

# HSE Implications of Industrial Networks

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**Abstract:** The purpose of this paper is to investigate how industrial networks (boundless organizations) with many different actors can affect work conditions and safety. Collaboration between many companies implies different organizational cultures with different work procedures, routines and company philosophy. By industrial networks we refer to relations between companies, either companies that are competitors in the same market or companies buying products or services from one or several suppliers. Outsourcing is one example on the latter. Most companies used to be self supplied by the support services such as the cleaning, maintenance and economy function, but from the 1990ies many companies started to hire such services from external companies. .

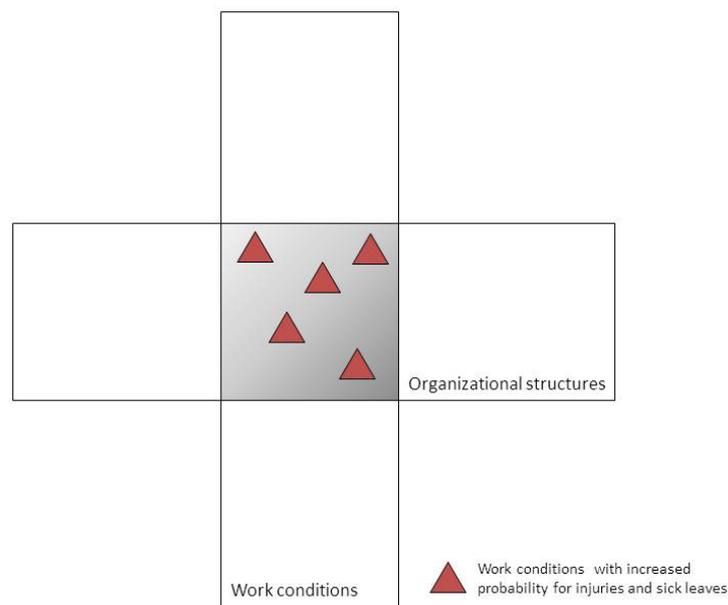
To explore on how industrial networks affect HSE conditions, we discuss findings from a case study conducted within cleaning and construction. Companies working together in industrial networks may have different agendas, goals and interests based on different tasks and responsibilities, and if not well managed they tend to sub-optimize to reach their own goals. We will also explore on how differences in work conditions among the actors in the network, such as terms of contract, regulations and management style, affect HSE conditions. The main focus will be on work conditions and especially work conditions with an increased probability for injuries and sickness absence.

**Keywords:** Work conditions, organisation structure, HSE, Sickness absence

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## 1. INTRODUCTION

The main focus in this paper is the relation between work conditions and organizational structure, as illustrated in Figure 1. There can be a difference between the organisation employees relate to in their daily work and the formal line organisation in which they are employed. Some work conditions may give increased probability for injuries and sickness absence. These conditions are indicated with red triangles in Figure 1 (signs of danger). We will focus on work conditions given by organizational structures such as industrial networks and especially contractor hierarchies and outsourcing.



**Figure 1. Relations between work conditions and organisational structures**

In this paper we give a theoretical background for industrial networks and how organisations can be studied from a network perspective. Thereafter we give an introduction to work conditions and especially work conditions with implications on the psychosocial work environment and the impact on sickness absence.

We present a case study and discuss the results from this with respect to work conditions and organizational structures. The paper concludes with the main findings from this discussion.

## 2. ORGANIZATIONAL STRUCTURES AND INDUSTRIAL NETWORKS

### Studying organizations from a network perspective

More and more organizations are being described as networks – from large multinationals to small entrepreneurial firms (Nohria & Eccles 1992). Typically, the term “network” is used to describe the observed patterns of organizations and to advocate what organizations must become if they are to be *competitive* in today’s business environment. Established firms are trying to restructure their internal organization along the line of networks. They are also trying to redefine their relations with vendors, customers and competitors. They are seeking more collaborative relations that will bind them together into a network. Through a network perspective one can analyze and explore organizations (Nohria & Eccles 1992):

- What explain the differences in the power and influence of individuals in organizations?
- What explains the effort to create a new organization or to mobilize change in an existing organization?
- What explains the choice to enter into strategic alliances?
- What distinguish the organizational characteristics of the so-called “new competition” from the old (hierarchical firms)?

