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The Finnish Occupational Accidents and Diseases Statistics Database Employed for Safety Promotion

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ABSTRACT

During recent decades, much emphasis has been placed on improving health and safety at work in the European Union (EU) and EU countries, including Finland. There have been major efforts, for example, to develop the recording of occupational accidents. Recently, a new European Statistics on Accidents at Work (ESAW) methodology to collect harmonised data on accidents at work on a national and EU level was implemented in the EU member states. In the Finnish official national occupational accident database, the ESAW methodology was implemented in 2003. At the same time, a web-based user interface of the database was introduced for organisations operating in the field of occupational health and safety (OH&S).

Furthermore, notable strategic goals of reducing occupational accidents have been set in both the EU and at the Finnish national level. Recently, improvements in working conditions and decreasing trends in occupational accidents have been reported in EU countries. Nevertheless, this positive development has not been uniform across categories of workers, companies, sectors and occupational accident types. Moreover, the advances in promoting OH&S may have been weakened due to the current economic recession. In addition, EU countries are currently facing major changes in working life patterns, which may have implications in terms of emerging risks to OH&S. Apart from these issues, in Finland, the major challenge at the moment seems to lay in changing the stagnating trend in occupational accidents into a positive downward trend. Hence, there is need to carry on with efforts targeted at preventing occupational accidents and improving health and safety at work in the EU and Finland. To guide and support these efforts, up-to-date information on occupational accidents is needed, particularly data related to topical and emerging occupational accident trends and health and safety issues. However, at the same time, there are not yet many experiences on how well the present national-level occupational accident data-collection systems and databases provide information that meets the current needs.

In this research, the Finnish official national occupational accident database was utilised to provide information concerning occupational accidents related to selected topical OH&S issue cases. An accident analysis was carried out in order to view the extent of and factors contributing to accidents at work related to violence (n=3441); accidents at work during temporary agency work (TAW) (n=5278); occupational accidents in the local government sector (n=17,961); and slipping, stumbling and falling (SSF) accidents at work (n=48,869). Moreover, the utilisation and usefulness of the database and the user interface regarding safety promotion were discussed from the user viewpoint. The utilisation and usefulness of the database and its web application for safety promotion in general was studied via a questionnaire directed to all known users (n=206, response rate 62%). To supplement the results of the questionnaire, a scenario analysis was used to chart the information-retrieval possibilities and potential challenges related to the selected OH&S issues.

The results of this research support the assumption that the OH&S issue cases viewed in this research are particularly relevant from the viewpoint of safety promotion, although the relevance of the various cases are due to slightly different reasons. Up to this point, both occupational accidents in the local government sector, and SSF accidents at work have accounted for the major proportion of accidents when compared to the total number of occupational accidents in Finland. Accidents at work related to violence or TAW constitute a rather small share of all

accidents at work in Finland, but the number and incidence of both seem to be increasing. Hence, focusing accident prevention on these OH&S issues may potentially aid in the effort to turn the static trend in occupational accidents around, reducing the rates in Finland and in other countries with similar trends. In general, the variety of factors contributing to occupational accidents related to these OH&S issues, and the variety of sectors and occupations these occupational accidents concern pose challenges to accident prevention.

According to the results, the major current challenge in preventing accidents at work related to violence and violence at work in general concerns taking into account the increasing trend particularly among women, younger women and in the service sector. Regarding TAW, the increased use of TAW in traditionally more accident-prone industries such as building construction work; engineering and structural metalwork; and packing, wrapping, warehousing and stevedoring work should be taken into account in accident prevention. The results also indicated that accidents at work often occurred in manual work assignments requiring less expertise such as when carrying and lifting loads. Hence, the importance of proper training in safe work practices is emphasised, particularly because temporary agency workers are often young and have less experience of working life. It seems that the factors contributing either to occupational accidents in the local government sector, or to SSF accidents at work have not changed notably during recent years. In both cases, the major challenge seems to be to enhance accident prevention in general. Reflecting on the employment structure of the local government sector, many of the occupational accidents involve women, older employees, and occupational classes with most employees, with medical and nursing work and farming work standing out as occupational groups. Furthermore, the risk of commuting accidents seems to be higher in the local government sector than in general in Finland. The risk of SSF accidents at work seems to vary according to a variety of factors such as the specific physical activity of movement, age and occupation class.

Generally, it is rather advanced for OH&S organisations in Finland to have access to the national occupational accident database with a web application. Often, the access to the national occupational accident databases remains restricted to the particular register's personnel. The users also seemed to regard the existence of this kind of information source as important and were mainly satisfied with the database and its web application. However, the utilisation and usefulness of the database and its web application could be enhanced. In general, users' awareness of the existence of the application and its utilisation possibilities could be improved. Less active users would benefit particularly from improved ease of use and additional guidance and directions. Active users would benefit from more advanced tools for information retrieval and processing. The OH&S issue cases demonstrated that sometimes retrieving information on occupational accidents might not be straightforward when employing the existing classifications. Nevertheless, the cases also highlighted that there were different ways to retrieve information. Additional methods such as accident-description analysis and methods of data mining are useful in supplementing information retrieval based on classification variables. Novel ways and examples of information retrieval and data analysis may enhance the utilisation and utilisation possibilities of the database and its web application. They may also provide new insights into safety promotion.

TIIVISTELMÄ

Viime vuosikymmenten aikana Euroopan Unionissa (EU) ja EU-maissa on panostettu merkittävästi työn terveellisyyden ja turvallisuuden edistämiseen. Esimerkiksi työtapaturmien tilastointia on pyritty kehittämään. Kansallisella ja EU-tasolla kerättävän työtapaturmatiedon yhdenmukaistamiseksi EU-maissa on hiljattain otettu käyttöön uusi yhteinen työpaikkatapaturmien luokittelumenetelmä ESAW (European Statistics on Accidents at Work). Suomessa ESAW-menetelmä otettiin käyttöön valtakunnallisessa työtapaturmatietokannassa vuonna 2003. Samalla kehitettiin suomalaisille työturvallisuusorganisaatioille suunnattu verkkopohjainen käyttöliittymä, Tapaturmapakki, tietokannan itsenäiskäyttöä varten.

