this: one, the companies in Top1700 simply have more connections and/or two, companies segmented from a regional perspective have more connections going out of the region thus showing less dense networks within their respective regions. This could be an explanation for the Frederiksborg Amt; many of the relationships could be going to the Copenhagen region nearby, being severed in this analysis. And a third explanation could be that the companies in e.g. Ringkøbing Amt have family members in their boards to a larger degree than the very large companies.

The fact that the regional data show less dense networks than Top1700 could also be an indication that smaller companies are less interested in their boards. These companies then obtain their inspiration from other, less formal, sources. The extent to which the companies are connected within the network we analysed can also be thought of as a representation of how closed the networks are to the surroundings. If we assume a limited capacity for maintaining relationships, clearly the more relationships that are within the network boundary, the fewer relations there will be room for with the outside.

Top1700 companies list more people and this provide a people network with larger components and also show relationships between both companies and people of greater strength (i.e.: companies have more people in common or people are on more boards with the same people, illustrated by thicker lines in the graphical representations).

As mentioned earlier, however, this does not imply a causal relationship between large companies (e.g. the Top1700) and dense relationships as expressed here by interlocking directorships. But now we know more about how the companies are related to one another and our understanding has been enhanced.

Conclusions

This is indeed one of the ways in which companies are connected and probably this is a major source of inspiration and new information. On the other hand this is not necessarily only for the good of the companies: Close relationships with other companies can be a source of information, transfer of tacit knowledge between boards etc, but it can also be an evil in the sense that ideas and perceptions that are less effective becomes promoted at the expense of innovation. To find out if the structural characteristics uncovered here are of benefit to e.g. the county of Ringkøbing Amt requires further research into what companies are successful and how they are related to other companies within the network. Without performance measures this analysis cannot be done.

However it is interesting to note a few things: Ringkøbing Amt has proved to be one of the best performing counties in Denmark based on number of new jobs created and number of new venture start-ups according to government statistics from 2000. And in general small companies are thought to be more innovative and agile than large companies. At the same time our research shows that the network density of interlocking directorships is much lower in Ringkøbing compared to the very large companies. This could be seen as a confirmation of the contextual linkage to social capital

illustrated in Table 2. Companies in Ringkøbing are more entrepreneurial, working in more uncertain and changing contexts compared to the large companies and thus they also have much sparser network relationships consistent with the *brokerage* perspective being the most important. The large companies on the other hand are older, more stable and have higher network relationship densities consistent with the *closure* perspective.

Earlier studies of interlocking directorships clearly indicate that the more directorships a person holds the more additional directorships the person is likely to obtain in the future. In this light the news are not very positive for the directors in Ringkøbing: Compared to the directors of large companies they will probably not gain as many new directorships.

On the foundations of this research, however, such conclusions cannot be made and remains hypothesis and topics for further research.

The analysis indicates that other types of network relationships should be studied if one wants to understand especially the companies in Ringkøbing Amt, how they are linked and how this is related to social capital. Probably many of the links are informal and difficult to observe. To flush out more details, questionnaires and interviews could be used possibly even with a "snowball" technique, where one interview identifies and points to the next interviews and so on. An egocentric network approach could provide a deeper understanding of where and how the companies get their inspiration and information.

An obvious expansion of this analysis would be a more detailed analysis of what companies 'supply' board members to other companies using directional network analysis. Compared with e.g. the size, turnover or profitability of the companies this could give some indications as to whether the managers of larger, more successful companies are on the boards of smaller, less prosperous companies. Another aspect could be to include ownership structure to investigate whether this has an influence on the structure of interlocking directorships.

From the perspective of inter-firm relationships in general this type of analysis could also be employed in other multiplex company relationships such as buyer-seller relationships or joint development programs etc.