Actors in a network have social as well as economic motives and their actions are influenced by the networks of relationships in which they are embedded (Granovetter 1992). Burt (1982) emphasizes the rational, utility-maximizing side of the actors. Others, such as Di Maggio (1992) emphasize the everyday practical considerations that shape the actions of actors. The practical actor approach views rationality as only one, and emphasizes affiliative ties among actors.

Two dialectical processes in networks are competition and cooperation according to Håkansson and Ford (2002). The picture of relationships provided by the network approach emphasizes cooperation, complementary and coordination. Firms buying and selling from one another have to have a minimal level of cooperation in order to complete even a single exchange. In practice, the existence of strong bonding demonstrates a high level of cooperation. Even those first judged as market competitors by traditional standards, being indirectly linked through customers, may find themselves cooperating in order, for example, to develop new products as a benefit for the network as a whole. Network control is not evenly distributed over the actors in a network. The efforts of the actors to increase control affect the control of other actors. Increased control of one actor is always achieved at the expense of the control of at least one other actor. Thus, in a network, there are a number of conflicting and common interests as well as efforts to provide for those interests. In this struggle the actors use their knowledge of the network as well as their relationships with other actors in order to increase their control. On the basis of control of activities and resources there are important power relations between the actors. The performance of the activities is to some extent organized on the basis of those power relations.

Relations between companies can be divided into four main groups according to Bø and Schieflo (2007).

- Network of suppliers around one core company
- Model of outsourcing, limited to support functions as cleaning, IT support and handling of goods.
- Production alliances, several companies cooperating on a common delivery
- Virtual organisations, looking like one organisations from the outside, acting as many organisations on the inside, cooperation through virtual communication

## **Outsourcing**

Increased use of outsourcing strategies is one of the heaviest trends in Western working life for the last two decades. Whereas major companies were previously self-sufficient with regard to support functions such as cleaning, maintenance, accounting and finances etc. these functions are now commonly outsourced to specialized companies. Moreover, this trend has continued to an extent that it is no longer only ancillary services that are outsourced, but also functions that are more or less integrated in the company's core activities. This has significantly changed working life in Western countries (Forseth & Rasmussen, 2002; Birindelli et al., 2007, Wikman, 2000).

Cost-cutting is usually a key motif in the decision to outsource services and functions (Heywood, 2001). Despite this, the literature on outsourcing rarely discusses the potentially adverse effects. It is conceivable that the employees are the ones paying the price for the companies' cost-cutting, in the form of a more demanding work situation. This is particularly relevant when work is outsourced at several levels, forming chains of sub-contractors.

Outsourced functions can be taken care of by a separate company, and they may form an industrial network like a contractor hierarchy. The other option is to use resources from a recruitment agency to replace the outsourced resources. This will mainly be the case for professions that are easily exchangeable like cleaners and other operational personnel. The use of hiring personnel will represent another type of industrial network with other work conditions than with use of a separate company to replace the outsourced functionality.

There is some research indicating that this way of organizing work has negative consequences for the work situations for those at the bottom of the sub-contracting hierarchy, such as lack of control and influence (Mayhew et al. 1997; Collinson 1999; Mayhew & Quinlan 2001; Clarke 2003; Johnstone, et al. 2005; Di Nunzio et al., 2009). However, there is still a great need for research into this topic.

Not all contractor hierarchies consist of functions that have previously been insured. In the oil and gas industry especially in drilling and well operations, functions have always been taken care of by specialists and supplier companies. These are expert in their field such as mud loggers and drilling super-intendants. The work conditions within these types of contractor hierarchies may be quite different and better even on the lower level than the work conditions in a contractor hierarchy where we find easily replaceable personnel on the lower levels. It is reason to believe that the work conditions for hiring experts are different to the work conditions for other type of personnel. Even if they are not socially integrated on the work place they have another status and it is reason to believe that they have better work conditions.