EU:ssa ja Suomessa on lisäksi asetettu kunnianhimoisia tavoitteita työtapaturmien vähentämiseksi. EU-maiden työolosuhteissa ja työtapaturmatrendeissä onkin viime aikoina raportoitu positiivista kehitystä. Kehitys on kuitenkin ollut epätasaista eri työntekijäryhmien, yritysten, toimialojen ja tapaturmatyyppien välillä. Viimeaikainen taloudellinen taantuma on myös voinut heikentää positiivista kehitystä. Lisäksi työelämän ajankohtaiset muutokset EU-maissa voivat vaikuttaa työolojen terveellisyyteen ja turvallisuuteen aiheuttaen esimerkiksi uusia työturvallisuusriskejä. Suomessa keskeisenä ajankohtaisena haasteena on saada pitkään ennallaan pysynyt työtapaturmatrendi jälleen uuteen laskuun. Työturvallisuuden edistämiseksi ja työtapaturmien torjumiseksi tehtävää työtä tuleekin edelleen jatkaa määrätietoisesti. Tätä työtä tukemaan tarvitaan ajantasaista tietoa sattuneista työtapaturmista erityisesti ajankohtaisiin työturvallisuuskysymyksiin liittyen. Nykyisten valtakunnallisten työtapaturmatietokantojen potentiaalista tarjota ajankohtaisia tarpeita vastaavaa tietoa on kuitenkin toistaiseksi verrattain vähän kokemuksia.

Tässä tutkimuksessa tuotettiin tietoa ajankohtaisiin työturvallisuuskysymyksiin liittyvistä työtapaturmista Suomen valtakunnallisen työtapaturmatietokannan pohjalta. Tutkimuksessa analysoitiin vuosina 2003 ja 2006 sattuneita väkivaltaan liittyviä työpaikkatapaturmia (n = 3441), vuosina 2006–2007 vuokratyössä sattuneita työpaikkatapaturmia (n = 5278), kuntasektorin työtapaturmia vuodelta 2004 (n = 17 961) sekä liukastumiseen, kompastumiseen tai putoamiseen liittyviä työpaikkatapaturmia vuosilta 2006–2007 (n = 48 869). Lisäksi tutkimuksessa tarkasteltiin itsenäiskäyttäjien näkökulmasta tietokannan ja sen verkkosovelluksen hyödyntämistä ja käyttökelpoisuutta työturvallisuustyössä. Yleisen kuvan saamiseksi tietokannan ja sen verkkosovelluksen hyödyntämisestä ja käyttökelpoisuudesta kaikille tiedetyille itsenäiskäyttäjille (n = 206) lähetettiin kysely. Vastausprosentiksi saatiin 62 %. Kyselyaineistoa täydennettiin tarkastelemalla skenaarioanalyysin avulla tiedonhaun mahdollisuuksia ja haasteita valittuihin työturvallisuuskysymyksiin liittyen.

Tutkimuksen tulokset tukevat käsitystä, että tässä tutkimuksessa tarkasteltuihin työturvallisuuskysymyksiin liittyvien työtapaturmien vähentäminen on erityisen olennaista työturvallisuuden edistämisen kannalta, vaikkakin hieman eri syistä. Kunta-alan työtapaturmat sekä liukastumiseen, kompastumiseen tai putoamiseen liittyvät työpaikkatapaturmat ovat kummatkin jo pitkään muodostaneet merkittävän osan kaikista työtapaturmista Suomessa. Väkivaltaan tai vuokratyöhön liittyvien työpaikkatapaturmien osuus kaikista työpaikkatapaturmista taas on verrattain pieni, mutta niiden määrä ja riski suhteessa työntekijöiden ja tehtyjen työtuntien määrään on kasvussa. Kyseisiin työturvallisuuskysymyksiin

liittyvien työtapaturmien torjunnan tehostamisella on siten potentiaalisesti merkitystä myös yleisen työtapaturmatrendin positiivisen kehittymisen kannalta Suomessa ja muissa maissa, joissa on havaittavissa samansuuntaisia trendejä. Yleisesti näihin työturvallisuuskysymyksiin liittyvien työtapaturmien torjunnan kannalta on haastavaa niihin vaikuttavien tekijöiden moninaisuus sekä niiden esiintyminen monilla eri aloilla.

Tutkimuksen tulosten mukaan työväkivaltaan liittyvien tapaturmien ja työväkivallan torjunnan ajankohtaisena haasteena on ottaa huomioon sen lisääntyminen naisten ja erityisesti nuorten naisten keskuudessa sekä palvelualalla. Vuokratyön tapaturmien torjunnassa tulisi ottaa huomioon sen lisääntyminen perinteisesti tapaturma-alttiimmilla aloilla kuten talonrakennustyössä, konepajatyössä ja rakennusmetallityössä sekä pakkaus-, varastointi- ja ahtaustyössä, mikä selittänee myös työpaikkatapaturmariskin kasvua vuokratyössä. Tulokset osoittivat myös, että vuokratyön työpaikkatapaturmat sattuivat usein vähemmän erikoisosaamista vaativassa käsin tehtävässä työssä, esimerkiksi siirrettäessä taakkaa käsivoimin. Vuokratyöntekijöiden ollessa usein nuoria vailla aiempaa kokemusta työelämästä, vuokratyön työturvallisuuden edistämisessä korostuukin perehdyttämisen merkitys. Kunta-alan työtapaturmiin tai liukastumiseen, kompastumiseen tai putoamiseen liittyviin työpaikkatapaturmiin vaikuttavissa tekijöissä ei ole juuri tapahtunut muutoksia viime vuosina. Kummassakin tapauksessa haasteena vaikuttaa olevan tapaturmien torjunnan tehostaminen yleisesti. Kunta-alan työtapaturmissa näkyvät selvästi kuntasektorin palkansaajien sekä kunta-alalle tyypillisten ammattien rakenne. Suurin osa kunta-alan työtapaturmista sattuukin naisille, iäkkäämmille työntekijöille ja ammattiluokissa, joissa myös suurin osa työstä tehdään. Ammattiluokista erityisesti terveyden- ja sairaanhoitotyö sekä maatilataloustyö nousevat esille. Lisäksi kunta-alalla on suurempi työmatkatapaturman riski kuin Suomessa yleensä. Liukastumiseen, kompastumiseen tai putoamiseen liittyvän työpaikkatapaturman riskiin vaikuttaa useita tekijöitä, tärkeimpinä esimerkiksi liikkuminen työsuorituksena, ikä ja ammattiluokka.

