Occupational Health Services Professionals; skills, needs and experiences shared in a learning network

Co-operative inquiry performed in the manufacturing sector

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Abstract

Work environment conditions can influence individuals, organisations as well as society, and economic consequences can be extensive. The employer is responsible for the work environment, but must engage Occupational Health Services (OHS) or similar if the own competence is not sufficient. Consequently, the professional skills of OHS providers is an important topic, as the services delivered are aimed at contributing to a good work environment. However, research in this area was scant and there was a call for illumination of what professional skills are needed within OHS. There was also a need to find arenas for knowledge development and sharing within and between occupational safety and health (OS&H) professionals and researchers.

One aim of this thesis was to gain a deeper knowledge and understanding about professional skills when it comes to OS&H engineers and ergonomists working within the manufacturing sector. A second aim was to gain experiences of using co-operative inquiry in a learning network for OS&H professionals in order to develop professional skills. The thesis is based on three papers, all with a qualitative research approach. The co-operative inquiry method was used to run a learning network for the research. This network consisted of ten OS&H professionals (engineers and ergonomists) employed at in-house as well as external providers of OHS for manufacturing companies, and two researchers. Everyone in the network acted as co-researchers in accordance with the intention of co-operative inquiry. The dialogues at the meetings were analysed with thematic analysis, using six socio-technical elements as themes.

The results showed that the OS&H engineers and ergonomists in the network wanted to work more preventively in the future. To achieve this, they expressed needs for both theoretically based arguments and communication skills to convince clients about the benefits with this approach. Research based knowledge, practical experience and good examples were shared and reflected on with the purpose of integrating the new knowledge into daily practice. The dialogues at the meetings dealt mainly with topics at an organisation level rather than details and individual level. The dialogues focused on e.g. co-operation in teams within the OHS firms and with different stakeholders at the client companies, integration of OS&H management into existing processes, participation from early stages in design and change processes, the use of risk assessment tools and, finally, communication skills.

The co-operative inquiry method was suitable, as the network functioned as an arena for reflective learning.

Keywords: Occupational Safety and Health, Work Environment, Ergonomics, Ergonomists, Occupational Safety and Health Engineers

Sammanfattning

Arbetsmiljöförhållanden kan påverka individer, organisationer såväl som samhälle och de ekonomiska konsekvenserna kan bli omfattande. Arbetsgivaren är ansvarig för arbetsmiljön men ska anlita företagshälsovård (FHV) eller motsvarande om den egna kompetensen inte är tillräcklig. Därför är yrkeskompetens för professionerna inom FHV ett viktigt ämne eftersom de tjänster som levereras syftar till att bidra till en bra arbetsmiljö. Det fanns dock inte mycket forskning inom detta område och det fanns ett behov av att belysa vilken yrkeskompetens som behövs inom FHV. Det fanns också behov av att hitta arenor för kunskapsutveckling och kunskapsspridning inom och mellan professioner som arbetar med FHV samt forskare.

Ett syfte med denna avhandling var att få en djupare kunskap och förståelse om yrkeskompetens gällande arbetsmiljöingenjörer och ergonomer som arbetar med FHV inom tillverkningssektorn. Ett annat syfte var att få erfarenheter av att använda metoden co-operative inquiry i ett lärande nätverk för FHV-professioner för att utveckla yrkeskompetens. Avhandlingen är baserad på två konferensbidrag och en artikel, alla med kvalitativ inriktning. I forskningen användes metoden co-operative inquiry för att driva ett lärande nätverk. Detta nätverk bestod av sammanlagt tio arbetsmiljöingenjörer och ergonomer anställda inom intern och extern FHV för tillverkningsföretag samt två forskare. Alla i nätverket agerade som medforskare i enlighet med metoden co-operative inquiry. Dialogerna på nätverksmötena analyserades med hjälp av tematisk analys där sex socio-tekniska element användes som teman.

Resultaten visade att nätverkets arbetsmiljöingenjörer och ergonomer ville arbeta mer förebyggande i framtiden. För att uppnå detta uttryckte de behov av både teoretiskt baserade argument och kommunikationsförmåga för att övertyga kunderna om fördelarna med detta förhållningssätt. Forskningsbaserad kunskap, praktiska erfarenheter och goda exempel delades och reflekterades över med syfte att integrera den nya kunskapen i dagligt arbete. Innehållet i dialogerna på mötena gällde främst ämnen på organisationsnivå snarare än detaljer och på individuell nivå. Dialogerna rörde t.ex. samarbete i team inom FHV-företagen och med olika intressenter hos kundföretag, integration av hantering av arbetsmiljöfrågor i befintliga processer, deltagande från tidiga stadier i design- och förändringsprocesser, användning av riskbedömningsverktyg och slutligen kommunikationsförmåga.

Metoden co-operative inquiry var ändamålsenlig i det här fallet eftersom nätverket fungerade som en arena för reflektivt lärande.

Nyckelord: Säkerhet och hälsa, arbetsmiljö, ergonomi, ergonom, arbetsmiljöingenjör.

Preface

Now here I am, trying to conclude what I have been working on in the past four years. And I am also thinking about the path that led me here. First about my background; I am a Registered Physiotherapist and finished my education in January 1978, so I have celebrated the 40th anniversary of the start of the path that I am on now.

For many years, I worked in primary care and was very satisfied with this and happy when I had helped patients with treatments…...until, after a while, they came back with the same disorders. Then, I started to make visits at their workplaces, often together with ergonomists from their OHS providers. The workplace visits really opened my eyes to the importance of good ergonomics, and I often found it meaningless to work with treatments if the disorders were caused by bad work environment. So, the next step was easy to take, towards starting to work with OHS. In 1989, I began to work as an ergonomist at an external OHS provider. At that time, we enjoyed some governmental subsidies and cooperated with colleagues at different OHS companies. But in 1993, the subsidies were withdrawn and the former colleagues at different OHS companies became competitors with whom we were no longer allowed to cooperate. It was, however, a very interesting and inspiring job with many exciting challenges, and I stayed there until 2005, when I moved to the Swedish Work Environment Authority (SWEA). This also meant that I could work with my favourite interest: visiting a lot of different workplaces, having work environment and ergonomics in focus. I would probably have stayed there much longer, if it had not been for a request from the manufacturing company Scania CV to work with method development and global support within the internal OHS department. I am still employed at Scania CV but have been working 50% as ergonomist and 50% as industrial PhD student since 2014.

Why become a student after all these years? Well, why not? The motivation for me was all the gaps I had experienced and they made me frustrated:
- I saw a great need for work environment improvements at many companies when I worked at SWEA, while, on the contrary, the OHS sector decreased.
- My experiences were that OS&H professionals often wanted to work preventively; nevertheless the services sold by OHS providers were mainly reactive.
- There was a lot of research about the connection between good ergonomics, quality, productivity, and economy; but decreasing amount of services were delivered from OHS providers.
- Sick leave at Swedish workplaces had increased; while the preventive services delivered from OHS had decreased

- My experiences from in-house OHS were very positive with high attention on work environment at every level, up to highest management at Scania; nevertheless the number of in-house OHS staff was decreasing
- The initiation and development of RAMP, which I have been involved in, made me aware of the importance of bridging the gap between research and practice.

So, I hope that my research will make at least a small contribution towards reducing some of the gaps I have experienced.

> *To those who devote their lives to science, nothing can give more happiness than increasing the number of discoveries. But their cups of joy are full when the results of their studies immediately find practical application. There are not two sciences. There is only one science, and the two activities are linked as the fruit is to the tree.*
>
> (Louis Pasteur, with the small adjustment: those instead of him)

Stockholm, August 2018
Lena Nord Nilsson

List of appended papers

This thesis is based on the following three papers that can be found in Appendix 1.

Paper A

Nord Nilsson, L. & Vänje, A. 2015. Kollegor eller konkurrenter? Samverkan i nätverk mellan arbetsmiljöingenjörer, ergonomer samt forskare. (Colleagues or competitors? Collaboration in a network between occupational safety and health engineers, ergonomists and researchers). *Forum for arbetslivsforskning (FALF), 2015. https://falf.se/wp-ontent/uploads/2015/08/Book_of_abstracts_2b.pdf*

Paper B

Vänje, A. & Nord Nilsson, L. 2015. WIKIOSH–to develop learning networks about safety and health in the engineering sector. *Proceedings 19th Triennial Congress of the IEA, 2015b. 14.*

Paper C

Nord Nilsson, L. & Vänje, A. 2018. Occupational Safety and Health Professionals' Skills – A call for system understanding. Experiences from co-operative inquiry within the manufacturing sector. *Applied Ergonomics, 70, 279-287.*

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Authors' contributions

Paper A

Nord Nilsson is the corresponding author. Both authors cooperated in the planning of the underlying study. The data was analysed by the co-researchers within the network. Both authors cooperated in the writing of the paper.

Paper B

Vänje is the corresponding author. Both authors cooperated in the planning of the underlying study. The data was analysed by the co-researchers within the network. Both authors cooperated in the writing of the paper.

Paper C

Nord Nilsson is the corresponding author. Both authors cooperated in the planning of the underlying study. The data was analysed in the first step by the co-researchers within the network. Nord Nilsson transcribed the audio recorded data and performed an analysis with the tool NVivo. The next analytic step was conducted by both authors in cooperation. Both authors cooperated in the writing of the paper.

Contents

Abbreviations

AFA Insurance: insurance company owned by Swedish employer and employee organisations.

AFS: Arbetsmiljöverkets/Arbetarskyddsstyrelsens Författningssamling [Provisions from the Swedish Work Environment Authority].

CREE: Centre for Registration of European Ergonomists

FORTE: Forskningsrådet för hälsa, arbetsliv och välfärd [Swedish Research Council for Health, Working Life and Welfare]

HTO: Human, Technology and Organisation

IEA: International Ergonomics Association

ILO: International Labour Organization

KTH: Kungliga Tekniska Högskolan [Royal Institute of Technology].

OS&H: Occupational Safety and Health

OHS: Occupational Health Services

RAMP: Risk Management Assessment Tool for Manual Handling Proactively

RPT: Registered Physiotherapist

SOU: Statens Offentliga Utredningar [Swedish Government Official Report].

SWEA: Swedish Work Environment Authority

WHO: World Health Organization

1 Introduction

This chapter starts with a brief description of the research background and why the research was initiated. The chapter then presents the aim, research questions and delimitations.

1.1 Background

Professional skills in the sector Occupational Health Services (OHS) is for many reasons an important topic. Providers of OHS are expert resources supposed to support companies and organisations with the prevention and elimination of health risks at workplaces. They should also have the competence to identify and describe relationships between the work environment, organisation, productivity and health (SFS, 1977:1160). There are several studies showing a relationship between good work environment, good quality and high productivity (Brännmark et al., 2012; Eklund, 1997; Falck et al., 2010; Ivarsson and Eek, 2016). Work environment risks can affect individuals and organisations as well as society, and costs for sick leave, quality deficiencies and production losses can be extensive (SOU, 2000).

Work environment conditions and employee health have also been emphasised as highly important factors for aging employees' possibility and desire to work longer and postpone retirement (Tåhlin, 2011; Stattin and Järvholm, 2005; Östlund, 2012; SOU, 2013; Nilsson et al., 2011). With ongoing demographic changes in Sweden (SCB, 2017) as well as in the rest of Europe (European Commission, 2017) with an escalating ratio of elderly in the population, the question about retirement at a higher age than today has been actualised as important for welfare and growth (Johansson et al., 2016; Kadefors et al., 2014; SOU 2013; Östlund, 2012). Further, statistics on sick leave in Sweden showed rising figures during 2010 and 2016 (Försäkringskassan, 2016). Despite these facts, there has been a considerable decline of the OHS sector since 1992 (Bohlin and Hjalmarson, 2007; Swedish Occupational Health Services, 2018a; SOU, 2011a). The number of employees in the OHS sector, who are experts in the knowledge field of work environment, has decreased substantially from 1992 to 2017 (SOU, 2011a; Swedish Occupational Health Services, 2018a). Since the beginning of the 1990s, the percentage of employees that are covered by OHS has decreased from 86% to 65% (Swedish Occupational Health Services, 2018b; Eliasson, 2017). In addition, companies in the OHS sector have difficulties in finding well-functioning relationships with their clients (Schmidt et al., 2015, 2017; Antonsson and Schmidt, 2003). The services performed have shifted focus from preventive towards reactive activities, such as rehabilitation (Axelsdotter and Tegle, 2009; SOU, 2011a), This trend towards a decline of performed preventive services has also been noticed in Finland, where the market for OHS providers has become more competitive since price regulations were abolished in 1995 (Kankaanpää et al., 2013).

Further, a decrease of deep branch specific knowledge among OHS professionals in Sweden has been noticed (Axelsdotter and Tegle, 2009). Research in this area is scarce. However, lack of branch specific knowledge has been mentioned in reports about OHS (SOU, 2007, 2011a) and can be found in a master thesis (Johansson and Tindholm, 2012), notes from meetings, etc. (FHV-forskning, 2012). One of the important challenges for OHS is current and coming recruitment needs of OHS professionals, which was highlighted already in 2007 (SOU, 2007). The average age of the employees in the OHS sector in Sweden is high, which contributes to the estimation 2015 that one quarter of the entire staffing force needed to be recruited within the next three years (Swedish Occupational Health Services, 2018a). A large part of the employees at OHS companies have specialist education combined with long and broad experience in the field, which contributes to extended requirements of knowledge transfer between experienced and newly employed professionals (Swedish Occupational Health Services, 2018a). Lack of knowledge transfer has been highlighted as so important that it may contribute to the decline of the OHS sector and adversely affect further development (Swedish Occupational Health Services, 2018a).

A number of reports where OHS is the main focus (SOU, 1992, 2004, 2007, 2011a, 2011b) have been carried out on the initiative of the Swedish government. In a report regarding objectives for public health (SOU, 2000) a good work environment was one of the highlighted areas for improving public health. Access to OHS for all workplaces in Sweden was considered important due to health reasons (SOU, 2000) but no decision has been taken on this proposal. OHS has also been pointed out regarding participation in improvements, especially when it comes to the coordination of efforts for efficient rehabilitation and to improve the process for "return to work" (SOU, 2007). Education was emphasised as essential for current and coming competence needs and for recruitment (SOU, 2007). In addition, OHS should be seen as a multidisciplinary knowledge area and be supported by research, evaluation and development for their specific needs (SOU, 2007).