### **3. WORK CONDITIONS AND HSE IMPLICATIONS**

In this paper we are using the terms, HSE (Health, Safety, Environment) and sickness absence. It is required to draw the lines and define the relations between these terms. Health, Safety and Environment (HSE) is a diverse and complex concept. "Safety" covers occupational accidents as well as major accidents, and "environment" covers both the external environment, such as pollution, and the working environment. The consequences for an occupational accident can be severe, but it will never develop into a catastrophic event. Major accidents cover events such as fire, explosions, large gas leaks and blowouts. Events and conditions related to the type of work and the workplace can end up with sickness absence.

Some work conditions will have implications on the probability for major accidents, while others will have implications on the risk of occupational accidents or working environment. Some aspects can affect all three. The measure used for the healthiness of the workplace in this paper is the sickness absenteeism. Not all sickness absence is caused by the working conditions. The part of the sickness absence which can be blamed on the workplace conditions are often a mixture between psychosocial stress and wear caused by physical strain. Occupational accidents will have a more direct cause consequence relation. In comparison studies sickness absence can be used to give an indication of non healthy work conditions.

Marklund et al. (2008) explore the role of organizational characteristics of workplaces for different individual health outcomes. The aim of the study was to look at differences in relative effect of workplace variations on five health outcomes, and to explain those differences in health outcomes by organizational characteristics. The results showed that a significant proportion of the variance in sickness absence, work ability, general health, and musculoskeletal disorders was attributed to the workplace.”

Psychosocial work environment includes the employees' experience and interpretation of their surroundings. Here, much research has focused on psychological job demands, the experience of control over their own work tasks, and experience of social relations in the workplace. Some of this research can best be described as a sociological direction, focusing on properties on the context, in the sense of workplace and work environment (e.g. Arvak et al., 1980; Johansen & Svarva, 1981; Kaul, 1982; Brandth, 1983, 1985; Nytrø 1995; Forseth, 2000, 2003). Other parts of this special field have a more psychological orientation that puts the individual at the centre (see e.g. Chan & Huak, 2004; Garcia et al., 2004; Savinainen et al., 2004). The assumption in both of these approaches is, however, that the experience of control or reciprocity in social relations in work plays a crucial role in the experience of stress and health consequences of the work. There is a lot of research that suggests that these factors are associated with adverse health effects such as muscle and skeletal problems, mental illness, cardiovascular disorders and increased sickness absence among employees (Bongers et al., 2006; Davis et al., 2000; deJonge et al., 2000; Head et al., 2007; Peter & Siegrist, 1999; Schnall, et al., 1994).

These factors have also been examined through the framework of the Demands-Control-Support model (D-C-S) and through the Effort-Reward-Imbalance (ERI) (Hammer et al., 2004; Johnson & Hall, 1988; Karasek & Theorell, 1990; Karasek, 1979; Siegrist & Peter, 1996). In this model, the combination between the (high) demand, (low) control and (low) support seems to be the cause of stress and increased risk of disease (Morrison et al., 2003; Tsutsumi & Kawakami, 2004). Although there are mixed results with respect to the test of the entire model (Beehr et al., 2001; Bishop et al., 2003), there is little doubt that the dimensions that are rolled up into the model is central to understanding the sick leave.

Industrial networks based on outsourcing will give implications for the work conditions. According to Mayhew, C., Quinlan, M. and Bennet, L. (1996), work conducted by sub-suppliers is often routinized, requires little autonomy and offers limited opportunities for vertical mobility. This has the potential to lead to poor job satisfaction and subsequent ill-health. Workplace disorganization can lead to ambiguity in task definitions, unclear relationships between different groups of workers at a workplace. Subcontractors may have less experience with the overall workplace and for subcontractors often have more serious injuries and fatalities.

According to Liukkonen et al. (2004) there is a relationship between social capital and health. Social capital is the sum of the resources a person has access through its network of relationships with other actors. Extends the "traditional" focus on social support to also include the source of power / resources the social environment can provide. They even find a link between security in employment and confidence collegial support on the one hand and self-reported health status and psychological "distress" on the other. Being among the hired personnel is associated with more stress and poorer health.