Yleisesti ottaen on edistyksellistä, että suomalaisilla työturvallisuusorganisaatioilla on mahdollisuus käyttää valtakunnallisen työtapaturmatietokannan sisältämää aineistoa itsenäisesti verkkopohjaisen sovelluksen kautta. Yleensä valtakunnallinen työtapaturmatieto on käytettävissä vain virallisten julkaisujen tai tietokannan ylläpitäjien kautta. Myös itsenäiskäyttäjät pitivät tärkeänä mahdollisuutta hyödyntää tietokantaa ja olivat pääasiassa tyytyväisiä tietokantaan ja Tapaturmapakkiin. Tutkimuksen mukaan tietokannan hyödyntämistä ja käyttökelpoisuutta voitaisiin kuitenkin edelleen edistää. Itsenäiskäyttäjien tietoisuutta Tapaturmapakin olemassaolosta ja sen hyödyntämismahdollisuuksista voitaisiin lisätä. Tapaturmapakkia vähemmän käyttävät hyötyisivät erityisesti helppokäyttöisyyden kehittämisestä ja ohjeistuksen lisäämisestä. Aktiivikäyttäjiä hyödyttäisivät kehittyneemmät tiedonhaku- ja käsittelymahdollisuudet. Tutkimuksessa tarkastellut työturvallisuuskysymykset osoittavat hyvin, että työtapaturmatiedon hakeminen tietokannasta käytössä olevien luokitusten avulla voi olla haastavaa. Tutkimus osoittaa kuitenkin myös, että tietoa voidaan hakea ja tuottaa hyödyntämällä muita menetelmiä. Esimerkiksi tapaturmakuvausten analysointi ja tiedonlouhinnan menetelmät voivat olla hyödyllisiä täydentäviä työtapaturmatiedon analysointimenetelmiä. Uudet menetelmät ja esimerkit tiedonhausta ja analysoinnista voivat lisäksi edistää tietokannan hyödyntämistä ja hyödyntämismahdollisuuksia sekä tuoda uusia näkökulmia työturvallisuustyöhön.

PREFACE

When I started my journey as a postgraduate student, little did I know what I was about to begin, how research is carried out and how the academic world operates. The doctorate in itself appeared merely a distant objective, whereas the journey as a learning process seemed more important to me. Nevertheless and perhaps particularly therefore, daringly I started, with an open mind and will to learn. Looking back at the journey now, I found myself surrounded by so many caring and inspiring people who encouraged me through my first humble steps as a researcher; already this has made the journey worthwhile. Moreover, with their support, this travel has enriched me not only as a professional but also as a person

This doctoral thesis is based on several independent research projects. First, I thank everyone who was involved in and enabled these projects. I acknowledge the Federation of Accident Insurance Institutions (FAII), the Centre for Occupational Safety, the Ministry of Social Affairs and Health, the Finnish Work Environment Fund and the VMP-Group for providing the funding for the projects. I am sincerely grateful to the representatives of the organisations who took part in the projects for their eager participation and for their valuable considerations in the steering groups. In particular, I thank senior investigator Dr Hannu Tarvainen from the FAII for being one of the most important initiatory persons in these projects and specialist Timo Suurnäkki from the Centre for Occupational Safety for his enthusiasm and expertise. I thank the representatives of the FAII for providing the occupational accident data used in this research and the details related to the data. In addition, I am grateful to the respondents of the FAII database user questionnaire, which was an important dataset for this research.

I also thank Professor Kaija Leena Saarela for supervising my thesis. Thank you for guiding me where necessary and also for allowing me to seek my own paths and trusting I would find them. I gratefully acknowledge Dr Tuula Räsänen (Finnish Institute of Occupational Health) and Professor Seppo Väyrynen (University of Oulu) for pre-examining the thesis and for their perceptive comments, which helped me to improve the quality of this manuscript.

I also acknowledge the financial support I received for the actual dissertation work. The funding I received from the Doctoral Program in User-Centered Information Technology (UCIT) allowed me to do the studies required for the degree and compile the articles of this compound dissertation. I thank the supervisors and peers at UCIT for creating an interdisciplinary learning environment. With the scholarship from the Finnish Work Environment Fund and financial support from the Finnish Doctoral Program in Industrial Engineering and Management, I was finally able complete my thesis.

I have many colleagues, former and present, who I want to thank for their help, support and interest in my work, for their professional exemplariness and for being excellent company. I owe special gratitude to Marileena Koskela, M.Sc. (hopefully forthcoming Dr) and Dr Sanna Nenonen for their peer support, for all invigorating discussions and for their constructive comments, which really took my work forward. Every post-graduate student should have such a valuable study group. Thanks are also due to Sanna Anttila, M.Sc. for her empathy and for the contribution to one of the papers. I particularly thank Dr Päivi Hämäläinen and Dr Tuuli Tulonen

for piquing my interest in and being among my first contacts in the academic world and especially the field of occupational safety.

My family and friends, you are my safety net. I want to give my special thanks to my fellow-dancers for both giving me such cheerful counterbalance to work and for accompanying me in that never-ending pursuit of (that perfect) balance, flexibility, focus and strength, abilities often useful in research as well. Precious Elite sisters, you are definitely not random. My loving thanks go to my family, for without their belief in education and, most importantly, in me, I would not be here now. Finally, my most heartfelt thanks belong to my husband. Thank you for your ever unconditional support, for putting up with my occasional absence and absent-mindedness during this process, and most of all thank you for giving me a reason to leave my workplace and go home.

Levonmäki, December 2012

Noora Nenonen

LIST OF ORIGINAL PUBLICATIONS

I. Hintikka, N. & Anttila, S. 2008. User experience of Finnish occupational accidents and diseases database. Proceedings of the International Conference on Occupational Risk Prevention ORP, May 2008, Coruña, Spain.

II. Hintikka, N. & Saarela, K.L. 2010. Accidents at work related to violence – Analysis of Finnish national accident statistics database. Safety Science 48, 517–525.

III. Hintikka, N. 2011. Accidents at work during temporary agency work in Finland – Comparisons between certain major industries and other industries. Safety Science 49, 473–483.

IV. Nenonen, N. 2011. Occupational accidents in the Finnish local government sector: Utilisation of national statistics. International Journal of Injury Control and Safety Promotion 18, 321–329.

V. Nenonen, N. 2013. Analysing factors related to slipping, stumbling and falling accidents at work: Application of data mining methods to Finnish occupational accidents and diseases database. Applied Ergonomics 44, 215–224.

The author of this dissertation is the single author of articles III, IV and V. Articles I and II were co-written with other authors. The author of this dissertation is also, however, the lead author in the co-authored articles. Apart from having the principal responsibility of writing the articles, the author was mainly responsible for the study design, data collection and analysis, and constituting the discussion and conclusions in all of the articles. In article I, the co-author participated in designing the study and in compiling the questionnaire that was composed. In addition, the co-author contributed by compiling the literature review, carrying out the descriptive data analysis and writing the corresponding parts of the article. In article II, the role of the co-author related to the overall commenting and reviewing of the study process and the article.