In accordance with suggestions in the report "Ny företagshälsovård – ny kunskapsförsörjning, SOU 2007:91" [New occupational health services – new provision of knowledge] (SOU, 2007) a Delegation for Occupational Health Services was appointed from the Swedish government with the assignment to conduct activities for improvement of knowledge and quality in OHS (SOU 2011b). When the assignment was ended in 2011, an infrastructure was built both for higher education with master's programmes as well as research about OHS. A new research domain was set up for the field of OHS with an own professorship. The Delegation for OHS has cooperated with the Swedish Research Council for Health, Working Life and Welfare (FORTE, former FAS) (FORTE, 2017) on two research programmes, one at Karolinska Institutet and

the other at KTH, which were carried out during the period 2011-2017. Focus of the programmes was the development of tools and methods with the purpose to improve preventive OHS (Kompetenscentret för företagshälsa, 2017). Also, the insurance company AFA (AFA Insurance, 2017) has funded a programme regarding research in the field OHS. The background of the AFA Insurance programme on OHS is that actors in the labour market had noticed that the offer of OHS and the content of the purchased services varied widely. It was also obvious that early prevention services, currently most rarely purchased, are those which can be expected to give the greatest impact from a long term perspective on better work environment and health; the so-called strategic services (AFA Insurance, 2017). The programme was aimed at contributing to the development of more demand-oriented OHS which promotes and enhances the quality of preventive OHS at workplaces, and increasing opportunities for companies and organisations to purchase OHS as a resource in the strategic preventive management of occupational safety and health (AFA Insurance, 2017). The programme lasted for three years and ended in 2016. The content of the projects included in the programmes has a wide range, from evaluation of a method for the assessment of work ability, knowledge development and dissemination, methods for OHS support in processes for purchasing of equipment and planning new workplaces, development of a tool for economical calculation on preventive work environment investments, implementation of evidence based methods, methods for leadership training and OHS for small enterprises, to the investigation of how OHS providers can be involved in preventive work environment efforts.

With funding from mainly AFA Insurance and partly FORTE, a competence centre for OHS was established by a collaboration between Karolinska Institutet, KTH Royal Institute of Technology, IVL Swedish Environmental Institute and Uppsala University (Kompetenscentret för företagshälsa, 2017). A purpose of the competence centre was to communicate and disseminate knowledge from OHS research. A web-based platform was developed by the centre: www.fhvforskning.se. The research within the competence centre had both proactive and reactive directions and concerned organisational as well as individual levels. The overall aim with the programmes was to reduce the risks of work-related disorders and to improve the health of the employees (Kompetenscentret för företagshälsa, 2017). Examples of research conducted within the programmes include the development of guidelines and tools for OHS (Kompetenscentret för företagshälsa, 2017), as well as research about the relationship between OHS and their clients (Schmidt et al., 2015). Another important topic was to gain knowledge of which needs for professional skills that the professionals within OHS express in order to improve their performance. The described background has emphasised the need of research

regarding knowledge development and dissemination in the OHS sector. Research in this area in Sweden has been scarce (SOU 2011b).

With funding from AFA Insurance, a three-year research project, (Vänje et al., 2016) was run by KTH. The project was based on three methods for development and dissemination of branch-specific knowledge for the OHS sector in preventive work with OHS: (i) Learning Networks, (ii) Web sites and (iii) Courses. The aim of the project was to strengthen the OHS knowledge area, develop learning methods and develop and transfer branch specific professional skills. Within the part "Learning Networks" one network has been run in the sector OHS for home care and another network in the sector OHS for large manufacturing companies.

The research that formed the basis for this thesis was carried out as a part of the AFA Insurance programme. The network regarding OHS for manufacturing companies was the part in focus. The network consisted of OS&H engineers and ergonomists besides researchers and was run between September 2014 and February 2016.

1.2 Aims and research questions

One aim of this thesis was to gain a deeper knowledge and understanding about professional skills when it comes to OS&H engineers and ergonomists within the manufacturing sector. A second aim was to gain experiences of using co-operative inquiry in a learning network for OS&H professionals in order to develop professional skills. There were four research questions formulated which were dealt with in three papers (Table 1).

Table 1. *The research questions and in which papers they are dealt with.*

Research questions	Papers		
	A	B	C
I. How can a learning network addressing OS&H issues be structured so that it becomes attractive to participate in?	√	√	
II. How can a learning network addressing OS&H issues be structured so that it facilitates reflective learning?		√	√
III. What kind of professional skills do OS&H engineers and ergonomists working in the manufacturing sector express needs for?	√	√	√
IV. What kind of professional skills do OS&H engineers and ergonomists working in the manufacturing sector share with each other when collaborating with researchers?			√

1.3 Delimitations

The approach was to generate qualitative knowledge with more focus on depth in a specific context than width for the whole OHS sector. The context of the research was delimited to OHS within the sector of large manufacturing companies in Sweden, and the base for the research was a learning network for OS&H engineers and ergonomist in this context. The research regards a network consisting of 12 participants, acting as co-researchers, representing internal as well as external providers of OHS and university researchers. The research was delimited to the professionals' own experienced needs for professional skills and the shared knowledge at the network meetings. Further, the research had an action-oriented approach with the purpose of illuminating qualitative and subjective experiences of the network rather than quantitative data.

2. The context Occupational Health Services

In this chapter the context Occupational Health Services is described. It starts with a presentation of the general history of OHS followed by the history of OHS in Sweden. Thereafter, the legislation regarding OHS in Sweden and the organisation of OHS today are described. The chapter ends with a presentation of OS&H engineers and ergonomists in Sweden.

2.1 History of Occupational Health Services

Already in the 17th century, Bernardino Ramazzini observed the connection between working conditions and different diseases, and he has been called "the Father of Occupational Medicine". He lived between 1633 and 1714 and worked as an Italian physician, and had patients from all social classes with a lot of different work backgrounds (SOU, 2011a). He published the book "De Morbis Artificum Diatriba" about occupational diseases with the purpose to support other physicians to treat workers more effectively. Besides treatment, the book includes different types of preventive advice of which some is what we today relate to ergonomics and to personal protective equipment. The book spread to other countries and in Sweden it was translated and distributed by Carl Linnaeus.

In the 19th century, private initiatives were taken by owners of large industries, such as chemical and mining industries, to offer OHS as a counterbalance to industrial hazards (Froneberg, 2006). The services included subsidies such as housing and meals to ensure better health and create a dependable workforce. Later, such initiatives were followed by different public social protection measures and schemes that included regulations about occupational health (Froneberg, 2007).

The International Labour Organization (ILO) was established in 1919 within the League of Nations to set labour standards, develop policies and devise programmes promoting decent work for all women and men (ILO, 2017b). ILO became the first associated specialised agency of the United Nations in 1946, and brings together governments, employers and worker representatives from the 187 member states (ILO, 2017b). The working methods include dialogue, counselling, expert assistance and technical assistance, but there are no sanction tools. The states that acceded to the ILO Conventions should report regularly about their work for the implementation of the rights. States have to provide national representatives for employers and employees organisations, providing an opportunity to comment on the reports. ILO has developed nearly 200 conventions and many of them have connections to OHS. Conventions that particularly address OHS are C155 "Occupational Safety and Health Convention", C161 "Occupational Health Services Convention" and C187

"Promotional Framework for Occupational Safety and Health Convention (ILO, 2017a). The intention from both ILO and World Health Organisation (WHO) is that all employees should have access to OHS and that the services should be focused on risk prevention (ILO, 2017b, WHO, 2017). However, statistics in 2013 showed a range from 3–97 % when it came to how many employees that were covered by OHS in different countries globally (Rantanen et al., 2013). Also, the funding and organisation of OHS services varied, although the majority of the countries studied had combined funding from employers and different insurance solutions (Rantanen et al., 2013). At the European level, the Framework Directive on Safety and Health at Work (Directive 89/391/EEC) (European Council, 1989) describes the basic obligations for employers and workers. The directive is a legal act for the EU Treaty and guarantees minimum safety and health requirements throughout Europe. It is binding in its entirety and obliges the EU member states to transpose it into national law.

2.2 History of Occupational Health Services in Sweden

Even in Sweden the industrialisation, especially mining, contributed to the development of OHS (SOU, 2011a). There were many work-related hazards and the number of occupational diseases and injuries increased, creating needs for health care close to the workplaces. In 1890, work related accidents and diseases had increased to such an extent that the government intervened and established a professional inspection for safety surveillance (SWEA, 2017). Around 20 years later, an act regarding occupational safety was decided (SOU, 2011a). The medical care included in the act, mainly regarded health examinations and first aid (SOU, 2011a).

In the 1960s, the social parties in the labour market collaborated with the aim that providers of OHS should become an independent, investigating and consultative resource, and that the partners should cooperate when formulating the assignments. The intention was to focus more on preventive than reactive services, and the "modern" OHS with technical, medical, ergonomic and psychosocial competences started to be established. The sector expanded rapidly during the 1980s and both internal and external OHS providers were founded, as well as OHS for special sectors such as construction (Bygghälsan). Between 1986 and 1992, the providers of OHS that fulfilled demands from the work environment authority, received funding subsidies of 20-25 percent of their budget from the public social insurance system (Bohlin and Hjalmarson, 2007).

There had been a central agreement since 1942 between the employer organisations and the unions about OHS for all employees in many sectors, and at the end of the 1980s, 86% of the Swedish workforce had access to OHS. However, this agreement was terminated by the employer organisations in 1993 and in the same year, the subsidies from the public social insurance system were

withdrawn, which caused reduced profitability and a competitive climate between the OHS providers. The demands to receive the subsidies had included preventive OHS and cross functional teams. After 1992, there has been a decline of the Swedish OHS sector and in 2017, approximately 65% (Swedish Occupational Health Services, 2018b) of Swedish employees had accesses to OHS through their employer. Further, the focus has shifted from prevention of work environmental risk factors towards rehabilitation and wellness activities (SOU 2004, 2007, 2011a, 2011b; Axelsson & Hök, 2009). The trend has also been that many small OHS firms have merged into larger companies and the total amount of employees in the sector has successively decreased (Alla bolag, 2014, 2017; Swedish Occupational Health Services, 2018a).

There have been numerous governmental investigations about OHS. A committee was appointed in 2007 to submit proposals for how education for OHS employees should be conducted (SOU, 2007). The committee described the actual situation (SOU, 2007) as similar to 2003, when a former investigation (SOU, 2004) expressed that questions about OHS had been investigated during the last forty years without leading to clarifying regarding task, roles or position in the work with public health. Today, OHS providers act on a free market where the kind of services delivered depend on what the clients are buying.

2.3 Swedish legislation about Occupational Health Services

In Sweden, the Framework Directive on Safety and Health at Work (Directive 89/391/EEC) (European Council. 1989) has been incorporated in The Swedish Work Environment Act and defines the term Occupational Health Services:

> *The Occupational Health Services company is an independent expert resource in the domains of the work environment and rehabilitation. Occupational Health Services shall in particular work for the prevention and elimination of health risks at workplaces, and shall have the competence to identify and describe connections between the work environment, organisation, productivity and health.*
> (SFS, 1977, Chapter 3, § 2c).

In the act it is also stated that:

> *The employer shall be responsible for the availability of the occupational health services which the work conditions require.*
> (SFS, 1977, Chapter 3, § 2c).

According to the Work Environment Act, the employer has the main responsibility for the work environment and the act describes, in general terms, how that responsibility is to be discharged. The government has appointed

SWEA (Swedish Work Environment Authority) to, in more detail, decide what is applicable for the work environment and to issue provisions which detail what applies for the work environment. The Provisions on Systematic Work Environment Management, AFS 2001:1, (SWEA, 2001) specify the procedure to be followed by the employer in discharging the responsibility for work environment. Section 12 in this provision describes the engagement of occupational health services:

> *When competence within the employer's own activity is insufficient for systematic work environment management or for work relating to job adaption and rehabilitation, the employer shall engage occupational health services or corresponding expert assistance from outside. When occupational health service or corresponding expert assistance is engaged, they shall be sufficient in scope and shall have sufficient competence and resources for this work.*
> (SWEA, 2001, section 12).

There are stipulations that must be fulfilled when OHS providers are engaged:

> *The employer shall make sure that the occupational health services or corresponding outside expert assistance engaged as provided in Section 12 receive information concerning the factors affecting or suspected of affecting the employees' health and safety, have access to information concerning current work environment risks, preventive measures, and the measures taken to appoint, train and equip the employees needed to carry out first aid, fire-fighting and evacuation. The information shall concern both the activity as a whole and each individual workplace or each individual job.*
> (SWEA, 2001, Appendix 2).

Besides the tasks to issue the work environment provisions, SWEA is appointed to control that employers fulfil their responsibility for the work environment. This means that the authority can, for example, demand employers to engage OHS or corresponding expert assistance from outside in line with section 12 in provision AFS 2001:1 (ref www.av.se). SWEA has formulated recommendations regarding the engagement of OHS. Those recommendations include that it is appropriate to involve OHS as a cohesive resource and not merely for single services, as this ensures continuity and a comprehensive assessment of work environment conditions. SWEA also declares that providers of OHS need to have a broad competence in, for example, work organisation, behavioural science, ergonomics, medical, rehabilitation and technology (SWEA, 2001). The recommendations are in line with the ILO convention no 161 (ILO, 2017b), which says that OHS shall be multidisciplinary. Another

criteria for fulfilment of the ILO convention 161 (ILO, 2017b) and the Swedish work environment law (SFS, 1977) is that OHS shall be independent of employers and employees in the performed services. Despite the definition in the Swedish Work Environment Act and the content in the ILO convention 161, there is no control of whether OHS providers work in conformity with the intention of the actual act and convention.