Appendix

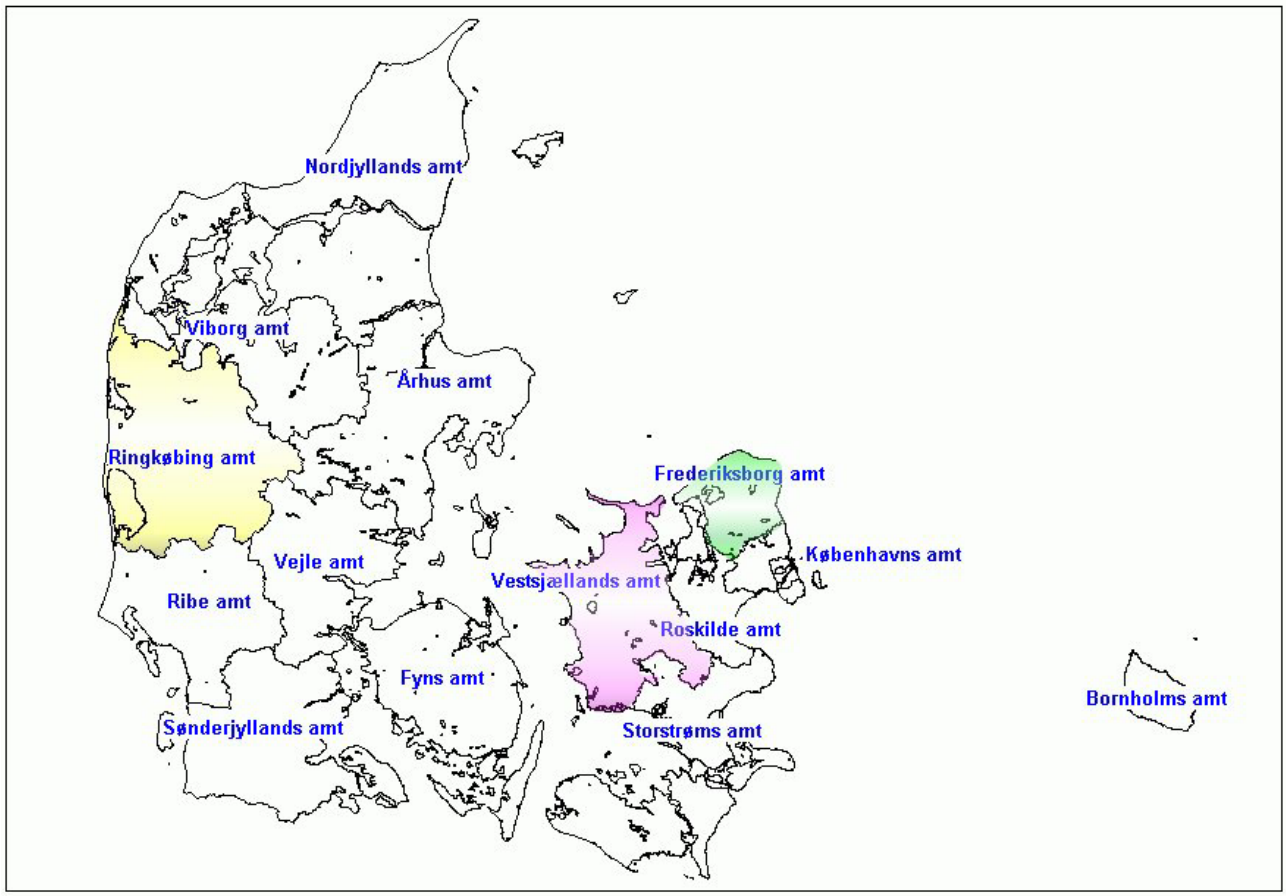

Figure 5: Map of Denmark showing the 3 counties studied

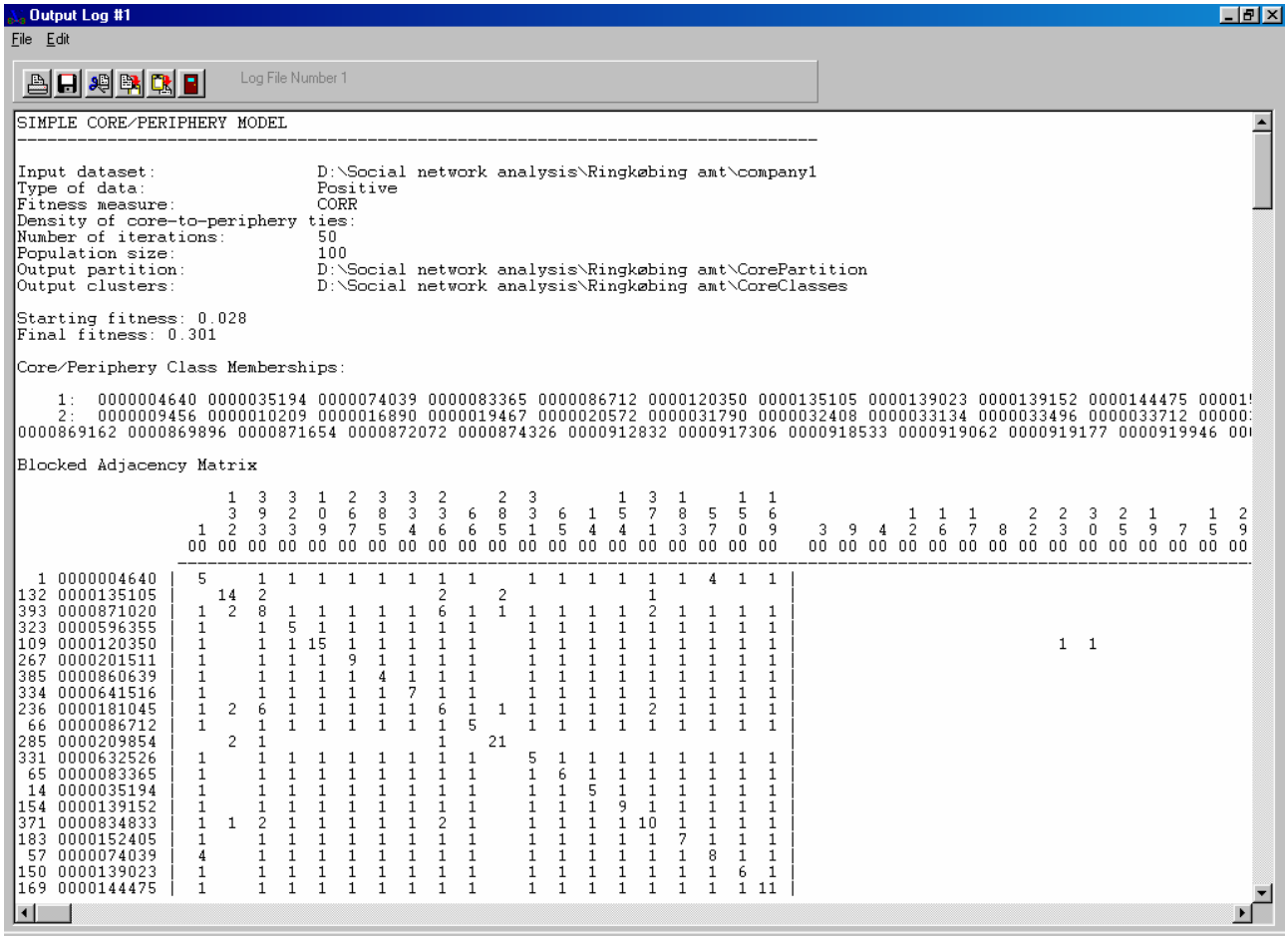

Figure 6: Core/Periphery for 419 Company component in Ringkøbing (UCINET output fragment)

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