Mustard et al. (2003) ask the question if position in the occupational hierarchy a determinant of decline in perceived health status and the hypothesis is that persons in low-status jobs will often experience negative changes in self-reported health, and this will be related to differences in psychosocial working environment and health behavior. This is based on research that shows the relationship between socioeconomic status and health. Occupation hierarchy is divided into occupational type (eg self-employed, middle manager, unskilled manual labor, etc.). Found a correlation between the location of the job hierarchy and the health of men, not women.

#### **4. CASE STUDY AND METHODS**

##### **HSE and sickness absence in contractor hierarchies**

This research project studies work conditions with implication on sickness absence within four different industries; the oil and gas industry, the construction industry, cleaning and health care. Statistical analysis are conducted for sickness absence for specific professions within these four industries, a large survey is used to analyze the work conditions related to contractor hierarchies and a qualitative study conducting around 80 interviews, are used in the case studies. These industries are quite different when it comes to the use of outsourcing and contractor hierarchies.

For the purpose of this paper the qualitative case studies from the cleaning industry and the construction industry will be used. Some reference will be given to preliminary results from statistical analysis on sickness absence for cleaners and carpenters. **Foreslår at vi beskriver registerdata som metode. Hvilke data er det vi har og bruker i diskusjonen?**

### **Case 1: Construction**

We have studied the work within construction at a large construction site; the building of a new school (upper secondary school). When we did the interviews the building period had lasted for approximately one year, and should be finished within three months. So, it was a busy period at the construction site - with workers from 12 companies present, and there were many nationalities present; from Poland, Sweden, Latvia and Norway. In the construction case we have totally interviewed 21 persons; Leaders and construction workers within different disciplines (carpenter, ventilation, concreter) at the building site, where all levels in the contractor hierarchy was covered; interviews with total entrepreneur – contractors – and sub-contractors. We have also been present at meetings and HSE inspections at the construction site, and have thus studied the collaboration and coordination across companies and disciplines. In the interviews we asked about tasks/responsibilities, work conditions, work environment and safety/health issues.

### **Case 2: Cleaning**

Cleaning is a business/activity that is frequently being outsourced in Norway. Large and small cleaning companies are established and this is a growing trend. We have studied the work of cleaners employed in a large cleaning company in Norway that sell cleaning services/personnel to different companies. The cleaners we have interviewed did their job in banks and shopping centers and in smaller firms. In the interviews we focused on cleaners' work tasks and work conditions; how they were integrated in the company that they were working in, and how they influenced or controlled their own work situation, and we also looked upon social support and leadership. In the cleaning case we have interviewed cleaners and their team leaders.