2.4 Organisation of Occupational Health Services in Sweden

There is no protected title for providers of OHS but the association for OHS in Sweden (Swedish Occupational Health Services, 2018b) has initiated a voluntary authorisation with purpose to increase quality and competence in the sector. In 2017 25% of OHS companies had been granted authorisation (Swedish Occupational Health Services, 2018b). As many of the authorised companies are large with many units 300 OHS provider units (of totally 450) are covered by an authorisation. Sweden Providers of OHS in Sweden are organised both as "external" and "internal". The most common organisation is privately owned external OHS provider companies (Swedish Occupational Health Services, 2018a). The external providers generally deliver services to several clients, where the assignments can differ from minor ordered services that are paid per hour to very extensive contracts. During the last 20 years, there has been a progress from many small OHS provider companies to large OHS corporations with units nationwide. In 2014, there were 5 large OHS companies (AllaBolag, 2014) while there were only 3 large OHS companies in 2017 on the Swedish market (AllaBolag, 2017) besides small OHS providers.

Internal OHS providers are departments or units that are incorporated into county councils, municipalities or large companies and support the organisation with issues related to work environment. The work field contains promotion, prevention and reactive services at individual, group and organisational levels. Both internal and external OHS providers are commonly organised in interdisciplinary teams consisting of competences related to physical and psychosocial work environments, occupational health, ergonomics, rehabilitation and health promotion. It was estimated 2015 (Swedish Occupational Health Services, 2018a) that more than 4,000 people were employed in this sector in Sweden and, additionally, the sector includes consultants and people working as suppliers to OHS companies. Further, there are OS&H professionals that are employed directly at companies or organisations without being a part of an interdisciplinary team. In 2015, it was estimated that nearly 65% of current employees in the OHS sector have an additional OHS education (Swedish Occupational Health Services, 2018a). For physicians, nurses and OS&H engineers, there was a clear dominance of OHS trained staff (Swedish Occupational Health Services, 2018a).

2.5 Occupational Safety and Health Engineers

Engineers working within OHS can have different titles, for example "Health and Safety Engineer", "Safety and Health Engineer", "Work Environment Engineer", "Occupational Safety and Health Engineer", "Occupational Health and Safety Engineer". Other relatively synonymous titles can be used for the same profession such as, "Safety Engineer"(Rantanen et al., 2013; Hämäläinen and Lehtinen, 2001).

One definition of "Work Environment Engineer" is:

> *A work environment engineer is a technical expert in occupational health and safety issues. Work environment engineers often work in occupational health services to ensure that workplaces are safe and non-hazardous* (SACO, 2017, www.saco.se/studieval/yrken-a-o/arbetsmiljoingenjor/)

In this thesis, the title Occupational Safety and Health (OS&H) Engineer is chosen. The daily work as OS&H Engineer includes identifying, measuring and investigating physical and chemical hazards at the workplace. Further, it includes implementing measures and ensuring that everyone at the workplace has sufficient knowledge about the risks and how the risks can be avoided, as well as following up this work (SACO, 2017). Specifically, it is to identify the risks of different accidents and to ensure that employees do not suffer from noise, radiation, dust particles or chemical substances. The work is both focused on systematic management of current work environment and on the prevention of new risks arising from the use of new products, materials or working methods. This may involve introducing new work routines or demanding the use of subcontractors. The work environment engineer also contributes with knowledge of occupational health and safety and current legislation in the field (SACO, 2017). It was estimated in 2017, that there were approximately 500 OS&H engineers on the Swedish labour market, of which approximately 200 within OHS (SACO, 2017). The main part of the current OS&H engineers in the OHS sector has a special education in the field of OS&H. But the sector is facing a generation shift and the need for OS&H engineers in Sweden is extensive. The branch organisation calculated 2015 that 55% of the OS&H engineers will, mainly due to retirement, have to be replaced within the next coming three years (Swedish Occupational Health Services, 2018a). Accordingly, this situation will cause a great need of transfer of professional skills between experienced and less experienced OS&H engineers.

2.6 Ergonomists

The ergonomists' role has been defined by International Ergonomics Association (IEA) as:

> *Practitioners of ergonomics and ergonomists contribute to the design and evaluation of tasks, jobs, products, environments and systems in order to make them compatible with the needs, abilities and limitations of people.* (IEA, 2017, https://www.iea.cc/whats/)

There is a possibility for ergonomists in Europe to apply for the protected title "European Ergonomist" and in Sweden, 38 ergonomists were registered with this title in 2017 (CREE, 2017). The minimum requirement for applying for European Ergonomist is three years of education at university level, including at least one year dedicated to ergonomics, and at least one year of supervised training followed by two years of professional experience (CREE, 2017).

As ergonomics is a very broad field, European Ergonomists are working in a lot of sectors such as design, research, education, rehabilitation and OHS. The main focus can be within three different areas: physical ergonomics, cognitive ergonomics and organisational ergonomics. The most common title used by practitioners in Sweden working with ergonomics within OHS is "ergonomist", which is an unprotected title. The background for most of the ergonomists in this sector is registered physiotherapist (RPT), often with an additional education in ergonomics or similar courses such as HTO (Human Technology and Organisation). Statistics 2015 (Swedish Occupational Health Services, 2018a) showed that around 300 ergonomists were employed in the OHS sector, and among them around 33% have this type of ergonomics education (Swedish Occupational Health Services, 2018a). The role as ergonomists at OHS is often complex and the services delivered to the clients can be at organisational level as well as to groups or individuals. The services can be either preventive, such as involvement in change projects, or reactive, like rehabilitation of individuals. Also, risk assessments and different kinds of education are services commonly performed. In 2015 it was estimated that the recruitment need for ergonomists in Sweden the three coming years was 20 % of the current workforce (Swedish Occupational Health Services, 2018a).

Education for OS&H engineers and ergonomists has been arranged in different ways during previous years. For example KTH has arranged educations for OS&H engineers and ergonomists on Degree of Master (One Year). Recently, a "Master Programme in Technology, Work and Health" started at the Division of Ergonomics, KTH, with engineers as the main target group (KTH, 2018).

3 Theoretical framework

This chapter gives a description of the theoretical framework of the research. It contains presentations of ergonomics, socio-technical theories, action research, learning and knowledge.

3.1 Ergonomics

This thesis is positioned in the scientific discipline Ergonomics, which has been defined by The International Ergonomics Association (IEA) as:

Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.
(IEA, 2017, https://www.iea.cc/whats/)

The current definition from IEA (2017) is broad, which is in line with different earlier definitions even though ergonomics has often been interpreted more narrowly (Eklund, 2003). Since the definitions do not give guidance of how to apply the knowledge, there have been different attempts and models developed to clarify the philosophy behind and guide to its application (Rollenhagen, 1997; Eklund, 2003; Karltun et al., 2017).

To demonstrate the broad meaning of ergonomics, the term macroergonomics is used and refers to organisational levels (Karsh et al., 2014; Hendrick, 2000). The term mesoergonomics derives from team or group processes (Karsh et al., 2014) while microergonomics is applied at an individual level (Hendrick, 2000; Karsh et al., 2014). Sociotechnical theories provide the basis for macroergonomics (Hendrick, 2000; Karsh et al., 2014; Holden et al., 2015) as well as the HTO models (Rollenhagen, 1997; Eklund; 2003; Karltun et al.; 2017,).

3.2 Socio-technical system theories

The term socio-technical systems was coined by researchers at the Tavistock Institute in London (Trist and Bamforth, 1951). The researchers based their theories on action research projects on workers in English coal mines during the post war reconstruction of industry (Trist, 1981). In the first research approach the organisation was exclusively considered as a social system. Later, also the technical factors were included and the relationships between the different social and technical factors became a new research field (Trist, 1981). Also the Human Relations Movement with for example Mayo´s research in the Hawthorne project (Mayo, 1933) contributed to the new theories. The findings indicated that socio-technical organisation models could be an alternative to the prevailing Weber's bureaucracy and Taylor's organisation concept. Both positive economic as well as human results were shown. Nevertheless, as the societal climate was not positive to this new mindset in the 1950s there was a limited dissemination of the ideas and few practical examples were performed (Trist,

1981). It was not until the early 1980s that the socio-technical theories became widespread and resulted in different forms of organisational democracy in a number of countries (Pasmore, 1995). In the Scandinavian countries research by Thorsrud (1977) and colleagues contributed to dissemination of the ideas. With the acceptance of the socio-technical ideas followed the need for models for work design (Cherns, 1987) and methods for work analyses (Emery and Thorsrud, 1976). Models with the origin in socio-technical system theories have been used in different sectors such as shipping (Klein, 2014), airports (Wu et al., 2015) and the automotive industry (Schöttl and Lindemann, 2015). There have been different purposes, from design in major IT projects (Maguire, 2014) to analyses of, for example, accidents (Davis et al., 2014).

Eventhough socio-technical systems thinking has been used in many sectors, Davis et al. (2014) have argued for a broadening of this approach and to include contextual aspects more clearly. Davis et al. (2014) have illustrated this in a model consisting of six elements: goals, culture, processes/procedures, people, technology and buildings/infrastructure. The elements interact with each other and with an external environment consisting of financial and economic circumstances, regulatory frameworks and stakeholders (Davis et al., 2014).

3.3 Learning, knowledge and professional skills

Theories about learning related to work are essential in the theoretical framework for this thesis. Learning is a broad area and even with the delimitation of only including learning related to work, previous research can be found under a lot different headings such as Organisational Learning, Workplace Learning, Human Resource Development and Continuing Professional Education (Wallo, 2008). The smallest common denominator for the different concepts is an interest in the individual's learning at work and how this is related to a collective learning at group or organisational levels (Wallo, 2008). Argyris and Schön (1996) have distinguished between the *product* and the *process* and explained the product as something learned (knowledge) and the process (learning) as the way to reach the product. Regarding learning at individual level Gustavsson et al. (1996) have stated that:

> *If we consider thoughts and actions as our individual knowledge, follows that learning can be defined as changes in the interpretation of something in the environment or changes in the way of acting, which is shown in increased skills. (Translated)*
> (Gustavsson et al., 1996, p. 15.)

Different researchers have recognised diverse types of learning processes such as Restrictive and Expansive learning presented by Engeström (2014), Instrumental and Transformational learning by Mezirow (1991), and Single-loop and Double-loop learning by Argyris and Schön (1996). Nilsen et al. (2012) have presented a model with two modes of learning and four levels of actions.

The modes of learning are *adaptive learning* and *creative learning.* Adaptive learning is beneficial for developing routines and habits to cope with daily work, while creative learning, including reflections, is acquired when well-learned and routinized actions need to be challenged (Nilsen et al., 2012). Nilsen et al. (2012) interpreted that the concepts "Creative Learning", "Double-loop Learning", "Expansive Learning" and "Transformative Learning" are broadly similar. Even though the two modes, adaptive and creative learning, can be separated in a theoretical model, they are intertwined in practice and Molander (1996) as well as Svensson et al. (2004) have emphasised that it is neither possible nor desirable to make a strict split between them. Instead, the concepts can be seen as complementary and a pendulum movement between them occur in a learning process (Ellström, 2010a). Even different kinds of actions are often intertwined in practice, and actions at different levels can be performed parallelly or in series (Nilsen et al., 2012).

Reflection has been mentioned as a necessary component in competence development (Gustavsson et al., 1996) and a reflective approach has been recommended by Schön (1983), especially regarding learning for the knowledge needed to manage complex, instable and uncertain situations. Reflection can increase the general understanding of the own work as experiences and assumptions are challenged (Nilsen et al., 2012). Nilsen et al. (2012) have expressed that:

> *Reflection is typically described as a mechanism to translate experience into learning, by examining one's attitudes, beliefs and actions, to draw conclusions to enable better choices or responses in the future.*
> (Nilsen et al., 2012, p. 404.)

However, there is no agreement upon one definition on reflection in work-related learning (Roessger, 2014) and different phenomena are often mentioned such as: reflection, critical reflection and reflective practice, where the cognitive process is the common denominator. Literature on reflection for learning has mainly focused on the area of education and training as preparation for a profession and work, while workplace learning and reflection amongst practitioners have been far less examined (Nilsen et al., 2012). Different methods can be used for reflecting on work-based experiences (Schön, 1983). In an interview study, Raven (2014) found three broad methods regarding reflective practices amongst education professionals. The first method was described as reflective conversation, which is an interactive, interpersonal reflection. The second method is written individual reflections in notebooks or notepads. Also the third reflective method is in a written form but based on reflective thoughts noted down in different electronic files or papers, organised in themes.

Svensson et al. (2004) have made a model that illustrates an ideal individual's competence development, where informal and formal learning interact and conditions for reflective learning are created. Learning by reflection leads to competence with dynamic involvement of both theoretical and practical knowledge.

The emotional aspect of reflective learning has been highlighted by Krogstie & Divitini (2013) who stated that positive affect generally increase creativity and that emotions can influence decision makings and memory. They (Krogstie & Divitini, 2013) also suggested that reflective learning can be used to improve emotional competence, for example when it comes to improved emotional regulation strategies. There is also a correlation between stress and competence development at work (Paulsson et al., 2005). Results from research indicate that high stress contribute to difficulties in completing training programmes (Paulsson et al., 2005). On the other hand, the results also show that increased control of the knowledge development process makes the learning more stimulating as well as simplifies the work and reduces the stress related to learning and Paulsson et al. (2005) have stated that it is important that learning at work allows employees to have time for the process of learning and reflection. Another factor for a positive outcome of learning is that those involved formulate their own goals and the measures to fulfil them (Thorsrud, 1976). Also the culture and atmosphere at workplaces influence knowledge development where an open and democratic atmosphere stimulates learning (Svensson et al., 2004; Schön, 1983).

"Organizational learning" has been described by Ellström (2010b) as:

> *Changes in organizational practices (including routines and procedures, structures, systems, technologies etc.) that are mediated through individual learning and knowledge creation.*
> (Ellström, 2010b, p. 37.)