CONTENTS

APPENDICES

KEY DEFINITIONS

Accident	An incident giving rise to injury, ill health or fatality (BS 18004 2008). An accident is usually sudden, unexpected, caused by an external factor/s and occurs against the will of the victim (see Kukkonen & Karmavalo 2004). In this research, accidents are discussed in the occupational context.
Accident at work	An 'occupational accident' that occurs at the workplace, in an area pertaining to it or on the way between the two premises of the workplace (FAII 2011). In this research, the term 'workplace accident' is also used with the same meaning as the term 'accident at work'.
Accident frequency rate	The number of accidents per hours worked (Boyle 2003), calculated here as per million working hours.
Accident incidence rate	The number of accidents per number of workers (Boyle 2003), calculated here as per 1000 employees.
Commuting accident	An 'occupational accident' that occurs while commuting from home to the workplace or vice versa (FAII 2011).
ESAW	European Statistics on Accidents at Work (ESAW) is a project and methodology for collecting EU-wide comparable data on accidents at work. Includes, for example, variables describing circumstances, causes and consequences of accidents at work (see European Commission 2001). In Finland, the ESAW methodology was implemented in the 'FAII database' in 2003 (FAII 2002).
FAII	Federation of Accident Insurance Institutions (FAII) is the co-ordinating organ of all the organisations engaged in statutory accident insurance in Finland (FAII 2012c).
FAII database	As one of its main responsibilities, the 'FAII' collects and maintains statistics of occupational accidents and diseases that are compensated for through the statutory accident insurance system in Finland (see 1948/608, FAII 2012c). In this research, the terms 'FAII database' and 'Finnish occupational accidents and diseases statistics database' are used to refer to this database. The official national occupational accident statistics are compiled based on the FAII database.
FAII database web application	A web-based user interface through which 'FAII database users' can retrieve information from the 'FAII database'.

FAII database users	Finnish organisations operating in the field of 'OH&S', others than the 'FAII', which have contractual access rights to the 'FAII database web application' (here also referred to as 'user organisations') and persons who have access rights as representatives of these organisations (here also referred to as 'users').
Finnish occupational accidents and diseases statistics database	See 'FAII database'.
Occupational accident	An 'accident' that occurs in the course of employment or in circumstances arising from employment (see 1948/608). In this research, the term 'occupational accident' is used to cover both 'accidents at work' and 'commuting accidents'.
OH&S	Occupational health and safety (OH&S) refers to the conditions and factors that affect, or could affect, the health and safety of employees or other workers (including temporary workers and contractor personnel), visitors and any other person in the workplace (BS 18004 2008). Such terms as health and safety at work, safety and health at work and occupational safety and health (OSH) may be used with the same meaning.
Occupational injury	Injury, ill health or fatality resulting from an 'occupational accident'.
Safety	In this research, safety is discussed in the occupational context. See 'OH&S'.
Safety promotion	All efforts carried out to control, improve and sustain the state of safety in order to ensure and maintain employees' working ability and to prevent occupational accidents, and diseases, and eliminate other health hazards at work and in the working environment (modified from 2002/738, Andersson 1999, WHO 1998, Welander et al. 2000).
SSF	Slipping-, stumbling- and falling.
TAW	Temporary agency work.
Usefulness	This is a question of a system's ability to do what is needed and how well users can use that functionality (see Nielsen 1993).
User experience	A person's perceptions and responses that result from the use or anticipated use of a product, system or service (SFS-EN ISO 9241-210 2010).
Workplace accident	In this research, the term 'workplace accident' is used with the same meaning as the term 'accident at work'.

1 INTRODUCTION

1.1 Accidents as an occupational health and safety problem

A healthy, and safe work environment and working conditions are not only provided for and regulated by statutes but are also prerequisites for decent and productive work. In the European Union (EU), the Framework Directive on the introduction of measures to encourage improvements in the safety and health of workers at work (89/391/EEC) sets the general objectives and requirements for work environments and conditions. In Finland, the Occupational Safety and Health Act (2002/738) – as a general provision and a national implementation of the EU Framework Directive – aims to improve safety and health in the working environment in order to ensure and maintain employees' working ability, to prevent occupational accidents and diseases, and to eliminate other health hazards at work and in the working environment (Pietiläinen 2008). Occupational accidents are indications of insufficiencies in occupational safety, and the prevention of occupational accidents is an important part of ensuring and improving safety at work. The consequences of occupational accidents are diverse, affecting not only the injured workers, but also their families, the working organisation and society as a whole. Besides the pain and suffering caused by the physical injuries, occupational accidents also bear economic costs, and may have psychological and social impacts (e.g. anxiety, loss of social interaction, stress) (see e.g. Burton et al. 2002, Dembe 2001).

Regardless of the increased attention on, and actions aimed at improving health and safety at work, and the long-term positive development of the field, occupational accidents continue to pose a major burden globally (see ILO 2011). Safety in terms of working conditions varies between countries, industries and social groups (ILO 2012). Although the burden of work-related accidents is particularly heavy in developing countries (Hämäläinen 2010, ILO 2012), occupational accidents are also still a major occupational safety problem in developed, post-industrialised European countries such as Finland. According to the latest estimations, approximately 132,000 occupational accidents received compensation through the statutory employment accident insurance scheme for employees in Finland in 2011. In addition, 7000 occupational accidents involving entrepreneurs received compensation (FAII 2012a). In 2010, altogether 61 fatal occupational accidents involved employees and entrepreneurs (OSF 2012d).

1.2 Current needs for occupational safety promotion and accident prevention

During recent decades, much emphasis has been placed on improving health and safety at work in the EU and EU countries, including the development of occupational health and safety (OH&S) legislation, and efforts to harmonise occupational accident statistics. Moreover, notable goals to reduce occupational accidents have been set both in the EU and Finland. In the latest European Community strategy on health and safety at work, a concrete goal was set to reduce the total incidence rate of accidents at work per 100,000 workers by 25% in the EU by 2012 (European Commission 2007). In the latest policy for the work environment and well-being at work from the Finnish Ministry of Social Affairs and Health, the objective is to decrease the frequency of occupational accidents by 25% by 2020 (Ministry of Social Affairs and Health 2011a).

Improvements in working conditions in the EU member states and decreasing trends in accidents at work in Europe have, indeed, been reported recently (see European Commission 2007, Eurostat 2010). In addition, in Finland, some improvement can be seen in the working conditions in various sub-sectors (Ministry of Social Affairs and Health 2008, 2010b). Nevertheless, occupational risk factors have not reduced uniformly across worker categories, companies, sectors and occupational accident types (see Eurostat 2010). Furthermore, the economic recession may have weakened the recent advances in promoting OH&S (e.g. Quinlan et al. 2010). In Finland, the positive development seems to also have partly stagnated and much work is still needed in terms of improving working conditions (Ministry of Social Affairs and Health 2008, 2010b). Regardless of the recent fluctuations along with the economic situation, the overall trend in occupational accidents has remained more or less on a level in Finland during the past decade (see FAII 2011). Recent efforts in occupational accident prevention have not had the desired effect on the statistics. In Finland, the current challenge in occupational accident prevention in general seems to arise from trying to change a stagnant trend into a positive reduction in that trend.