## **5. DISCUSSION**

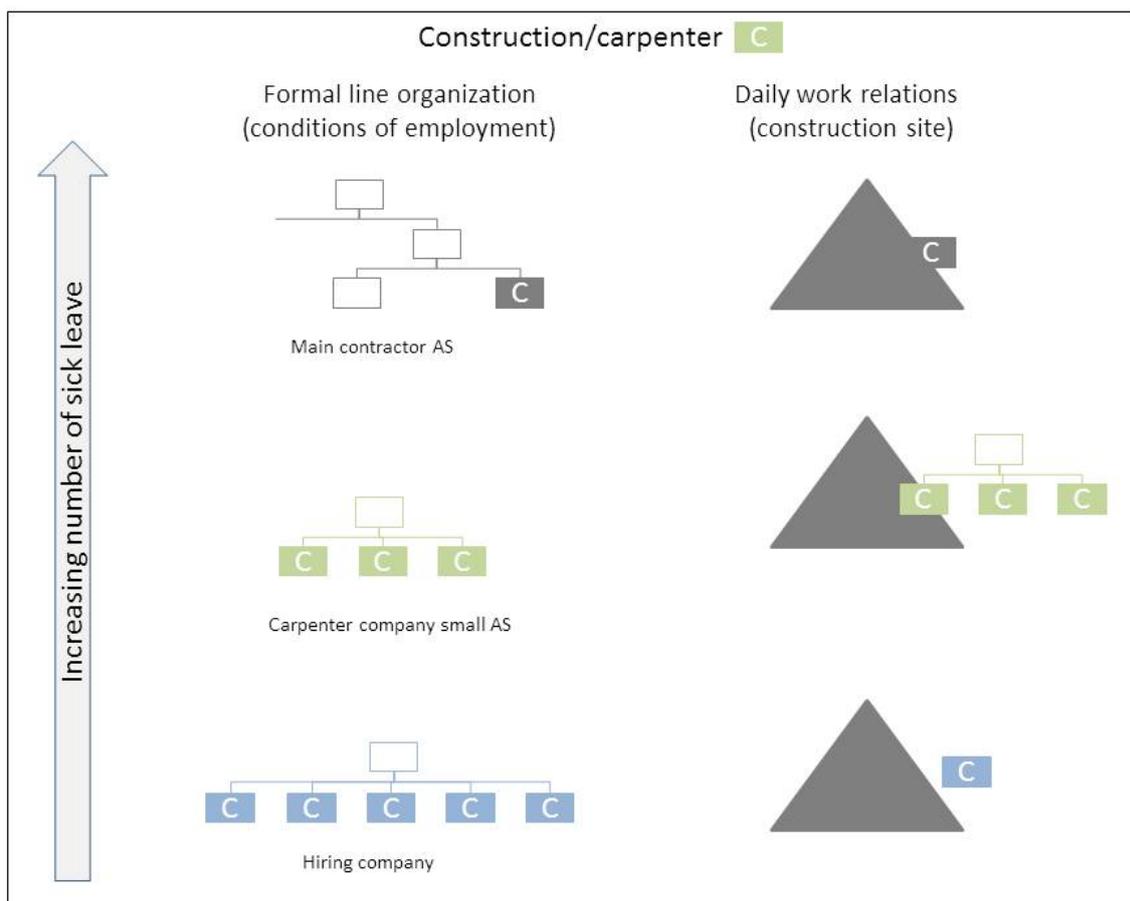
### **5.1 Formal line organization vs. daily work relations**

Outsourcing and network organizations represent a fundamental change in the organization of work. This involves among others that employees work outside their own line organizations. Here, we discuss the consequences of this work situation. The daily work relations at the workplace where one work may be more relevant for work conditions than the formal line organisation. For some employees and professions, the daily work relations are the same as the line organisation, but for others their daily work relations are quite different from the formal line organisation. Cleaners employed in a cleaning company will in their daily work life, relate to personnel employed in the companies where they are doing their cleaning jobs. Their working conditions will differ if they are performing their job in one single location or in many different locations during their working day or week. They may not be in daily contact with their line management and as we will discuss later, their relations with their customer will affect their working conditions. Carpenters employed in a large construction company may have their daily work life on a construction site where they will relate to a different organisation. The organization on the construction site may last for a few weeks up to several months depending on the size of the building project.

### **5.2 Organizational structure and work conditions within construction**

Figure 2 illustrates different organisations for carpenters. The daily work relations are in this case are a construction site and this organisation is represented by the grey triangle in the figure. In the upper row the carpenter is employed by a total entrepreneur and the total entrepreneur held most of the organisation on the construction site. In his daily work life the carpenter relates to colleagues from his own company and the other companies represented on the construction site, but not to his own line management. The second row represents an outsourcing of the carpentry from the total entrepreneur. The carpenters are employed in a small carpenter company. On the construction site the entire small carpentry company is represented and the carpenter is working together with his colleagues as well as with his line manager. In the third row the carpentry work are outsourced to a hiring company and the carpenter are hired to the construction site, sometimes together with colleagues from the same recruitment agency but not together with their line management. In this category we will find most of the carpenters of other nationalities such as poles. The arrow to the left in Figure 2 indicates the statistics for sickness absence for carpenters in different types of organisations. As will be discussed in more details, the sickness absence are lower for a carpenter employed in a small carpentry company than one employed in a total entrepreneur, and it is even lower for carpenters employed in a recruitment agency.