Nevertheless, it is not evident that individual learning automatically ensures knowledge development at group or organisational level (Svensson et al., 2004). Further, it is common, especially in small professional organisations that new knowledge mainly remains in the mind of certain individuals and is lost for the organisation if the individuals leave (Argyris & Schön, 1996). The connection between individual and organisational learning is very complex (Antonacopoulou, 2006). Results from a longitudinal study showed that individual learning did not have a significant impact on organisational learning mainly caused by the limitations within learning structures at different levels (Antonacopoulou, 2006).

A model has been introduced (Ellström, 2010b), which can be used to analyse how individual knowledge development in the execution of a work process can be transformed to organisational learning as changes in the formal dimension of a work process. Further, there are connections between research on workplace learning and innovation research (Ellström, 2010b). The term innovation has been extended to also include a function of the learning and knowledge development that takes place in the production of goods and services, as well as innovations related to production processes (Ellström, 2010b). Even though a lot of research regarding learning can be found, Ellström (2010a) has highlighted that the research focus is mainly on formal rather than informal learning at work. In addition, the focus is often on the subjective aspect of learning. Ellström (2010a) as well as Roessger (2014) have called for research on objective outcomes, such as new or improved work-related skills, new ideas or models that can be expressed and categorised.

Knowledge can be divided into research-based knowledge and practice-based knowledge (Nilsen et al., 2012). Research-based knowledge originates from models and theories as well as empirical research, while practice-based knowledge derives from practitioners' experience. Practice-based knowledge is often tacit and used in concrete, everyday situations. Furthermore, it is often personal, unique and difficult to share (Nilsen et al., 2012). Both practice-based and research-based knowledge is necessary to acquire a high level of competence which can be defined as an individual's ability to act knowledgeably, effectively, deliberately, strategically and reflectively in a situation (Svensson et al., 2004).

In this thesis, the term professional skills is used. The meaning of the term in this case is the skills that are required for a person to perform work with high quality in a specific profession. The professional skills consist of both practical and theoretical knowledge.
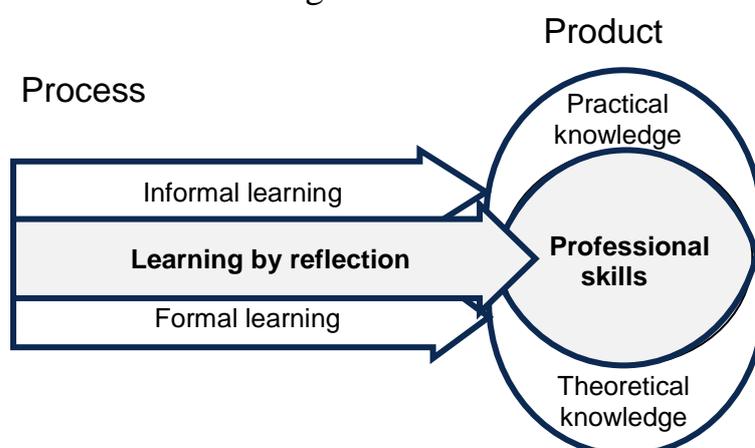

Figure 1. Model of a learning process, inspired by Argyris and Schön (1996) and Svensson et al. (2004).

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3.4 Action research and co-operative inquiry

The term Action Research originates from Lewin (1946) who started to conduct field research in Germany in the 1940's. Action Research is described by the Danish network for Action Research (2014) as follows:

> *Action Research is understood as a scientific method for making research. It underlines the connection between understanding and change, between theory and practice, and an active co-operation between researchers and the participants in the production of new knowledge.*
> (Danish network for Action Research, 2014, www.aktionsforskning.net)

Over the years, action research has had different approaches, and new sub concepts such as Research for Change, Development-Oriented Research, Participatory Research, Dialogue-Based Research, Emancipatory Action Research, Action Science, etc. have been developed within the broad concept of Action Research (Svensson, 2002). There are big differences between all these sub concepts, but a common denominator is the aim to contribute to change and development or problem solving (Aagaard Nielsen and Svensson, 2006, Svensson, 2002, Reason and Bradbury, 2001).

> *Action research rests on the belief that all people – professionals and researchers included – accumulate, organize and use complex knowledge constantly in everyday life."*
> (Greenwood, D. J.; Levin, M., 1998, p. 238.)

In different countries action research has been developed in diverse directions. In Sweden, the former action research mainly focused on research *for* while later action research is more oriented towards research *with* (Gustavsen, 1993; Gunnarsson, 2007, Lindberg, 2010). The latter approach is often labelled interactive research, which is a concept and orientation introduced by a group of Nordic researchers (Aagaard Nielsen and Svensson, 2006). Svensson (2002) has argued that in traditional action research the action is often overtaken at the expense of the theory. This causes, among other things, the research to be short-term, not having sufficiently critical distance and to be restricted to specific contexts (Svensson, 2002). Instead, interactive research was emphasised with the ambition to contribute to a more long-term theory development (Svensson et al., 2007). Svensson (2002) also points to the rapid change in working life, which has led to increased need for research that is interactive and supportive of development and innovation. Interactive research is about common reflective cooperation for joint development of knowledge that is practical and theoretically interesting (Schön, 1983). Three common characteristics in interactive research can be distinguished: (i) different kinds of knowledge are integrated in the development of new knowledge, (ii) an attempt to create equal

cooperation between researchers and stakeholders, (iii) the research is assumed to contribute to change processes Winther Jörgensen (2008).

Huzzard et al. (2010) have used interactive research for knowledge development in health care. The process of knowledge production took place through interaction between researchers and practitioners and the knowledge became non-hierarchical, heterogeneous and extended across several disciplines. They (Huzzard et al., 2010) emphasised the benefits of creating new constellations of actors with different knowledge and experiences, which helps to develop new methods and practices:

> *Interaction with new partners offers opportunities to reflect on one's own views of reality from the perspective of others. In this sense, the networks offered both structures that crossed established boundaries between caregivers as well as possibilities for reflective learning*
> (Huzzard et al., 2010, p. 300)

Also Pettigrew et al. (2001) and Thorsrud (1976) have argued for opening up research for wider and deeper cooperation between researchers and practitioners and to see theory and practice as a more tightly linked duality where researchers and users are co-producers of knowledge.

There are different traditions and methods within interactive research. Aagaard Nielsen and Svensson (2006) have separated one pragmatic and one critical trend where practice is central to the pragmatic approach, while theory is more prominent in the critical tradition. They (Aagaard Nielsen and Svensson, 2006) connected the critical orientation to the paradigm critical theory. Herr and Anderson (2005) used the term participatory research when they described research primarily used to investigate issues that practitioners think are important to influence through their own actions. Johansson and Lindhult (2008) have emphasised that the critical tradition suits particularly well when reflection and critical thinking before action is extra important. In addition, Andersson (2012) has pointed out that knowledge, developed by critical thinking, can also be value-added in itself as a deeper understanding of the own work situation or organisation.

A method described by Holmstrand (2008) is "Kunskapsfördjupande forskningscirkel" [knowledge-enhancing research circle]. The research circles were developed in the late 1970s, but the traditions go back to study circles that have roots early in the last century (Holmstrand, 2008). A common denominator of the research circles is that the focus of the work in the circles is decided by the participants.

Co-operative inquiry (Heron and Reason, 2006) is another method in the field of action research that has been used for different kinds of networks were the purpose has been to jointly develop knowledge. All participants, often both practitioners and researchers, in the network act as co-researchers. The approach can been described in terms of a cyclic process consisting of four phases;

1) Interactions. The network participants become co-researchers and decide to jointly explore an area.

2) Reflection. The co-researchers become active and observe themselves and the processes around them.

3) Learning. By identifying knowledge and highlighting experiences from practice, unforeseen actions and creative insights can occur.

4) Actions. The co-researchers share what is for them new knowledge and develop changes based on Phase 2 and 3. (Heron and Reason, 2006).

However, the inquiry does not follow a linear structure. It can rather be described as cycling movements between the phases, and there is continual cycling between ideas and reflections on one side and experience and action on the other side (Heron and Reason, 2006; Mash and Meulenberg-Buskens, 2001). The co-operative inquiry method has also been emphasised as possible to use by professionals without support from an external researcher (Reason, 1994). Especially professionals experienced in doing investigations and with an academic education have been mentioned, as well prepared for using this method (Aagaard Nielsen and Svensson, 2006).

3.5 The role as action researcher

An important difference between action research and other research is the researcher's role (Herr and Anderson, 2005). In action research it is those who participate in research, which, to a varying degree, conduct or influence research (Lewin, 1946). The researcher's influence in the knowledge process is considered as something positive (Lewin, 1946; Aagaard Nielsen and Svensson, 2006). Others, like Cammarota and Fine (2010) have argued that action research, and especially participatory action research, is primarily an approach to the research process and the participants. In interactive research, the researcher's role is more supportive than pushing (Svensson, 2002). It is also important that the researcher creates arenas for dialogue and has the ability to organise learning processes that have their own driving force (Kemmis, 2001).

In the descriptions of Forskningscirklar [Research circles] by Holmstrand (2008) research skills are highlighted, which means having the ability to work with a problem area in a structured and systematic manner. In the term research skills, a critical review approach is also included. This kind of research, where theoretical knowledge is mixed with the knowledge of the circle participants, usually based on experience, requires higher demands on the professional

researcher in terms of personality and social skills compared with much other research (Holmstrand, 2008). The researcher must have an open approach and genuine respect and understanding of the circle participants and the others involved in the research. In research circles the practitioners and researchers meet equally (Andersson, 2012). This does not mean that the roles have the same content, but they are equally worthwhile. The evaluation of practical and theoretical knowledge is also of equal value in the critical tradition of interactive research (Andersson, 2012). The professional researcher's role in research circles has many similarities (Andersson, 2012) with an approach used by Johannisson (2008). Johannisson (2008) has practiced an orientation of interactive research where he, as a researcher, has initiated events and committed others to participate in the implementation. Within the engineering research that Johannisson (2008) practiced, the researcher's role can be likened to an entrepreneur who starts and pursues an event.

In interactive research, reflection is an important part. For the professional researcher it may mean to reflect on what is studied in the research, but also the own role (Andersson, 2012; Berner, 1989). Tydén (2006) has emphasised the importance of the researcher having a balance between proximity and distance in order to achieve good quality research. The proximity provides an understanding of the context while distance provides the opportunity for reflection and overview.

When Andersson (2012) reflected on her own role as a researcher, she pointed out that the participants in interactive research not only have different roles but also different knowledge interests. The goal is mutual learning, as a result of equal relations, to gain both theoretical insights and useful practical knowledge. While many researchers in interactive research have mentioned "researchers" and "practitioners" who have different but equally important roles, Gunnarsson (2007) has gone deeper in the discussions around the roles. Further, Gunnarsson (2007) has pointed out that the often described dichotomy researchers - practitioners is problematic due the division that is made and argues that the division between theory and practice should be avoided. Her (Gunnarsson, 2007) experience is also that those who are referred to as "practitioners" in the research context often have academic education and do not identify themselves as practitioners. Likewise, those who are called "researchers" often can have high practical skills. Gunnarsson (2007) has called for continued broad discussions to challenge the stereotypical and hierarchical features that often exist in the division between "researchers" and "practitioners".

4 Method

In this chapter the research method is presented. This includes the method for initiation and running the network, presentation of the co-researchers in the network, as well as brief descriptions of the network meetings. Finally, the data analyses are described.

4.1 Co-operative inquiry

The research was performed in different steps where the first part was an inquiry including initiating and running of a learning network. A criterion for choice of method for the inquiry was that it should support the development of professional skills based on both theoretical as well as practical knowledge and include learning by reflection (fig 1). A purpose with the network was that OS&H engineers and ergonomists should have the possibility to meet and develop knowledge, even though the companies they were employed at were often competitors. Consequently, there were high demands on the method to support an open, creative and collegial atmosphere. An open and creative climate is also essential for learning (Svensson et al., 2004; Schön, 1983). As OS&H is a large and complex knowledge area, it was also important to use a method which was open for the co-researchers to decide the focus of the inquiry. There is also research showing that learning seemes highly dependent on that those involved formulate their own objectives and decide relevant measures to achieve them (Thorsrud, 1976).

As research about the professional skills among OS&H engineers and ergonomists was scant, one aim was to gain a deeper knowledge and understanding about this area. The intention was to obtain qualitative data and subjective knowledge. In order to meet the above prerequisites, an applicable method for knowledge generation was sought where the actors in the network are active and contribute to the content. Co-operative inquiry within the field of action research seemed to fulfil these needs. This method was chosen as its cornerstones are to jointly identify needs and develop knowledge and all participants act as co-researchers (Mash and Meulenberg-Buskens, 2001; Hummelvoll and Severinsson, 2005; Waterman et al., 2015; Godden, 2017).

For the analysis of the data, there was also a need of a suitable method. As OS&H engineers and ergonomist operate in a complex context the method should be applicable for this complexity. The decision was to make a theoretically based template analysis with six socio-technical elements (Davis et al., 2014) as nodes. Sub-nodes were created and added to every node. The elements were based on socio-technical system theories (Davis et al., 2014), an approach that seemed appropriate for the current purpose. The material was further analysed by thematic analysis (Braun and Clarke, 2006), and possible interactions between the sub-nodes and common patterns were identified.

4.2 Trustworthiness and robustness

The way of showing scientific rigour differs between quantitative and qualitative research. In quantitative research the terms validity and reliability are often used, while terms like credibility and trustworthiness are more common in qualitative research (Pearce et al., 2014). In action research the term "robustness" (Gunnarsson, 2007) is sometimes used instead of reliability. Nowotny et al. (2001) have argued that the reliability of the research increases, gives "social robustness", if research opens up for participation outside the academic sphere and extends to new areas. Through this inclusion it is possible to achieve a stronger "contextualisation" (Gunnarsson, 2007).

In the co-operative inquiry method, validity is built into the different phases were the co-researchers regularly agree on the inquiry and its findings (Heron and Reason, 2006). Heron and Reason (2006) have also expressed that in the co-operative inquiry approach, knowing will be more valid if four specific ways of knowing are congruent with each other. The ways are defined as knowing being: (i) grounded in experience, (ii) expressed through images and stories, (iii) expressed in worthwhile actions in practice and (iv) understood through theories which make sense (Heron and Reason, 2006).