Furthermore, EU countries, including Finland, are facing major changes in working life (e.g. ageing of the working population, changes in the occupational structure, new employment trends, new and larger flows of migrants towards Europe, and a growing number of women at work), and these changes are affecting health and safety at work (see e.g. Eurostat 2010, Lehto & Sutela 2008). At the same time, occupational safety risks are changing and new risk factors are emerging, carrying with them implications such as an increased occupational accident risk and differing health and safety issues (see EU-OSHA 2002b, 2012, European Commission 2007, 2009, Eurostat 2010). Emerging risks have recently been identified related to, for example, such issues as ageing of the workforce, complex human–system interfaces, new forms of employment contracts, high emotional demands including violence at work and work intensification (EU-OSHA 2005, 2007). These changes bring new challenges to safety promotion. In order to understand their meaning better and identify effective prevention measures, further research is needed (European Commission 2007).

Hence, there is a need to carry on with the efforts to prevent occupational accidents and improve safety at work in the EU countries, including Finland. To support this work, up-to-date information on occupational accidents is needed, particularly that data that is related to topical and emerging occupational accident trends and health and safety issues. A question also arises, however, as to how well the existing occupational accident data-collection systems and databases can provide the data that meets the current needs.

1.3 Current potential of national occupational accident databases for safety promotion

Data on occupational accidents that have taken place provides the opportunity to learn from the occurrences and, hence, forms an important basis for occupational accident prevention and safety promotion. Occupational accident data serves as a tool for target setting, and for the selection of prevention measures as well as for monitoring safety performance. In order to be useful, the data should be accurate, reliable and up-to-date (see e.g. Kjellén 2000). Official national occupational accident databases are an important data source providing a statistical picture of health and safety at work and forming the basis for safety promotion at the country level. Recently, a new

European Statistics on Accidents at Work (ESAW) methodology for the classification and codification of accidents at work has been implemented in national databases in the EU countries in order to harmonise European statistics. The new classification variables that are accordant with the ESAW methodology have the potential to provide detailed information on the circumstances, causes and consequences of accidents at work for accident prevention. In Finland, the ESAW methodology came into use at the beginning of 2003. At the same time, a new web-based application of the Finnish occupational accidents and diseases statistics database was developed in Finland. The new user interface allows better access for Finnish OH&S organisations to occupational accident data available in the database. However, with the ESAW methodology only recently being implemented, little is known regarding the functionality and usefulness of the new variables and the utilisation of accident data accordant with the new variables. Nor are there many experiences on the utilisation of the Finnish national occupational accident database for safety promotion along with the ESAW variables and the new user interface, particularly from the user point of view. Furthermore, minimal research is currently available related to the quality of web services and users' experiences in general (see Bauer & Hammerschmidt 2004).

In this dissertation, the Finnish official national level occupational accident database is utilised to provide recent information on occupational accidents related to selected topical OH&S issues. Information is provided on accidents at work related to violence; accidents at work during temporary agency work; occupational accidents in the local government sector; and slipping-, stumbling- and falling-related accidents at work. Furthermore, the utilisation and usefulness of the database and its web application for safety promotion are discussed from the user viewpoint.

2 REVIEW OF THE THEORETICAL AND EMPIRICAL CONTEXT OF THE RESEARCH

2.1 Role of occupational accident data in safety promotion

Occupational accident information is generally considered essential in preventing accidents, and in managing and promoting safety. Heinrich (1980), for example, has argued that prevention of accidents in a systematic way requires the following steps: collection of data about accidents, analysis of this data, the selection of remedies, implementation and an evaluation of the effects. Kjellén (2000), again, sees safety, health and environment (SHE) information systems as a vital element in an organisation's safety management systems. Indeed, monitoring of performance and the transfer of information about possible risks and how best to combat them are widely agreed as the being among the key elements of good safety management (see e.g. Fernández-Mũniz et al. 2009). The standards, such as BS 18004 (2008), specify requirements for accident reporting, recording, investigation and follow-up actions among others. The role of accident information as a requirement for continuous improvement is emphasised in safety management systems (EU-OSHA 2002a, Lind & Kivistö-Rahnasto 2008). According to the Finnish Occupational Safety and Health Act (2002/738), previous occupational accidents need to be taken into account when identifying and assessing hazards in workplaces. Furthermore, several studies have shown, for example, that companies with low accident rates have better functioning safety information systems. Additionally, in many studies, the implementation and improvement of a safety information system is associated with reductions in accident rates (see Kjellén 2000).

In general, accident data can be used to learn what has gone wrong in the past so that safety measures can be implemented or improved (Boyle 2003). Data collected on accidents gives answers to such questions as what the characteristics and causes of accidents are, where to focus preventive actions and what the preventive actions should be like (see Kjellén 2000). Accident information supports safety management in all of its phases. Accident information can be used in establishing safety goals, identifying and evaluating risks, selecting and prioritising where to focus attention, developing preventive measures, measuring safety performance, monitoring safety performance and evaluating the efficiency of safety management (see Kjellén 2000). Boyle (2003) distinguishes three main aspects in the use of accident data: trend analyses, comparisons and epidemiological analysis. Trend analysis can be used to measure whether the performance is improving or deteriorating. Comparisons can be made, for example, between parts of the same organisation, between different organisations, between an organisation and the relevant industry and between countries. The major variations in accident data collection should be taken into account in comparisons. In epidemiological analysis, the patterns in terms of the occurrence of accidents are investigated in order to identify causal factors and remedial actions. Furthermore, epidemiology is used to identify problems that would not be apparent from the analysis of single incidents (Boyle 2003).

Accident models and theories are simplified representations of the accident occurrence. These models and theories can be used to define the amount and quality of required accident information to be collected. In general, the SHE information systems should be designed with users' needs in mind; that is, by considering the purpose the data on accidents is used for (see

Kjellén 2000). Occupational accident data collection should be reliable (repeated measures give the same results), accurate (giving accurate information in relation to the factual circumstances) and of adequate coverage (giving data on different factors that affect the risk of accidents). In addition, the distribution and presentation of occupational accident information should be relevant (in relation to the data needs and type of use), comprehensible and easy to survey (to avoid information overload), timely (to avoid non-detection of hazardous changes over a long period) and available when needed. From the viewpoint of the SHE information system as a whole, the methods for data collection, analysis and distribution of information should be easy to understand and acceptable for the involved parties, the system should promote the involvement of the involved parties, develop a shared understanding on safety goals and measures and be cost-efficient. The effectiveness of the safety information system can be determined by its ability to provide the necessary basis for decisions on safety promotion and accident prevention actions (Kjellén 2000).