The carpenter profession is dominated by male workers and the average age is quite low. This is a hard physical work and workers may have to quit this profession in young age because of back pain and other muscle and skeletal problems. **Beskriv kilden** In the general statistics men have lower sickness absence than women and younger people have lower sickness absence than older workforce. Carpenters should, based on this have lower statistics than the average work crew.



**Figure 2 Formal line organisation vs. daily work conditions within construction**

As indicated in the figure the carpenter is on the "lowest level" in the hierarchy in the total entrepreneur organisation. Based on the findings from the case study, we found that the carpenters at the building site are well integrated, the carpenters are likewise important to the others operational personnel on the construction

site and all have important roles for the work to be performed in time. This is indicated by the placement of the carpenter on the right side and in the first row in the figure (as integrated in the grey figure). The carpenters relate to the construction site managers, but are rarely in contact with their own line manager, which may have implications of their feeling of support on the work place. Carpenters have an important role in the organisation but can only to a certain degree control their work tasks and their work day. The findings from the case study indicated that the carpenters felt threatened by the company's decision of outsourcing the carpenter competence. This seemed to be very negative and they responded by using the possibility to take sickness leaves as a protest to this development. This can probably not explain the higher **Få tydeligere frem at det er resultatene fra registerdatanalsen.** statistics in sickness absence for carpenters employed in large total entrepreneur companies, more likely it is explained by their lack of support and too little control of their work activity.

The statistics for sickness absence is lower for carpenters employed in smaller carpenter companies than in a total entrepreneur company. One explanation may be that they experience a closer support from their line management in their daily work life. As indicated in the figure, they are well integrated in the organisation on the construction site. It may be that this integration mainly is represented by their line management being present on the construction site, but their daily support on the workplace is with no doubt positive for the experience of support and well being on the workplace. Carpenters employed in small companies also do other carpentry work, house building and other smaller jobs. It is reason to believe that they in these work situations have more control of their own work situation and that this affects the lower statistics for sickness absence for this category of carpenters. The company will depend on each of the carpenter employed and will be affected by sick leaves among their workers.

When it comes to the carpenters hired from temporary staff recruitment agencies, their statistics on sickness absence is far lower than for the other categories of employment. As indicated in Figure 2 these employees are less integrated in the workplace organisation and this is especially true for the foreign employees that do not speak the language. Most of them has come to Norway to earn money and will work as many hours as they are allowed to. One other aspect is that they do not necessarily have good arrangement for sickness absence (paid sick leave). It is no reason to believe that their work conditions on the construction site are better than the other carpenters. Through the case study we have heard stories about how foreign carpenters are doing their job more cumbersome because the Norwegian carpenters influence on what they should do and how at the building site. The challenge is that the foreign carpenters and the Norwegian carpenter do not work as a team, and thus the work is not performed as smooth as it should/could be.

As described by Heywood (2001), cost-cutting is usually a key motif in the decision to outsource services and functions. The reasons for outsourcing the carpentry work can be diverse. One reason given by the total entrepreneur in our case study was that this gives a better possibility for use of sanctions. If these sub-suppliers do not deliver at time, they can be charged for extra days. This may give worse work conditions for the carpenter especially if the contracts are exposed to cost competition. When the carpentry work is taken care of by own personnel, the management don't not have the same possibility for sanctions if the carpenters don't deliver. The statistics for sickness absence do however, not reflect these conditions.

According to Mayhew et al. (1996) workplace disorganization can lead to ambiguity in task definitions, unclear relationships between different groups of workers at a workplace. Subcontractors may have less experience with the overall workplace and for subcontractors often have more serious injuries and fatalities. Roles and responsibilities needs to be clear and from the case study on the construction site this seems to be essential especially on a work place with many activities taking place at the same time and with many different professions and different companies present.