4.3 The network and its co-researchers

The network was initiated by KTH and organised by me, with experiences from practice as an ergonomist, and one senior researcher experienced in action-oriented approaches. In this network, the focus was the OHS sector for large manufacturing companies. As many of the occupational risks in this type of industries often are related to safety and ergonomics (SWEA, 2014) the chosen professionals in the network were OS&H engineers and ergonomists. The recruitment process of co-researchers to the network was inspired by snowball sampling (Noy, 2008). There was an intention to obtain a heterogeneous group when it came to work experience, age, gender, both OS&H engineers and ergonomists and to have co-researchers from both internal as well as external OHS providers. One common denominator was the work with OHS for large manufacturing companies.

The co-researchers from internal OHS providers were mainly recruited through personal contacts or by recommendations. After an inventory of the five biggest external OHS firms (approximately 75–1000 employees) managers at those companies were contacted and offered one place per company for a co-researcher in the network. The ambition was to get a total of 12 co-researchers in the network as this is considered a balanced number to create a base for open and reflective dialogues (Schön, 1983) and recommended for co-operative inquiry (Heron and Reason, 2006). Every prospective co-researcher and their managers received letters with information about the network, its aims and

"what was in it" for them. Recruitment of co-researchers was easy but two of the intended co-researchers had to be replaced just before start of the network, as they changed jobs to other sectors. The recruitment process ended with six OS&H engineers and four ergonomists signing up for the network besides the two professional researchers. These persons represented four internal and six external OHS providers (5 big and 1 small) plus one university (Table 2). Among the six persons representing external OHS, four of them worked with only one client company. Experience in working with occupational health services ranged from one to 33 years. Geographically the participants were mainly from southern Sweden (from Olofström to Gävle) and with the maximum distance of 510 km to KTH in Flemingsberg. To minimise the financial barriers to participation, travel costs were paid by KTH. Obstacles that occurred were cancelled trains and other transport problems which made it impossible for some co-researchers to attend some of the meetings.

Table 2. *Characteristics of the co-researchers in the network.*

The co-researchers in the network		
Profession	OS&H engineer	6
	Ergonomist	4
	Researcher	2
Employment	External OHS	6
	Internal OHS	4
	University	2
Age	< 35 years	2
	35–50 years	3
	> 50 years	7
Gender	Men	4
	Women	8

For starting up the first network meeting recommendations from Reason and Bradbury (2013) were used. This included aspects such as joint agreements about the aim of the network and practical questions about future arrangements of the network including where and when to meet. The following meetings were performed in accordance with the description by (Heron and Reason, 2006) with a cyclic process consisting of four phases; interactions, reflection, learning and actions (Heron and Reason, 2006).

A total of six network meetings were performed during a period of one and a half year. All of them were physical meeting in accordance with a joint decision at the first meeting. The content in the meetings 2-6 was based on needs that were expressed during the start-up of the network. The different meetings are presented briefly in table 3. This includes main content, place where the meetings were conducted and the kind of data that was collected.

Table 3. *Presentation of the network meetings.*

The network meetings

Meeting	Main content	Place
1	Start up, practical questions for the future meetings. Investigation of expectations, expressed needs and eventual barriers to participation.	University
2	Work environment and economics, including topics such as key figures and how to motivate investments in work environment improvements; seminar by an invited researcher.	University
3	The relationship between productivity, quality and ergonomics; workshop by an invited researcher. Sharing of good examples. Reflections on what "gives energy" and what "takes energy".	University
4	Reflections on problem projects: what kinds of obstacles have been encountered and how have they been tackled? The topic future working-life was reflected on.	University
5	Study visit to an industrial company that runs an internal OHS organisation. Focus was on OS&H management integrated into production processes and daily work.	Industrial company
6	Systems for incident reporting. Summing up of the meetings in the network.	AFA

The network meetings included a continual cycling between ideas and reflections on one side and experience and action on the other side in line with the method co-operative inquiry (Heron and Reason, 2006). In practice this meant that both theoretically based knowledge as well as practical experiences were reflected on. Also reflections on daily practice were crucial parts and for these notebooks were used as diaries.

Changes in the OHS sector could be noticed in the network. During the period when the network was running, two of the five largest OHS companies were bought by two of the other big external OHS providers. This resulted in that one of the co-researchers changed employer but not client company. Another co-researcher came in a similar situation but this was due to the client purchasing services from a new OHS provider who employed the concerned professionals. A third co-researcher changed employer from an external OHS provider to internal OHS at the former client company. Further, one co-researcher moved from external to internal OHS within a new sector. Finally, at one of the represented internal OHS providers a process for outsourcing started.

4.4 Data

All data originates from the network for OS&H engineers and ergonomists. The data contained notes taken on whiteboard, in PowerPoint, post-it notes and audio recordings (Table 4).

Table 4. *Presentation of the data and analyses.*

Meeting	Data	Analyses
1	Tutorials, sharing of examples and verbal reflections. Notes taken on whiteboard, post-it notes and in PowerPoints.	Summarised and validated jointly by the co-researchers.
2	Sharing of examples and verbal reflections. Notes taken on whiteboard, post-it notes and in PowerPoints.	Summarised and validated jointly by the co-researchers. Analysed by the professional researchers with theoretical based template analysis and thematic analysis.
3	Sharing of examples and verbal reflections. Notes taken on whiteboard, post-it notes and in PowerPoints	Summarised and validated jointly by the co-researchers.
3	Audio recordings	Audio recordings transcribed. Analysed by the professional researchers with theoretical based template analysis and thematic analysis.
4	Sharing of examples and verbal reflections. Notes taken on whiteboard, post-it notes and in PowerPoints.	Summarised and validated jointly by the co-researchers.
4	Audio recordings	Audio recordings transcribed. Analysed by the professional researchers with theoretical based template analysis and thematic analysis.
5	Sharing of examples and verbal reflections. Hand notes.	Summarised and validated jointly by the co-researchers.
5	Audio recordings	Audio recordings transcribed. Analysed by the professional researchers with theoretical based template analysis and thematic analysis.
6	Sharing of examples and verbal reflections. Notes taken on whiteboard, post-it notes and in PowerPoints.	Summarised and validated jointly by the co-researchers. Analysed by the professional researchers with theoretical based template analysis and thematic analysis.

4.5 Data analyses

From meetings one, two and six the data consisted of summaries that the co-researchers had agreed on jointly. The summaries were based on whiteboard notes, post-it notes and PowerPoints. For dialogues two and two and some other workshops post-it notes were used for notes. These types of outcomes were analysed jointly in the network by clustering them in "families" before they were summarised and agreed on. As a further validation the summaries were sent out to all co-researchers for feedback.

The dialogues at meetings three, four and five were audio recorded and fully transcribed. In addition, summaries were written and sent out to the co-researchers. The data from meeting one (practical agreements on the future network meetings, beliefs and expectations, needs and obstacles) was not further analysed. The results were presented in paper A and B. In paper C the data from this meeting was briefly described.

The summaries from meetings two and six and the transcribed audio recordings, from meetings three, four and five, were further analysed in different steps by the professional researchers. The first step of this analysis was performed as a theory-based template analysis. For this purpose, a template was created with the six socio-technical elements (people, buildings/infrastructure, technology, culture, processes/procedures and goals) described by Davis et al. (2014) as nodes. In addition, every node (element) was given sub-nodes by the researchers in order to have a common starting point. Sections from the data were then coded into the different nodes and sub-nodes. The result of this coding showed that data related to the nodes (elements) *people* and *processes/procedures* occurred most frequently. In the next step interactions between the different sub-nodes were analysed by thematic analysis (Braun and Clarke, 2006), and common patterns were identified. The nodes and sub-nodes were then given new labels that more correctly described their content. The analysis process and the results are presented in paper C.

5 Results and summary of the appended papers

This chapter starts with a brief overview of the results in the different papers followed by summaries of the appended papers where the results are further presented. Paper A is more thoroughly described, as the original paper is written in Swedish.

Table 5. *Overview of the three papers included in the thesis.*

Paper, Outlet, Year of publication	Main content and research questions in the papers	Main results
Paper A Conference paper, 2015	The initiation of the network and the three first meetings. What motivates the co-researchers in the network to participate in the network? What kind of professional skills do the co-researchers in the network want to develop and share?	Opportunity to meet and cooperate with new colleagues and researchers, share experiences and knowledge motivated the co-researchers to participate. The co-researchers wanted to develop skills related to four main themes: The connection between work environment quality, productivity and economics, relationship between OHS and clients, knowledge sharing and future working life. The expressed needs were mainly complex and at an organisational level.
Paper B Conference paper, 2015	Meetings 1-3 with focus on the method co-operative inquiry. How can a learning network addressing OS&H issues be structured and implemented so that it becomes (i) attractive to participate in and (ii) sustainable over time? What kind of OS&H issues will be highlighted by the network co-researchers?	Co-operative inquiry was suitable for establishing the network as there was an open and creative climate despite the fact that the co-researchers had different employers that often compete in the market. A prerequisite for participation was that the co-researchers and their managers must experience benefits from the network in relation to the time spent. The issues highlighted were mainly complex and at an organisational level
Paper C Journal paper, 2018	Brief description of meetings 1-6. Focus on the dialogues at meetings 2-6. What kind of professional skills do OS&H engineers and ergonomists working in the manufacturing sector (i) express needs for, as well as (ii) share with each other when collaborating with researchers?	The OS&H professionals had wishes to work more preventively and more broadly than currently. They expressed needs to develop skills for communication with the clients to obtain such assignments and tools to perform this type of commissions. Good examples were shared on how to turn reactive and individually focused services towards preventive assignments at a higher organisational level. Using the tool co-operative inquiry increased insights, as it established an arena for reflective learning and knowledge sharing between co-researchers with different backgrounds and professions. The results indicated that using co-operative inquiry was suitable for bridging the gap between practice and research.

5.1 Summary of paper A

The aim of this conference paper was to describe the initiation of a network for OS&H engineers and ergonomists working with OSH services for manufacturing companies, and the processes during the first three network meetings. The research questions were:

1. What motivates the co-researchers in the network to participate in the network?
2. What kind of professional skills do the co-researchers in the network want to develop and share?

The intention during the recruitment to the network was to invite actors with diversity regarding age, gender, length of OHS experience and employment in the form of both internal and external providers of OHS. When the recruitment was completed there were 12 actors in the network, six OS&H engineers, four ergonomists and two researchers. The OS&H engineers and ergonomists represented both external as well as internal OHS providers and also the other diversity intentions were fulfilled.

For initiation and running the network the action oriented method co-operative inquiry (Heron and Reason, 2006) was chosen. The recommended outlines for the first meeting described by Reason and Bradbury (2013) were followed to a high degree. This included dialogues on practical issues as well as obstacles for participation in the network. Furthermore, expectations and beliefs were highlighted together with expressed needs for professional skills. In line with Heron and Reason (2006) all participants in the network acted as co-researchers. Every co-researcher received a notebook that would serve as a diary for notes and reflections on every day practice. One intention, besides own reflection, was that the co-researchers should bring the notebooks to the meetings and the notes serve as base for dialogues in the group.

The co-researchers network expressed beliefs and expectations on the network to be an arena for knowledge sharing, opportunity for meetings between practitioners and researchers as well as providing international and national outlooks. In addition, they had expectations on sharing cases from practice and spill-over effects to the "home organisation". Last but not least, they had beliefs in an open and creative climate in the network. On the other hand, the fact was mentioned that some of the co-researchers were employed at OHS firms that compete on the same market, which could influence the openness in the network. Also obstacles from participating in the meetings were highlighted. They felt that both the co-researchers and their managers need to experience that the benefits of the network are in proportion to the time spent.

During the first meeting, many needs arose for development and sharing of professional skills at the coming meetings. The needs could be categorised in four main themes with subthemes. The main themes were: The connection between work environment quality, productivity and economics, relationship between OHS providers and clients, knowledge sharing (for example of good examples, handling problem projects and obstacles, managing proactive and preventive OHS), and future working life.

The second meeting started with dialogues on the diary notes that the co-researchers had brought with them. This was followed by a presentation by an invited researcher, on the jointly decided theme "the connection between work environment, productivity and economy". Economic arguments for work environment improvements and how they can be calculated on were demonstrated. The co-researchers reflected on this theme and had dialogues on how to implement the new knowledge into daily work. A common experience was difficulties in performing such economic calculations, and one of the obstacles was problems in obtaining access to figures at the client companies. Another problem was that clients rarely ask for this kind of calculations so the clients can not be charged for the time spent performing them.

The third meeting also began with discussions on notes in the diaries about daily work practice. Themes for reflection had been agreed upon at the previous meeting; energy boosters and drainers in the daily OHS work. Aspects highlighted as giving energy at work were good relations with the clients including interest and trust, being able to contribute to improvements, and participating in early steps in change processes at the client companies. Energy drainers were related to the professional role, e.g. working a lot and alone, difficulties in achieving awareness of the benefits of working systematically with OS&H. In addition, the lack of well-functioning expert tools for risk assessments of ergonomic conditions were mentioned as an energy drainer. Further good examples were shared and jointly reflected on. A majority of the good examples contained close cooperation with the clients, positive feedback on the performed services, customised solutions, an interdisciplinary approach and new creative methodologies.

On the agenda was also an invited researcher who held a workshop on the theme "the connection between work environment, quality and productivity". At both meetings two and three there were discussions regarding the challenge to convince the clients about how to motivate investments in improved work environment. The co-researchers shared experiences of practical difficulties and possibilities in describing different arguments, such as quality, productivity and economy, for these kinds of investments.

The data was collected by handwritten notes, post-it notes and notes on whiteboard and summarised in PowerPoint presentations. In line with the method co-operative inquiry the data was validated within the process. This included validation during the meetings as well as feedback on notes sent out to the co-researchers.