Occupational accident data is collected by different bodies at different levels, at company, national and at the international level, and for different purposes. The major work to improve safety and prevent accidents is done at the workplaces and companies collect their own statistics. Nevertheless, one important source of occupational accident data is the official national databases giving a statistical picture of health and safety at work at the country level. Furthermore, in the EU, the compilation of statistics is centralised to Eurostat, the statistical office of the EU. In addition, both national and international research institutions and occupational safety and health (OSH) organisations such as the European Agency for Safety and Health at Work, publish their own reports. The International Labour Organisation compiles the global statistics.

2.2 Reporting and registration of occupational accidents and official national databases

2.2.1 Legislative basis and importance of national databases

The legislation in different countries usually contains some provisions requiring the employers to investigate accidents in order to plan preventive measures, keep a record of accidents and to report them to authorities (Kjellén 2000). According to the European Directive (89/391/EEC), the employer is responsible for keeping a list of occupational accidents resulting in a worker being unfit for work for more than three working days. Furthermore, the employer is responsible for reporting occupational accidents to the responsible authorities in accordance with national laws and/or practices (89/391/EEC). Commonly, it is a requirement that severe accidents are reported immediately to the authorities. The requirements to report less severe accidents to the authorities vary more between countries (Boyle 2003, Kjellén 2000). The employer's duty to investigate accidents is not explicitly mentioned in the European Directive (89/391/EEC) nor is it mentioned in many EU countries' legal systems. Nevertheless, the accident investigation is commonly regarded as an inherent step in the accident recording procedure. Fatal and severe accidents are the exception, as authority inspectors carry out a further investigation and analyses of these accidents (Jacinto & Aspinwall 2004).

Records of occupational accidents are kept at workplaces for the purposes of worker compensation and prevention. Reporting occupational accidents further to authorities is

important because this data comprises the main source of information for national occupational accident databases, which are used for the production of official national statistics (Jacinto & Aspinwall 2004). Occupational accident data reported to authorities forms, again, the basis for official EU statistics. This data forms the basis of accident prevention and safety promotion at both the national and EU level. The reporting of accidents to the authorities provides the necessary knowledge on accidents and their prevention for the development of regulations and the supervision of compliance with the regulations (Kjellén 2000). Furthermore, this data serves as an indicator in defining and implementing targeted strategies for preventing and controlling risks, and for monitoring the progress made at the national level. In the study by Jacinto and Aspinwall (2004), all EU countries acknowledged the benefits of using their systems for the development of preventive policies and/or planning of inspection activities. In addition, the data was used for the purposes of insurance policies, research, and in order to provide advice and assistance for enterprises (Jacinto & Aspinwall 2004).

In the EU, reliable, comparable and up-to-date statistical information is vital for setting policy objectives and adopting suitable policy measures. An accurate statistical picture of health and safety at work is critical for monitoring policies and identifying preventive needs (Eurostat 2010). The national occupational accident databases do not only support national policies, systems and programs for safety promotion. Apart from the authorities, other OSH organisations and companies can also utilise official occupational accident statistics for similar purposes. From the company perspective, accident information can be divided into internal information collected from inside the company and external information available from outside the company (see Kjellén 2000, Lind & Kivistö-Rahnasto 2008). Although companies monitor safety performance with their own statistics, official accident statistics can be used, for example, to give a broader perspective and for comparison purposes. Safety management standards recommend the utilisation of external accident information, for example, in hazard identification (see BS 18004 2008).

2.2.2 European Statistics on Accidents at Work (ESAW) methodology

Accident models and classifications are used as a tool to standardise the collection and analyses of data on accidents (see Kjellén 2000). Jacinto and Aspinwall (2004) have compared the reporting and registration systems and national databases used to compile official occupational accident statistics between EU countries. They found that, despite some similarities, many of the EU countries have different methods and procedures for collecting and compiling data, which makes the comparison of occupational accident statistics difficult between the EU member states (Jacinto & Aspinwall 2004). Along with the efforts to improve working conditions and health and safety at work in the EU, work has been carried out to harmonise the criteria and methodologies applied in recording and producing statistics on accidents at work. In the 1990s, a project aiming to harmonise ESAW in order to collect EU-wide comparable data on accidents at work and establish a database was launched. In the project, a methodology for collecting and recording data on accidents at work was developed. The ESAW methodology was gradually implemented in the member states' national systems in the 1990s and at the beginning of the 21st century (see European Commission 2001, 2009). In Finland, the ESAW methodology has been used to classify and code accidents at work since 2003 (FAII 2002).

The ESAW methodology includes variables describing the date and time and geographical location of the accident, the employer, the employee and the consequences of the accident. Furthermore, the ESAW methodology includes variables describing the causes and circumstances behind the accident at work (see European Commission 2001, 2009). A detailed description of the ESAW methodology is provided in European Commission (2001, 2009).

The implementation of the ESAW methodology has unified the collection of data on occupational accidents in the EU member states. Nevertheless, there are still differences in reporting and registration systems between countries. For example, occupational accidents are recorded in two ways on the national level in the EU member states. In insurance-based systems, data on occupational accidents is collected via the notifications of accidents to the insurer, which may be public or private. Data collection may also be based on the legal obligation of the employer to notify occupational accidents to the relevant national authority, often the national labour inspection service (see European Commission 2001, 2009). Moreover, there are differences in the legal definition of what is counted as an "accident at work" between the EU countries (Räsänen 2007). In addition, the coverage of accidents involving self-employed and family workers and accidents en route between the two premises of the workplace varies between member states. Mainly, the same ESAW variables are to be used in every member state. The use of some of the variables describing the causes and circumstances, however, is optional. Hence, with regards to these variables, the national implementation varies between member states. However, all the ESAW data to be submitted to Eurostat is extracted by member states from their national data according to harmonised criteria (see European Commission 2001, 2009).

The ESAW variables, particularly the new variables describing the circumstances, causes and consequences of accidents at work have the potential to allow for a more detailed analysis of the conditions under which the accidents at work occurred and, hence, for defining new policies in accident prevention (European Commission 2009). Nevertheless, as the ESAW methodology has only recently been implemented, not many studies have yet been published where occupational accident data is analysed according to the new ESAW variables. Furthermore, of those studies available, only some (e.g. Jacinto et al. 2009, Jacinto & Guades Soares 2008, Rajala & Väyrynen 2010) discuss the functionality and usefulness of the ESAW variables.