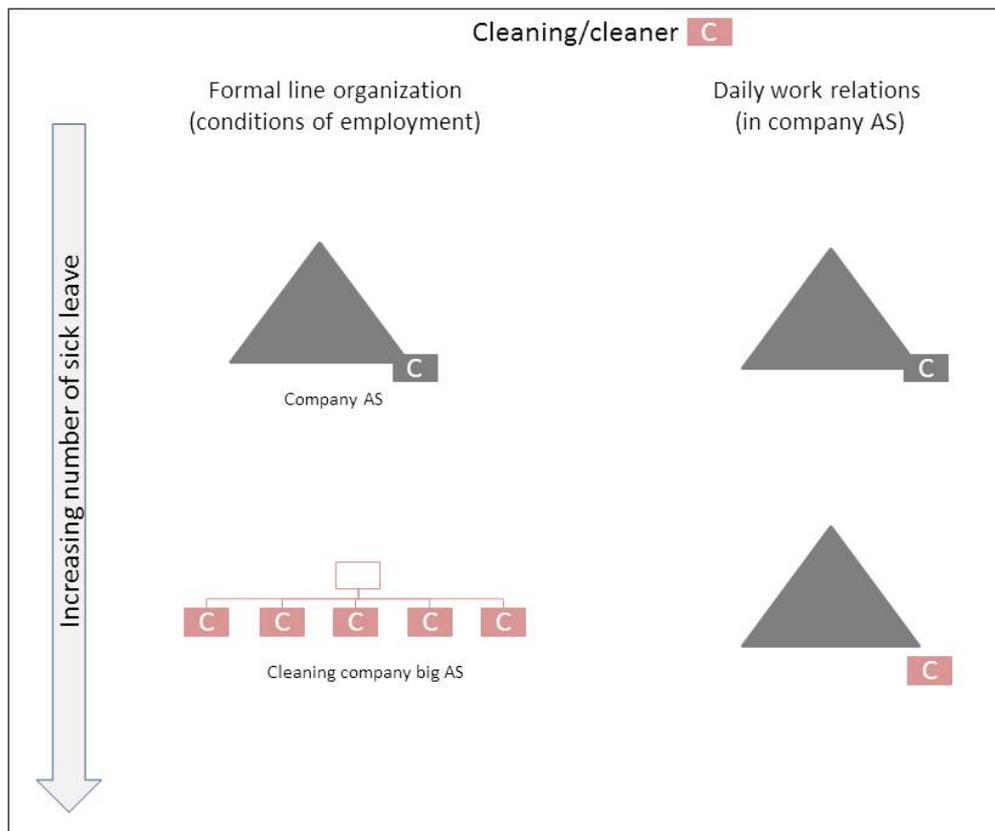
### **5.3 Organizational structure and work conditions in cleaning**

Cleaning is one of the functions that are frequently outsourced. Large and small cleaning companies are established and this is a growing trend. We know that this has lead to a professionalization of the business, it has become usual to have certificate as a cleaner and their equipment has become more technical and modern. It could be anticipated that this would improve the status for the cleaners and give a better work environment and consequently result in lower statistics for sickness absence, but the reality is the opposite.

The daily work relations for the cleaners are probably, and in line with what we have discussed in this paper, more important for the individuals when it comes to work environment and healthiness on the work place.

Figure 3 illustrates different organisation structures for cleaners. The daily work relations in this case are a company of any kind (except for a cleaning company), denoted as "company AS" and represented by the grey triangle in the figure. In the first row the company has kept the cleaning function in-house. The cleaners have the same daily work relations as their formal line organisation. In the second row the company has outsourced the cleaning function; the cleaner is employed in a cleaning company. The "company AS" have a contract for cleaning with the cleaning company and the daily work relations for the cleaner are other personnel in the "company AS". The arrow in the left side of Figure 3 indicates the sickness absence for the cleaners, which seems to be significant higher for a cleaner in a cleaning company than for a cleaner in employed in another type of company having kept the cleaning function in-house. Not showing in the figure is that the sickness absence for cleaners in large cleaning companies seems to be higher than for cleaners employed in smaller cleaning companies.