The results and main conclusions were:
- The recruitment of co-researchers to the network was easy, which indicates that these kinds of networks are attractive.
- Opportunity to meet and cooperate with new colleagues and researchers to share experiences and knowledge were some aspects that motivated the co-researchers to participate in the network.
- The kind of professional skills that the co-researchers in the network wanted to develop and share could be categorised in four main themes with subthemes. The main themes were: the connection between work environment quality, productivity and economics, relationship between OHS and clients, knowledge sharing (for example of good examples, handling problem projects and obstacles, managing proactive and preventive OHS), and future working life.
- The kind of professional skills requirements that were expressed were mainly complex and at an organisational level rather than at a detail level.
- The fact that many suggested themes for the coming network meetings were lifted already at the first meeting indicates that the co-researchers had a relatively large need for knowledge sharing.
- The co-researchers had expectations on the climate in the network to be open and creative. However, the reality with some of the co-researchers employed at OHS firms that compete on the same market was mentioned as a risk for decreasing the openness within the network.
- Barriers to participating in the meetings concerned both the co-researchers' and their managers' need to experience that the benefits of the network were in proportion to the time spent.
- The co-researchers shared thoughts, experiences and good examples in a generous way, which can be interpreted as that they regarded each other more like colleagues than as competitors.

5.2 Summary of paper B.

This paper is a conference paper with the aim to critically explore the scientific method co-operative inquiry (Reason and Bradbury, 2006) when used as a tool for initiating a learning network with professionals working with OHS within manufacturing industries. The research questions were:

1. How can a learning network addressing OS&H issues be structured and implemented so that it becomes (i) attractive to participate in and (ii) sustainable over time?
2. What kind of OS&H issues will be highlighted by the co-researchers network?

For initiating and running the network there was a need for a method to build up collegial support in order to gain a creative climate between OS&H engineers and ergonomists, despite the fact that they had different employers. There was also a need for practitioners and researchers being able to meet on equal ground to develop and disseminate both practical and theoretical knowledge. The method co-operative inquiry was chosen as it has an action-oriented approach that is judged to be suitable for knowledge sharing and opens up for learning on a democratic basis (Aagaard Nielsen and Svensson, 2006). The method's core value is that the participating co-researchers are to be seen as co-researchers and the research is done with, and not on the participants (Reason and Bradbury, 2001). Research in accordance with co-operative inquiry can be described as a cyclic process with four different phases: Interactions, reflections, learning and actions (se figure 2).
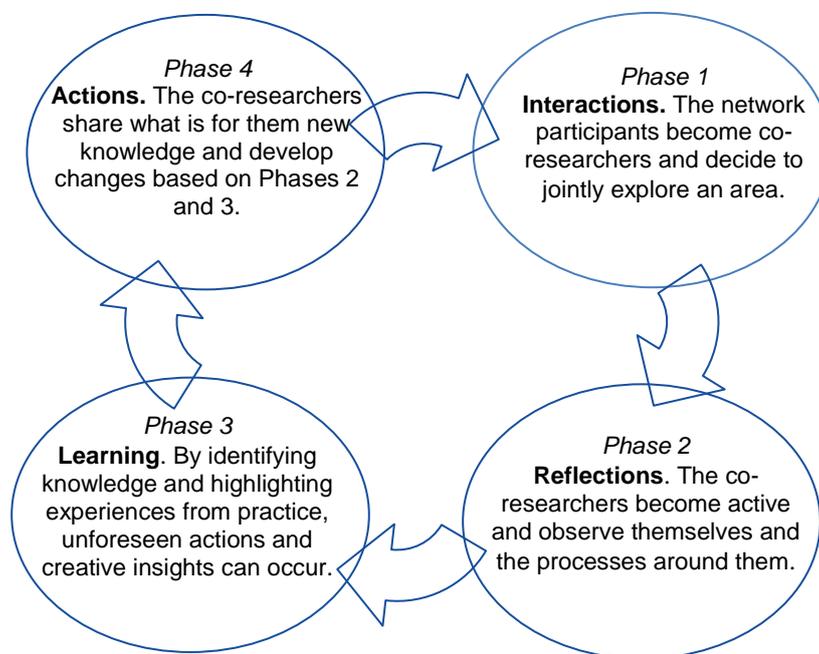
Figure 2. The process of the co-operative inquiry methodology inspired by Heron and Reason (2006), (Vänje and Nord Nilsson, 2015).

The results in this paper originate from the recruitment process as well as from the three first network meetings. All these three meetings were conducted at the University. At the first session, there were some crucial points to be met as to create an open and reflective atmosphere where the co-researchers could feel trust and be open-minded. The meeting included dialogues on beliefs and expectations, obstacles to participating in the network, practical issues and jointly defined themes for content in the coming network meetings.

The wishes regarding content for coming meetings were categorised in four main themes;

 I. Work environment and productivity (work environment and quality, key figures and how do you motivate investments in OHS)
 II. Knowledge sharing (Reflections upon good examples, how to handle problem projects and obstacles, information about programmes and courses in higher education, how to tackle working alone)
 III. Future working-life (Managing proactive OS&H, what will the future qualifications be for working with OHS, OS&H safety and health engineers and ergonomists as in-house professionals?)
 IV. Relations between OHS and the clients (The client's procurement skills, forces on the market, code of conduct, client agreements)

At meetings two and three, researchers were invited in accordance with a joint decision at the first meeting. The first presentation regarded "the connection between work environment, productivity and economy" while the second was performed as a workshop with the focus "the connection between work environment, quality and productivity". The co-researchers reflected on how to use this knowledge practically and shared different experiences of the themes. During meeting three the co-researchers also reflected on energy boosters and energy drainers and shared good examples. A majority of the good examples presented during this session had resemblances with the aspects that were considered as energy boosters. The shared themes were close cooperation with the clients, interdisciplinary work and OHS customised to the client's contexts.

The main results and conclusions were:
- Co-operative inquiry was a suitable tool for establishing the network as:
  o It has been shown to gain an open and creative climate between the co-researchers in the network despite the fact that they had different employers that often compete on the same market.
  o The fact that the co-researchers came up with a wide range of themes for the coming network meetings already at the first session.
  o There was an openness in the dialogues and sharing of good examples.
- Knowledge sharing and trust were present in the network. These factors are important for a network to be sustainable over time.
- A challenge for participating in the network was that both the co-researchers and their managers must experience a high level of benefits from the network in relation to the time spent.
- The network has turned out to be an arena for complex knowledge sharing, on practical and theoretical topics.
- There have been needs for sharing knowledge and reflecting on complex themes rather than finding solutions to specific practical problems.
- One factor that may have been important for the positive outcomes such as openness and knowledge sharing, could be the fact that the network meetings have been conducted at the university on "neutral ground".
- The network has been initiated and run by the university. The intentions with co-operative inquiry, that all involved co-researchers own the network and its aim, turned out to be hard to tackle.

5.3 Summary of paper C

This paper is a journal paper published in Applied Ergonomics. The aim of the paper was to illuminate what kind of knowledge areas OS&H engineers and ergonomists, working in the manufacturing sector, highlight when participating in a co-operative inquiry, where learning and knowledge dissemination are crucial factors.

The research question was:
What kind of professional skills do OS&H engineers and ergonomists working in the manufacturing sector (i) express needs for as well as (ii) share with each other when collaborating with researchers?

The results presented in this paper originate from all meetings in the network for OS&H engineers and ergonomists. The network was run during one and a half year and six meetings were conducted.

At the first meeting there was an inventory of the co-researchers' expressed needs for improved professional skills. These needs formed the basis for the contents during the following five meetings. One of the expressed needs related to knowledge regarding the connection between work environment, quality, productivity and economics. More specifically, the co-researchers requested different arguments and key figures to be able to motivate clients to invest in improved work environment. Skills in how to manage proactive OS&H was another highlighted topic that the co-researchers wanted to develop. They also wanted to share good examples, as well as reflect on how to handle problem projects and other challenges. Further, they wanted to elaborate and reflect on interactions with the clients, as well as thoughts about future working life for OS&H engineers and ergonomists. Since reflection is an important component of co-operative inquiry, the co-researchers were handed notebooks. The purpose of the notebooks was to use them for notes on reflections in every day practices. The books were then brought to the meetings and the notes served as a ground for further joint dialogues.

Of the following five meetings, three took place at the university, while one was conducted as a study visit at a large in-house OHS. Finally, the last meeting took place at the case study's financing body AFA Insurance. The themes of the meetings were jointly decided by the co-researchers but all meetings were organised by the professional researchers. These five meetings comprised time for tutorials, different kinds of knowledge sharing and reflections. The whole inquiry with its six meetings was documented by hand notes, PowerPoint presentations, post-it notes from group work and whiteboard notes. All documentation was continuously validated jointly by the co-researchers during the meetings, as this was built into the process. Further summaries from each

meeting were sent out to the co-researchers for feedback. The dialogues during three of the network meetings (meetings 3, 4 and 5) were audio recorded and fully transcribed.

The material from meetings two to six was analysed by the professional researchers using theoretical based template analysis. As a basis for this analysis, a template consisting of six socio-technical system elements (Davis et al., 2014) was developed. The elements; buildings/infrastructure, culture, goals, people, processes/procedures and technology, were given subtitles to describe their meaning and give a common starting point for the coding. Sections from the transcribed and handwritten material were then interpreted and coded into the different elements and their subtitles. After the coding it became obvious that the main part of the sections were related to the two elements *people* and *processes/procedures* and their subtitles. In the next step a thematic analysis (Braun and Clarke, 2006), was performed with purpose to analyse eventual interactions between the subtitles. This analytic step resulted in two thematic trees linked to the elements *people* and *processes/procedures.*

The element people consisted of themes regarding professional knowledge and how to work preventively, followed by the sub-themes (i) moving from reactive to preventive OHS, (ii) clients' knowledge about OS&H and OHS providers' role and (iii) need for internal and external cooperation. The element process included different dimensions of processes, communication topics and risk assessments, followed by the sub-themes (i) integration of OS&H, (ii) communication skills and (iii) tools for risk assessments.

The main results and conclusions were:
- The OS&H engineers and ergonomists had clear wishes to work more preventively and in a more broad perspective than currently. They expressed needs to develop skills both in how to communicate with the clients to get such assignments and how to obtain tools to perform this type of commissions.
- The co-researchers shared good examples of and reflected on different ways of turning reactive and individually focused services towards more preventive assignments at a higher organisational level.
- The professional skills that were shared and reflected on regarded:
  - Communication skills and arguments for benefits with preventive OS&H management.
  - Teamwork including cooperation with stakeholders from different levels and areas at the client companies.
  - Integration of occupational safety and health management into existing processes at client companies.
  - Participation in change projects from early stages.

- Skills in the use of different kinds of risk assessment tools for a more preventive management of occupational safety and health issues than currently.

- Focus of the dialogues in the network was at a meso level in the organisational context.

- There was a call for a system understanding, in order to develop OS&H knowledge for integration with social and technical systems instead of the common individually centred approach.

- Using the tool co-operative inquiry for the networking increased insights as it established an arena for reflective learning between co-researchers with different backgrounds and professions.

- The results also indicated that using co-operative inquiry for the learning network was suitable to bridge the gap between practice and research.

6 Discussion

In this chapter the findings from the research are discussed and compared with results from other research. It starts with a general discussion, followed by discussions about results, methods and finally my own role.

6.1 General discussion

The border between results and methods was difficult to draw in this research as one of the aims and two of the research questions are related to the method. The decision was to discuss the first aim and the third and fourth research question in the results discussion while the second aim and the first and second research question are discussed in the method discussion.

6.2 Results discussion

The first aim of the research was to gain a deeper knowledge and understanding about professional skills when it comes to OS&H engineers and ergonomists working with OHS within the manufacturing sector.

It can be concluded that this aim has been fulfilled when it comes to needs and experiences that were shared in the inquiry. The communicated needs gave answers on the third research question which was: what kind of professional skills do OS&H engineers and ergonomists working in the manufacturing sector express needs of?

The professional skills that the co-researchers expressed needs for and wanted to develop jointly were categorised into four main themes; the connection between work environment quality, productivity and economics, relationship between OHS and clients, knowledge sharing (for example of good examples, handling problem projects and obstacles, managing proactive and preventive OHS), and future working life. The kind of skills that were required were mainly complex and at an organisational level rather than at an individual and detailed level. It can be interpreted that a common denominator behind the themes was a wish to work more with preventive services than at present. The requested professional skills mainly related to convincing the clients about this approach. Consequently, there was a call for arguments and communication skill as well as for system understanding.

The difficulty for OS&H consultants to obtain assignments for preventive services, such as involvement in design and change projects, has likewise been highlighted by other researchers (Kuorinka, 2001; Broberg and Hermund, 2004; Daniellou, 2005; Dul and Neumann, 2009; Schmidt et al., 2015; Eliasson, 2017). To overcome this problem Kuorinka (2001) has pointed out a need for increased interdisciplinary collaboration and emphasises the consultant's energy and skills

in integrating his/her discipline with other actors and entrenching her/his role. Therefore, Kuorinka (2001) listed some of the professional skills needed:

- *Understand the social functions of an organisation*
- *Skills to communicate one's ideas*
- *Skills to sell an idea and a project to the management*
- *Understand other professional groups' roles and characteristics*
(Kuorinka, 2001 p. 948)

The skills pointed out by Kuorinka (2001) have many similarities with the needs expressed by the co-researchers in the network. A question is if these kinds of issues are included in contemporary educations for OS&H engineers and ergonomists.

The fourth research question was: what kind of professional skills do OS&H engineers and ergonomists working in the manufacturing sector share with each other when collaborating with researchers?

Not surprising, the majority of the shared professional skills were in line with the expressed needs. However some topics came up as shared good examples without having been mentioned as specific needs. An example of this was the role as trainer. Different good examples came up with some common denominators. One common denominator regarded a broad approach where different OHS professionals were involved. The examples contained a mixture of both practical and theoretical training, were executed close to the workplaces and involved the different senses of vision, hearing and sensation. Pedagogical skills were underlined as very important for OS&S engineers and ergonomists in different kinds of training. One of the good examples concerned training with the purpose to improve safety culture among employees. This is a topic studied by Laberge et al. (2014) who states that occupational health and safety training approaches are seldom effective for improving safety. Laberge et al. (2014) found that safety training was often disconnected from the work context. To prevent occupational injuries they (Laberge et al., 2014) suggest a new approach to learning and integration of injury prevention strategies within organisational contexts. On the other hand, Laberge et al. (2014) also found that learning occurred outside special training sessions. The latter is in line with results from research by Broberg and Hermund (2007) who identified that OS&H professionals sometimes acted as facilitators of learning without this being intentionally considered. This took place when OS&H professionals facilitated meetings between actors from different parts of organisations and worked across different departments and borders. Broberg and Hermund (2007) conclude that it is important to properly understand both learning models and the learning aspects of OS&H professionals' work practice.