The benefits of the new ESAW variables are highlighted, since they allow for a better understanding of causation pathways (Jacinto & Guades Soares 2008) and for the description of the actual occurrence of an accident (Rajala & Väyrynen 2010). Nevertheless, Jacinto et al. (2009) have also argued that the current variables are not yet sufficient to clarify accident mechanisms and that there is a need for more detailed information. They suggest the implementation of an additional variable, associated with the deviation, aimed at promoting the inclusion of specific underlying factors within the local workplace environment (Jacinto et al. 2009). Nevertheless, not much is yet known concerning the utilisation of accident data in accordance with the ESAW methodology. Further research applying ESAW methodology would facilitate in identifying opportunities for preventive joint ventures across activity sectors or across countries by allowing comparison and cross-references between studies (see Jacinto & Guades Soares 2008). Reliable, comparable and up-to-date statistical information is vital for

monitoring and promoting safety in the EU; thus, it is important to continue with the efforts to improve the quality of European statistical data on health and safety at work (Eurostat 2010).

2.2.3 Finnish occupational accidents and diseases statistics database and its users

Reporting and registration of occupational accidents on a national level in Finland

In Finland, the reporting and registering of occupational accidents on a national level is insurance-based. According to the Finnish Employment Accidents Insurance Act (1948/608), the right to receive compensation via statutory accident insurance is based on the employment relationship (in the private or public sector). The employer is responsible for taking out accident insurance from an accident insurance company for its employees (see 1948/608, Kukkonen & Karmavalo 2004). In addition, some groups, such as agricultural entrepreneurs, pupils and students in circumstances comparable to work, and those caring for close relatives etc. are covered through separate legislation. The statutory Employment Accidents Insurance Act does not obligate self-employed persons and their close relatives to take out insurance. Nevertheless, the same cover can be taken out voluntarily (see Kukkonen & Karmavalo 2004). In Finland, the statutory accident insurance system is operated by private insurance companies from which private and local government employers take the insurance. In addition, the agricultural entrepreneurs' employment accident insurance is organised through the Farmers' Social Insurance Institution. The State Treasury Office is responsible for the accident insurance coverage of state employees (FAII 2012c, Kukkonen & Karmavalo 2004).

Events insured against and compensated for through statutory accident insurance include occupational accidents and diseases (see 1948/608, Kukkonen & Karmavalo 2004). An occupational accident is any accident that causes injury to or illness in an employee in the course of employment, in circumstances arising from their employment, or while the employee was trying to protect or save their employer's property or, in connection with their employment, trying to save a human life. Circumstances arising from employment include the time that the employee is at the workplace or in areas pertaining to work, commuting from his/her home to the workplace, or vice versa and attending to business for the employer elsewhere (Finnish Employment Accidents Insurance Act 1948/608). The legal practice usually requires that the accident is sudden, unexpected, caused by an external factor and it occurs against the will of the victim. Nevertheless, some other occupational accidents also receive compensation such as other injuries occurring over a short time period (e.g. abrasions due to work movements), injuries or illnesses resulting from an assault or from another intentional act by another person, and substantial exacerbation of previous injuries or illnesses. Occupational diseases are diseases that have probably been caused principally by physical, chemical or biological factors at work (Kukkonen & Karmavalo 2004).

The Federation of Accident Insurance Institutions (FAII) is the co-ordinating organ of all the organisations engaged in statutory accident insurance (FAII 2012c). The FAII is the official keeper of the occupational accident statistics database in Finland. As one of its main responsibilities, the FAII collects and maintains statistics (the FAII database) of employee and self-employed occupational accidents and diseases that have received compensation through the insurance scheme of the statutory accident insurance system in Finland (See 1948/608, FAII 2012c). The data concerning agricultural entrepreneurs' occupational accidents and diseases is

not available in the FAII as this is gathered by the Farmers' Social Insurance Institution (FAII 2012c). If an occupational accident occurs, the employee is responsible for informing the employer about the accident. The employer is responsible for keeping a list of occupational accidents and for making a notification of an occupational accident to the insurance company. Insurance companies deliver the information to the FAII (Kukkonen & Karmavalo 2004). The notification form contains data concerning, among other aspects, the employer, the injured person, the time and location of the injury or illness, the type of injury, employment and salary. In addition, a short description of how the accident happened or how the occupational disease developed is written in the notification. The FAII statistics are used in investigations and calculations related to insurance premiums, in research concerning the causes and consequences of occupational accidents and diseases, in compiling publications on occupational accidents and diseases statistics and other work carried out to prevent occupational accidents and diseases. The statistics are also used to evaluate and develop the implementation of the system (See FAII 2012c).

National-level data on occupational accidents is also collected through other sources. For example, the Finnish Victim Survey by the National Institute of Health and Welfare and National Research Institute of Legal Policy, the Work and Health Survey by the Finnish Institute of Occupational Health and the Quality of Work Life Survey by Statistics Finland have charted exposure to occupational accidents in Finland. According to the Finnish legislation, OH&S authorities and the police must be notified without delay if the occupational accident or disease has caused a severe injury or death (see 1948/608, 2006/44). The reports compiled by the OSH inspectors of these occupational accidents causing severe injuries or death are registered in the database of the Regional State Administrative Agencies. The FAII also maintains a separate register on the investigation reports of fatal workplace accidents.

FAII database web application and its users

Recently, a new interface, a web application for the FAII database was developed. The web application is intended for the research, training, planning and development purposes of also other Finnish OH&S organisations than the FAII (described in more detail in the following section). Access rights to the application are based on contracts and training. FAII offers training in which users are instructed on how to use the application. Nevertheless, there are some exceptions and not all users of the application have participated in training. Single companies cannot access the application, but, for example, insurance companies or labour market organisations can produce information for companies' needs. The application allows the OH&S organisations and their representatives to retrieve information from the FAII database independently through the Internet. Although the users have also previously been allowed to use the data for their own customised analyses, previously such an interface did not exist and the information for the analyses needed to be separately requested from the FAII. The application was taken into use along with the implementation of ESAW variables in 2003.

The web application is tailored to meet the needs of different OH&S organisations using the application, and the content available through the application varies slightly according to the organisation. In general, information concerning occupational accidents and diseases can be retrieved from the application using different classifications. For example, classifications of economic activities, occupational classification, gender, age and ESAW variables concerning

circumstances, causes and consequences of accidents at work can be used. The short descriptions of accidents at work written in the notification form of occupational accidents and diseases are also available on the application. The users can also define their own information-retrieval criteria by using the classifications. There are also some predefined information-retrieval alternatives in which the search criteria are defined in advance. As an information-retrieval result, the application presents a table containing the requested information. For the sake of confidentiality, not all data is, however, available for the users.

Organisations operating in the field of occupational health and safety in Finland

Inside workplaces, both the employer and employees have OSH responsibilities that are dictated by the law. Furthermore, the legislation emphasises the importance of cooperation between employers and employees on safety and health in workplaces supported by OSH representatives and occupational health care services. Indeed, work carried out inside workplaces plays a principal role in ensuring, sustaining and improving a healthy and safe work environment and conditions. Nevertheless, there are also several organisations operating in the field of OSH in Finland supporting safety promotion in workplaces. These national-level operators include OSH authorities, research and service institutions and other OSH organisations (see Figure 1).