Cleaning is a trade employed by women and the average age is quite high. In the big cleaning companies men are more represented and the average age is lower. As men and younger work force are lower represented on the statistics of sickness absence in general, this can not explain the variation in statistics illustrated in the figure.



**Figure 3 Formal line organisation vs. daily work relations for a cleaner**

As indicated in Figure 3 the cleaners are in the lower part of the hierarchy in the organisation. But, depending on the size of the company and their traditions, the cleaners can be well integrated in the organisation. From the case study we have heard stories of how they feel to be a part and play an important role in the organisation, taking part in social events such as Christmas parties. The feeling of social support may than be rather good and they feel social integrated. It is also reasons to believe that they can control their work activity and this is important for healthiness in the work place.

From the case study we heard that the daily work conditions may vary a lot for cleaners. Some of the big cleaning companies have long term contracts with companies and the same cleaner may be dedicated to the same work place for a long time. They are in the lowest part of the organisation hierarchy and they will rarely be involved in the social life at the work place. We have heard stories of how the cleaners are invisible on the work place, other personnel do not see them and do not even say hello. In addition, the cleaning are often arranged to be done outside working hours for others, meaning inconvenient working hours and the cleaners are literally invisible for the other work force. Some times they work partly early in the morning and late in the evening, with the inconvenient this lead to for their personnel life and stress level. Other cleaners tell stories of how they are integrated on the work place, being invited to the social events and so on, but unfortunately this seems to be rare.

As we have discussed before, cost-cutting is usually a key motif in the decision to outsource services and functions (Heywood 2001). Despite this, the literature on outsourcing rarely discusses the potentially adverse effects. It is conceivable that the employees are the ones paying the price for the companies' cost-cutting, in the form of a more demanding work situation. The work environment for the cleaners is influenced by the type of contract their company has for the cleaning job. The contract is exposed to cost competition and they report a higher demand on effectiveness. This affects especially the larger cleaning companies, negotiating about large contracts. The recruitment agency option could have been included in the discussion for cleaners as we did it for the carpenters, but due to lack of statistics for this group we have left them out.

## 6 CONCLUSIONS

One assumption we made in this paper was that organizing work in contractor hierarchies and outsourcing has negative consequences for the work situations for those at the bottom of the sub-contracting hierarchy, such as lack of control and influence. (Mayhew et al. 1997; Collinson 1999; Mayhew & Quinlan 2001; Clarke 2003; Johnstone, et al. 2005; Di Nunzio et al., 2009). Using sickness absence as an indicator does not support this assumption when it comes to carpenters. The sick leave statistics for carpenters are lowest for carpenters in recruitment agencies and it is lower for carpenters employed in smaller companies than in bigger companies. We have discussed how outsourcing of carpenters and the conditions they have in the smaller carpentry companies enhances their social support and improves their influence on the work place. The low sick leave statistics for carpenters in recruitment agencies do not tell us anything about their work conditions but more about the frame conditions such as social rights and paid sick leaves.

The assumption above seems to be supported by the statistics for sick leave and also from the qualitative study concerning the cleaners. Status gained through certificates is of no use as long as the cleaners experience that they are invisible on the work place. In addition they experience a high demand for efficiency through contracts exposed to cost competition. As we have described in this paper, both cleaners and carpenters can be placed at the lower level of the organizational hierarchy but the carpenters are much more integrated with the other roles at the work place. We have discussed that the daily work relations are more important than the formal line organisation. Social support by line manager or other work relations are essential in daily work life. Smaller companies seem to provide better social support than larger companies.

## Acknowledgements

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Kaul 1982

Brandth 1983, 1985

Nytrø 1995

Forseth 2000, 2003

Chan and Huak 2004

Garcia et al 2004

Savinainen et al 2004

Bongers et al 2006

Davis et al 2000

De Jonge et al 2000

Head et al 2007

Peter and Siegrist 1999

Schnall et al 1994

Hammer et al 2004

Johnson and Hall 1988

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Karasek 1979

Siegrist and Peter 1996

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Mayhew, Quinland, Bennet 1996