Another area that was widely discussed but not included in the first inventory of needs was tools for assessments of physical load at work. This topic came up at different meetings, where some of the co-researchers expressed needs for such tools while others had good experiences from using different tools. A rather new tool: Risk Assessment and Management tool for manual handling Proactively (RAMP) (Lind et al., 2014; Lind and Rose, 2016; Lind, 2016) was presented and later tested by some co-researchers. Experiences were shared on how the use of research based tools for risk assessments had facilitated communication with managers, engineers and designers at the client companies and lead to new assignments:

> *"We have got much more difficult tasks when we have learned this. … when we present figures they tend to listen to us differently, resulting in a much better impact… I think the key is that we are skilled in how to use assessment tools. I think this is the key to ergonomics ... It is extremely important."*
> (Ergonomist in the network).

The importance of using reliable tools for risk assessments of physical load at work has been highlighted by other researchers (Lind, 2017; Palm, 2017; Eliasson et al., 2017). For example, reliability was low when assessments of repetitive work were performed without an explicit method (Eliasson et al., 2017). Salmon et al. (2017) argues that the complexities of systems thinking requires further methodological development. Both researchers and practitioners need appropriate tools to explore contemporary as well as future problems (Salmon et al., 2017).

The results presented in this thesis indicate that reliable tools are important both as a basis for communication with the clients and to support reliable management of risks. Reliable tools also make it easier to visualise and follow up results at different management levels. At the company visit, this kind of follow up of ergonomic improvement progress was demonstrated. In this case safety and ergonomics issues were followed up weekly by a group led by a workshop manager. Maybe, reliable tools can also promote the role of OS&H professionals as being an independent expert resource in accordance with the intention in the Swedish Work Environment Act (SFS, 1977). The co-researchers included in this research interpreted the term "independent" as "neutral" between employer and the worker's organisations. The role as being a neutral actor was highlighted as a problem and sometimes experienced as a balancing act between the employer, the employees and the worker's organisations. Broberg and Hermund (2004) suggest a new role for OHS professionals as "political reflective navigator" when creating healthy work conditions and participating in technological changes. This role includes mediation and facilitation, across an organisation, from a work environment

perspective (Broberg and Hermund, 2004). Probably, the use of reliable tools can reduce subjective discussions about risk levels and instead put focus on solutions for an improved work environment.

There were also good examples shared on improved interdisciplinary teamwork within the OHS company. Even though most of the network's co-researchers were organised in interdisciplinary teams they expressed that the cooperation in teams was or had been scarce. Different attempts had been made to increase the team-work. The experience of this was a better, more coherent and time-efficient support to the clients. However, extended team-work can be a financial challenge as it can be difficult for the OHS provider to charge the clients for additional OS&H professionals for different assignments.

How to work mainly preventively ran like a red thread through the discussions and shared expressions. This related to different examples, such as having economic and quality arguments for preventive assignments and being skilled in communication. Theoretical knowledge was given during two network meetings as tutorials about the connection between work environment quality, productivity and economics (Drury, 1997; Abrahamsson, 2000; Eklund, 2003; Oxenburgh et al., 2004; Neumann and Dul, 2010; Brännmark et al., 2012; Rose et al., 2013; Wilson and Sharples, 2015; Karltun et al., 2017). The co-researchers reflected on how to implement this knowledge into daily work at the client companies and shared good examples from their own practice. Although there is a lot of research in this area, it seems that this knowledge not is well spread to production companies. Consequently, there is a need for knowledge dissemination to a broader group than OS&H engineers and ergonomists. This is in line with results from research by Dul and Neumann (2009) who have argued for the integration of ergonomics as a part of company strategies. Further, Eklund (2003) has stated that the potential of ergonomics is underestimated by many decision makers and managers when it comes to improvement of company performance. Nevertheless, there are difficulties in sharing knowledge as, for example, best practice across groups that have different perspectives, vocabulary and methods (Mulholland et al., 2005). Another aspect is to which extent OS&H professionals have access to top level managers at client companies? The majority of the OS&H engineers and ergonomists included in this study mainly had one company as client and had the opportunity to have contact with stakeholders at different levels. This situation is seldom the case for external OHS providers. Instead, the contacts between OHS providers and their clients commonly go through the HR department at the client company (Schmidt et al., 2015) and the procurement process is often performed by special appointed salespersons at the OHS firms.

The OH&S engineers and ergonomists in the network were all employed at workplaces where there had been long-term collaborations between the OHS providers and the clients. As a long-term collaboration is one key factor for a change toward more preventive services (Schmidt et al., 2015) they had probably more possibilities to deliver preventive services than many other OHS providers.

The importance of working close to the client was often highlighted at the network meetings. This included having contacts and cooperating at different levels and with different departments at the client companies. Especially managers at different levels in the line organisation and the quality departments were pointed out. To integrate the management of OS&H issues in the client companies' own processes was pointed out as a success factor for achieving structured and sustainable improvements of work environment. Some co-researchers had positive experiences of the outcome of this approach. In addition, it was demonstrated on the company visit how OS&H issues were integrated from strategic plan to different production processes as well as follow-up systems. This kind of integration is in line with recommendations by Dul and Neumann (2009) and Hendrick (2008). Some companies have special departments working with the development of the company's processes. To cooperate with this kind of stakeholders can be a key factor for OS&H professionals in the attempt to integrate OS&H issues in the processes.

Further inclusion in change processes from early stages was underlined as extra important in order to have the possibility to contribute to improved working conditions. Other research emphasises the cost efficiency of integrating ergonomics and other work environment aspects early into technological changes (Broberg and Hermund, 2007; Dul and Neumann, 2009; Hendrick, 2008). Nevertheless, it is also highlighted that OS&H professionals are rarely involved in design and change processes (Broberg and Hermund, 2004; Dul and Neumann, 2009; Daniellou, 2005). The co-researchers in the research shared examples of involvement in change projects and different positive outcomes. Besides the obvious results of OS&H professionals' involvement in change projects, Broberg and Hermund (2007) also highlight that knowledge transfer occurs during this kind of cooperation.

Different solutions for moving towards more preventive work were discussed in the network. One example was to try to adjust reactive assignments so that they become more proactive and preventive. Another example was to attempt to include system perspectives even in assignments at a detail or individual level. For both these examples, it is a necessity to have system perspective knowledge. The need for this kind of knowledge was expressed by the co-researchers. In this research, the majority of the OS&H engineers and ergonomists worked with one

large client company each. This prerequisite made it easier to establish co-operation with different stakeholders at the client company, than if they have had a number of clients.

Anchoring activities at different levels within the client company was also emphasised by the researchers as important for clarifying the expectations on services delivered. Especially support from high management levels was highlighted, as this is also important for the implementation of improvements, in other words to really achieve results from the services. However, it is not self-evident for OS&H engineers and ergonomists to have these contacts. Instead, results from other research have shown that contacts between OHS providers and the clients often are conducted with the HR department at the client companies (Schmidt et al., 2015). At external OHS providers, the client contacts during the procurement process often go through specially appointed salespersons at the OHS firm. This means that the salespersons also need to have an approach with focus on prevention and have system knowledge. The salespersons also need to have knowledge, arguments and interests in selling preventive services.

It can be interpreted that the co-researchers in the network had a lot of system knowledge, learned by experience. However, they expressed a need of theoretically based knowledge to emphasis their message in communicating with clients. It can be concluded that the OS&H professionals in the research wanted to work more preventively, which is in line with the Framework Directive Directive 89/391/EEC on Safety and Health at Work (European Council. 1989) and the Swedish Work Environment Act (SFS, 1977). Nevertheless, OHS providers act on a free market and the services delivered depend on what the clients want to buy.

6.3 Method discussion

A second aim was formulated as: to gain experiences of using co-operative inquiry in a learning network for OS&H professionals in order to develop professional skills.

The description by Reason and Bradbury (2013) for the start of the first network meeting was easy to follow and gave support to organise the network. A positive start of a network is probably very important for the future outcome. The experiences from the research confirmed that co-operative inquiry is a suitable method for this kind of networking as it creates an arena for practitioners' experience-based knowledge and researchers' theoretical knowledge to meet and be reflected on. The method was shown to gain an open and creative climate between the co-researchers in the network despite the fact that they had different

employers. A wide range of themes were reflected on and there was openness when it comes to dialogues and sharing of knowledge.

Different alternatives for the meetings in the network were discussed at the first meeting. There was a joint decision to meet physically in line with other networks using co-operative inquiry. Some of the co-researchers had a long distance to travel to the meetings. Besides the fact that it took a long time to travel, there also were problems with transport, such as cancelled trains, which made it impossible for some co-researchers to attend some of the meetings. On the other hand, the long distance between the co-researchers' workplaces was probably an advantage related to not regarding each other as competitors on the market.

According to co-operative inquiry the intention is that all participants in the inquiry act as co-researchers but can have different roles (Heron and Reason, 2006). Svensson et al. (2007) have also argued that an interactive research presupposes close cooperation throughout the entire research process. However, there can be different levels of participation by co-researchers in a co-operative inquiry, and there are sufficient challenges to really get involvement by all co-researchers through the whole process (Godden, 2017). For the actual research, the researchers at the university initiated the network and organised the meetings, which is in line with Holmquist (2009). The future management was discussed at the first meeting and it was a clear wish from the co-researchers that the forthcoming meetings would be organised by the university. However, the arrangements with the network organised by the university, held on a "neutral ground" and travel costs paid by the university may have been essential prerequisites for carrying out the network meetings.

One challenge was how to document the meetings. The choice was to start with only written documentation on whiteboard, post-it notes and PowerPoint presentations, which was jointly agreed on and summarised. An alternative was to tape record the meeting, but this was not suggested to the co-researchers until the third meeting. The purpose of waiting with this suggestion was that it was essential to create trust in the network. After two meetings, which had been conducted in an open atmosphere with trust, nobody disagreed to tape recording the coming meetings. On the other hand, one disadvantage with this arrangement was that there are not tape-recordings from all meetings.

The approach was qualitative and the intention to obtain subjective knowledge was fulfilled. However, one question is how trustworthy or robust the results are. The actual inquiry includes participators outside the academic sphere, which according to Nowotny et al. (2001) and Gunnarsson (2007) increases the social robustness of the research. In line with the co-operative inquiry method (Heron

and Reason, 2006) validity was built into the different phases were the co-researchers regularly agreed on summaries of the findings. In addition, the summaries were sent out to the co-researchers for feedback.

Other research has shown that knowing is more valid if four different criteria are fulfilled and congruent with each other (Heron and Reason, 2006). In line with these criteria, the knowledge has to be grounded in the experience, expressed through images and stories, expressed in worthwhile actions in practice and understood through theories which make sense (Heron and Reason, 2006). The results from the inquiry contain different topics where it can be argued that the knowledge meets the four criteria. Further, there are results from other research on different topics that are in line with the results in the current inquiry. This is exemplified later in this chapter.

The first research question was: how can a learning network addressing OS&H issues be structured so that it becomes attractive to participate in?

It was easy to recruit co-researchers to the network, which can point to that these kinds of networks are attractive. A motivating factor mentioned by the OS&H engineers and ergonomists in the network was the opportunity to meet and cooperate with new colleagues and researchers for sharing experiences and knowledge. Some of the co-researchers were alone in their profession at their workplace and wished especially for cooperation with other colleagues. This kind of cooperation between different OHS providers has been minimised since 1993, when the market became deregulated. The fact that many proposed themes for the coming network meetings were lifted already at the first meeting, indicates that the co-researchers had a relatively large need for knowledge sharing.

The co-researchers had expectations on the climate in the network to be open creative and with trust. These factors have been emphasised as important in co-operative inquiry (Heron and Reason, 2006). This kind of aspects were probably especially important for the OS&H engineers and ergonomists in the actual network. The reality with some of the co-researchers employed at different OHS firms that competed on the same market was mentioned as a risk for decreasing the openness in the network. However, the experiences from the network meetings were an open and creative climate where the co-researchers shared good examples and thoughts in a generous way. One circumstance that may have been important for the positive climate can be the arrangement with the main part of network meetings conducted at the university on "neutral ground". In addition, the co-researchers worked at a relatively long distance from each other, which probably decreased the feeling of being competitors. Further, half of the participants of the group were employed at in-house OHS, which also

could have contributed to a feeling of seeing each other more as colleagues than competitors. Among the other co-researchers at external OHS providers the majority worked with mainly one client, which has many similarities with internal OHS.

One obstacle to participation was the time aspect. The co-researchers highlighted that both they and their managers had to experience benefits from the network in relation to the time spent. The fact that invitation letters with the intention for the network was sent out to both the co-researchers and their managers may have contributed to support from managers and willingness from the co-researchers to participate.

Holmquist (2009) has emphasised the advantages of leaving the own workplace and meet persons from different workplaces in a network. The co-researchers in the networks started by Holmquist (2009) were chosen from different companies which did not compete on the same market. For professionals within the OHS sector it is difficult to combine those two prerequisites without recruiting co-researchers who are geographically widely spread. On the other hand, participants from different small OHS units within the same company may have benefits of starting learning networks similar to the methodology in co-operative inquiry. If this should be the case, it may be difficult to involve external researchers but there are positive examples of groups who have used co-operative inquiry for networks without involving professional researchers (Heron and Reason, 2006).

The second research question was: how can a learning network addressing OS&H issues be structured so that it facilitates reflective learning?

Reflection is an essential part in the method co-operative inquiry and the recommended arrangement of the network meetings includes different ways of reflection. In the actual network, both theoretical and practice based knowledge were reflected on at the network meetings. Different obstacles from working proactively and preventively were reflected on and there was high attention on finding solutions to overcome hindrances. The co-researchers never stuck in discussing circumstances were they could not see ways of going around hindrances. Since the co-researchers had different background and experiences, they had a lot of good examples to share of how to handle obstacles. For every obstacle highlighted there were usually a couple of experiences shared of how to manage the hindrances.

To support reflections between the meetings in the actual network, all co-researchers received notebooks. The intention was to use them as diaries with notes on reflections on the daily work between the meetings and then bring them

for dialogues at the meetings. In the beginning, there were some difficulties in getting started with noting down reflections between the meetings. The co-researchers were not used to this and at meeting two, a joint decision was taken to narrow the reflections to a theme for the coming period. The theme was: what gives and what takes energy in the daily work? After this step, the co-researchers noted reflections from daily practice and the notes were then reflected on at network meeting three. In practice, this was arranged so that the co-researchers had dialogues two and two based on their own notes, and then further discussions were held in the whole group. The lessons learned from this was that it is probably best to start with a quite narrow jointly decided topic for reflections in daily work until the co-researchers are familiar with reflecting on daily practice and using the notebooks.

Another aspect highlighted by Nilsen et al. (2012) is the increased focus on research-based knowledge and evidence-based practice. This has been seen in many work fields including the OHS sector. The description of evidence-based practice often relates to making practice more standardised based on knowledge from research. An important but often neglected fact is that existing routines and methods must be changed "unlearned" as they can otherwise become barriers for new knowledge (Nilsen et al., 2012; Thorsrud, 1976). Nilsen et al. (2012) have argued that reflection can be a tool for challenging established patterns and reducing pre-existing knowledge, methods and routines that need to be replaced by evidence-based practice. Even though the benefits of reflections on daily work can be shown, it is likely to be a challenge to take time for reflection in the context where OS&H professionals work. It is common that professionals employed at external OHS in Sweden have high work demands and are individually monitored as to how much time they charge the clients. The time aspect can also be a hindrance for physical network meetings or contribute to increased stress and a need for (or feeling of) having to work extra hard before and after the meetings to "compensate" for the time one is unable to charge the client. Experiences from two mini cases (Nilsen et al., 2012) underscored that time for reflections at a place separated from the daily work was a key factor for learning, as well as the importance of having a facilitator.

The professional skills requirements that were expressed and shared were mainly complex and at a meso level rather than at a micro level. For this kind of skills for handling complex as well as uncertain and instable situations, reflective learning is an especially suitable tool (Nilsen et al., 2012, Schön, 1983). Reflective learning has been emphasised as a perspective and a tool that includes informal as well as formal processes based upon practical and theoretical knowledge (Svensson et al., 2004). The results in this case study indicate that the method co-operative inquiry was useful as an arena for reflective learning and that the method was suitable for linking the gap between

research and practice. For example, there were dialogues on how to use the knowledge about the connection between work environment, quality, productivity and economy. The results of the discussions related to how to implement the new knowledge into daily work, and different good examples were shared with the purpose to improve professional skills. Even though it can be stated that the co-researchers reflected on how to implement new theoretical knowledge into daily work, it is not certain that they have changed their practice as this has not been measured in this study.

Although a lot of research regarding learning can be found, Ellström (2010) has highlighted that focus of the research is often on formal learning rather than informal learning at work. In addition, focus is often on the subjective aspect of learning. Ellström (2010) as well as Roessger (2014) have called for research on objective outcome as new or improved work-related skills, new ideas or models that can be expressed and categorised.

To use the socio-technical elements as the basis for analysis was constructive as they offered a broad approach on the data. It was also rather easy to analyse the data into the different sub-nodes. From the results of the research it can be interpreted that the methods have given a deeper knowledge and understanding of professional skills when it comes to the OS&H engineers and ergonomists in the actual network. It can be concluded that reflective learning based on both theory based and practical knowledge occurred at the network meetings. There was a high focus on how to apply the knowledge into daily work. This can point to that the method co-operative inquiry was suitable for the development of professional skills.

6.4 Reflections on my own role

In action research the researcher's influence is considered as something positive (Lewin, 1946; Aagaard Nielsen & Svensson, 2006). Svensson (2002) proposed a more supportive than pushing approach. Also the importance to reflect on the own role has been highlighted in action research (Berner 1989; Andersson, 2012).

The intention in the actual research was to have a supportive role as researchers. I have tried to develop and improve this kind of approach in my work as ergonomist within OHS. On the other hand it is not easy to critically reflect on the own role. Even though we as researchers tried to have a supportive role during the meetings we had initiated and arranged the network. In this sense we had a pushing role in the beginning. My experiences of the context made it rather easy to arrange the start of the network. This as I knew which manufacturing companies had internal OHS and other facts about current OHS as well as the manufacturing sector.

6.5 Practical implications

One aim was to gain a deeper knowledge about professional skills when it comes to OS&H engineers and ergonomists in the context OHS within the manufacturing sector. A second aim was to gain experiences of using co-operative inquiry in a learning network for =S&H professionals in order to develop professional skills. The majority of the findings are in line with results from other research. Therefore, the outcomes can be presented in the form of proposals as below, mainly addressed to managers and employees in the OHS sector working with large manufacturing companies. All suggestions support a proactive and preventive approach of services delivered by OHS providers.

- Cooperate in interdisciplinary teams
- Develop knowledge on system understanding
- Develop skills in how to be a good trainer and how to disseminate knowledge on work environment
- Develop skills on and use reliable risk assessment tools
- Develop communication skills
- Work close to the clients
- Strive to have contacts and cooperate at different levels and with different departments at the client companies, especially with managers at different levels in the line organisation and the quality departments
- Use the possibility to work across different levels and borders
- Spread knowledge about the connection between work environment, quality, productivity and economy within the OHS organisation and to the clients
- Discuss about work environment in terms of quality, productivity and economy
- Strive to integrate the management of OS&H issues in the client companies' own processes. Inclusion in change processes is extra important
- Try to adjust reactive assignments so that they become more proactive and preventive
- Attempt to include system perspectives even in assignments at a detail or individual level
- Be aware of the role as trainer in all work at the client companies, not only in direct articulated training situations
- Organise and plan time for reflections on daily practice

The above suggestions can also provide input to the content of courses for OS&H professionals. The method Co-operative inquiry is useful for knowledge development by reflective learning and can be used by OS&H professionals even if they are employed at different companies.

7 Conclusions and further research

In this chapter the conclusions of the research are drawn. Thereafter follows proposals for further research.

7.1 Conclusions

There were two aims in the research included in this thesis. One aim was to gain a deeper knowledge and understanding about the area of professional skills when it comes to OS&H engineers and ergonomists working with OHS within the manufacturing sector. The second aim was to gain experiences of using co-operative inquiry in a learning network for OS&H professionals in order to develop professional skills.

The results showed that a wish to work more preventively than at present went like a red thread through the whole inquiry from the professionals' expressed needs to the shared experiences. The main focus was to gain different skills and arguments with the purpose to obtain these kind of assignments by convincing the clients about this preventive approach. Experiences and good examples were shared of how to perform such commissions and how to turn reactive assignments to more preventive services. The main part of the content in the inquiry was related to a meso level in the organisational context. The focus was on system understanding in order to turn work with OS&H from being reactive and individually centred to integration with the systems and processes at the client companies.

Some practical implications could be pointed out as suggestions to support a proactive and preventive approach of services from OHS providers. The proposals regarded cooperation in teams within the OHS firms and with different stakeholders at the client companies, integration of OS&H management into existing processes, participation from early stages in design and change processes, use of risk assessment tools and, finally, communication skills. The ambition to work more preventively is in line with the Framework Directive on Safety and Health at Work (Directive 89/391/EEC) (European Council. 1989) and The Swedish Work Environment Act (SFS, 1977).

This inquiry showed that it was easy to gather OS&H engineers and ergonomists despite the fact that some of them were employed by different OHS providers that competed on the same market. The climate at the network meetings was open and experiences and thoughts were shared in a generous way.

Finally, the experiences of using co-operative inquiry for a learning network were positive and point out the method as useful for reflective learning. It might be a suitable tool for future knowledge development in the OHS sector both for networks across different borders and within organisations of OHS providers.

7.2 Further research

Since the research in the area of learning and professional skills for OS&H professionals is scant but pointed out as very important, there is a big need for further research in this field.

The research presented in this thesis is based solely on the OS&H engineers' and ergonomists' own perceived needs. Extending the research to also include clients' perceived needs for support and expertise from the concerned professionals would probably give important perspectives. Other interesting aspects include whether participation in a learning network leads to changes in daily work and if the knowledge is disseminated to the "home organisation". Moreover, to make research with OHS providers serving clients in other sectors would be interesting, as it gives possibilities for comparing similarities and differences. Including other professionals at OHS providers is also an area for future research.

In addition, the method co-operative inquiry would be interesting to explore further when used in other ways for knowledge development in the OHS sector.

Tack!

Nu när det snart är dags att sätta den sista punkten i avhandlingen tänker jag på att det är många faktorer och många människor som bidragit till innehållet före denna allra sista punkt – och som bidragit till att det blivit någon avhandling överhuvudtaget. Att uttala sig tvärsäkert om orsakssamband inom forskning är annars en utmaning men i det här fallet är jag helt övertygad om att det aldrig blivit någon avhandling för min del om det inte funnits andra personer som bidragit på olika sätt. Jag vill därför tacka alla som på olika sätt har gjort det möjligt för mig att forska och som bidragit till min licentiatavhandling. Några vill jag tacka extra:

Först sänder jag en tacksam tanke till AFA som finansierat projektet jag forskat inom. Ett citat som jag hört är: "Det sägs att forskare söker sanningen, men sanningen är att forskare söker pengar". (Anonym källa). Visst är detta citat tillspetsat men forskning är beroende av finansiering och inom arbetsmiljöforskningen i Sverige idag är AFA:s satsningar mycket viktiga. På Scania har vi flera projekt som pågår där vi samarbetar med olika universitet och har AFA som finansiär. Att denna möjlighet finns tror jag gjort oss öppna för att starta projekt för att försöka lösa problem i det dagliga arbetet.

Nästa tacksamma tanke går till KTH som vågade satsa på en doktorand som inte har särskilt många år kvar till pensionen, och som dessutom sökte en heltidstjänst men bara ville ha en halvtid.

Sedan är jag naturligtvis mycket tacksam mot min huvudhandledare Jörgen Eklund och bihandledare Annika Vänje. Jag sökte doktorandtjänsten för att jag tyckte det lät intressant och viktigt att forska runt lärande och kunskap inom företagshälsovården. Jag visste att det handlade om att starta ett nätverk för arbetsmiljöingenjörer och ergonomer inom tillverkningsindustrin men hur forskningen runt det nätverket skulle genomföras hade jag svårt att se. Där har mina handledare hjälpt till att lotsa mig mellan olika idéer och alternativ. Annikas erfarenhet av kvalitativ forskning har också varit värdefull eftersom mina tidigare erfarenheter av forskning mest handlat om kvantitativ inriktning. Jörgen med sin enorma kunskap, erfarenhet och positiva inställning har också varit en viktig person genom hela processen. Hans stora bibliotek har också varit bra att ha tillgång till. Oavsett vilken fråga jag haft har Jörgen alltid haft exempel på olika artiklar och böcker om ämnet.

Även på min arbetsplats på Scania är det många som bidragit till att jag kunnat, velat och orkat genomföra forskningen. För att kunna bli industridoktorand på Scania behövs beslut på flera chefsnivåer och jag är tacksam för att alla varit positiva och gett mig den här möjligheten. Mina ergonomkollegor på Scania är också värda ett alldeles särskilt tack. Under de här fyra åren har jag enbart

upplevt positiv respons på att jag varit på KTH på halvtid. Ingen har klagat på att det är svårt att nå mig, svårt att boka möten eller ifrågasatt vad jag gjort på KTH. Tvärtom har jag fått kommentarer om att det varit positivt och att även de känt att de har kommit närmare till olika forskning på KTH.

Som industridoktorand har jag också haft förmånen att vara med i ett industridoktorandnätverk inom produktionen på Scania. Det har gett mig både inspiration och nya kontakter som jag också har nytta av i mitt arbete som ergonom.

Alla mina nya kollegor på avdelningen för ergonomi på KTH är en annan källa för kunskap och inspiration. Jag tänker särskilt på allt roligt vi haft i doktorandgruppen och då är våra skrivarstugor det som först dyker upp i tankarna. Där har vi verkligen förenat nytta med nöje!

De som sedan är värda ett väldigt stort tack är de arbetsmiljöingenjörer och ergonomer som varit med i nätverket som hela avhandlingen handlar om. Att de överhuvudtaget ville vara med och dessutom delade med sig generöst av sina erfarenheter och tankar är jag oerhört tacksam över.

Stöd och hjälp har också dykt upp från oväntat håll och exempelvis har grannar vid sommarstugan och en industridoktorand på Scania läst avhandlingen och gett både synpunkter och hittat stavfel. Många andra vänner har bidragit med trevligheter som middagar medan vi inte varit lika flitiga med att bjuda igen, men nu blir det snart ändring på det….

Sist men inte minst tänker jag tacksamt på min familj. Mina barn Rasmus och Cecilia är utflugna och har inte "drabbats" direkt av min forskning och när jag träffat dem har jag plockat undan dator och vetenskapliga artiklar. Ändå har de bidragit till att ge mig positiv energi och de har hela tiden varit entusiastiska över att jag forskat. Barnbarnen Adrian och Felicia ger mig som farmor oerhört mycket ny energi bara genom att de finns till. Nu kan jag snart vara barnvakt oftare…

Det allra största tacket har jag sparat till min man Janne. Under årens lopp har vi utsatt vårt långa förhållande för olika prövningar som äventyrliga seglingar och resor till udda resmål. Andra prövningar har varit olika examensarbeten som jag gjort. Då har Janne varit mentalt stöd i den "nöd och lust" som examensjobben fört med sig. Nu har han också stöttat med praktisk service som att laga mat vilket varit nog så viktigt. En hungrig och utmattad doktorand har nog svårt att skriva något vettigt. Så än en gång: tack min älskade Janne!

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