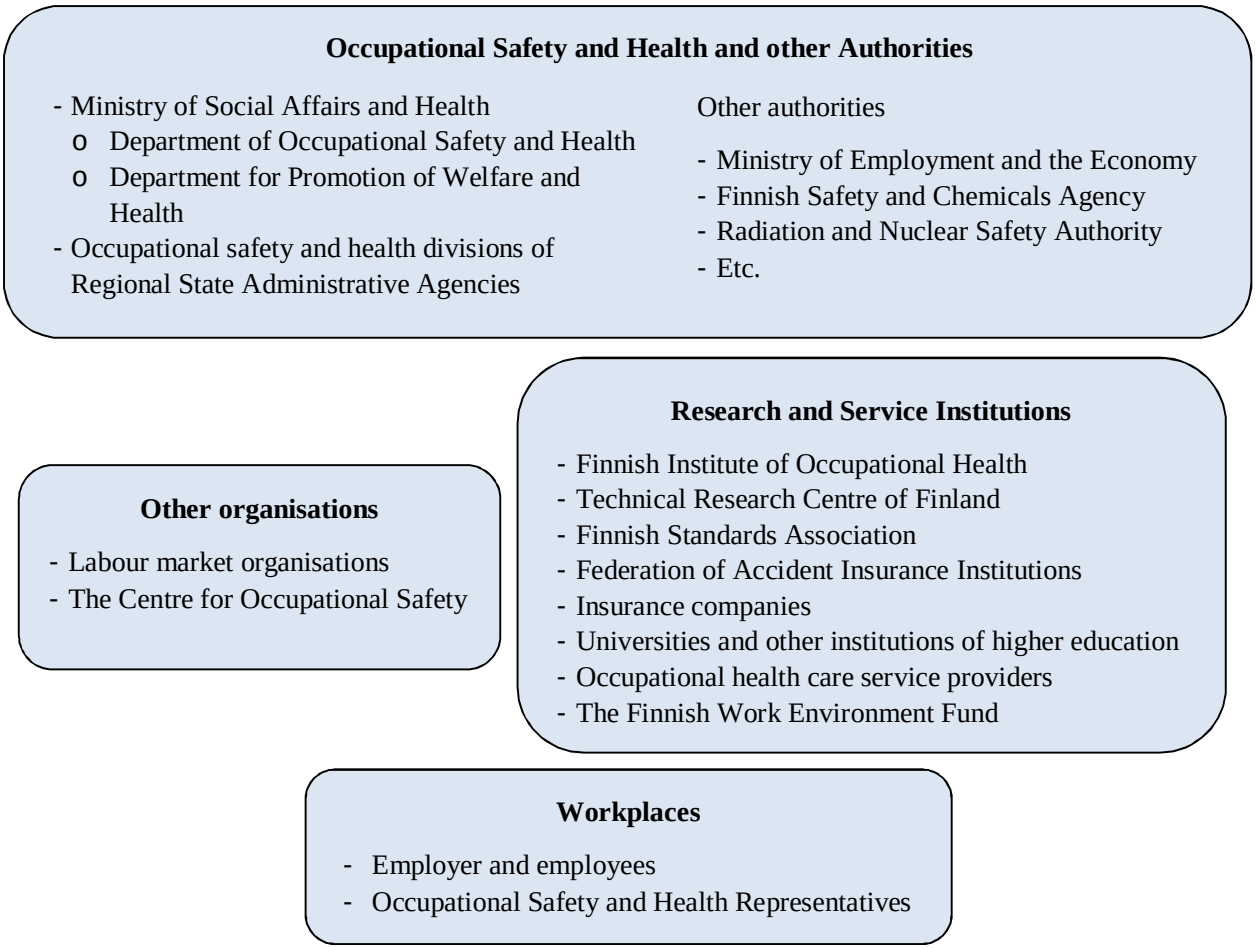

Figure 1. Operators in the field of occupational safety and health in Finland (modified from Ministry of Social Affairs and Health 2004, 2010a).

In Finland, the occupational safety and health administration consists of the Department of Occupational Safety and Health at the Ministry of Social Affairs and Health and the occupational safety and health divisions at the Regional State Administrative Agencies. In general, OSH authorities are in charge of the preparation and enforcement of legislation related to OSH and labour. The authorities also give advice and guidance on operations concerning the improvement of working conditions. There are also other authorities, whose sphere of operations is closely connected to OH&S. Research and service institutions provide research, communication, training, expert services, research funding etc. related to OSH. The other organisations include labour market organisations providing collective agreements, among others. The Centre for Occupational Safety, again, produces and offers workplace communities training, information, materials and services needed for developing safe working conditions (see Ministry of Social Affairs and Health 2004, 2010a).

2.3 Goals to reduce occupational accidents in the European Union and Finland

In the EU's social policy, health and safety at work, and, in particular, issues relating to accidents at work are emphasised as one of the most important areas of action (European Commission 2009). The European Commission's policy agenda to improve health and safety at work in the EU is communicated in the Community Strategies on health and safety at work (see European Commission 2002, 2007). A variety of measures to improve health and safety have been defined in these strategies. The objective of the 2002–2006 strategy was to bring about a continuing improvement in well-being at work and a reduction in accidents and illnesses at work (European Commission 2002). It was concluded that along with a large body of Community laws, the strategy led to considerable improvements in working conditions in the EU member states (European Commission 2007). The 2007–2012 Community strategy continues on from the previous strategy, with the primary objective of an on-going, sustainable and uniform reduction in accidents at work and in occupational illnesses. The concrete objective is to reduce the total incidence rate of accidents at work per 100,000 workers in the EU-27 by 25% by 2012. The Community strategy calls the member states to develop and implement coherent strategies geared to national conditions in cooperation with the social partners and with measurable targets for further reducing accidents at work and occupational illnesses. Especially the most common risks and sectors of activity, enterprises and workers who are most at risk should be targeted (see European Commission 2007).

In Finland, the strategy for the social and health policy of the Ministry of Social Affairs and Health and the policies for the work environment and well-being at work, specified on the basis of the strategy, define Finland's position on the Community strategy(see Ministry of Social Affairs and Health 2011a). The Community strategy of 2007–2012 was already taken into account in the OSH strategy of the Ministry of Social Affairs and Health for the years 1998–2010. The implementation of the Finnish OSH strategy confirmed by the Ministry of Social Affairs and Health is evaluated every three years (see Ministry of Social Affairs and Health 2010b). According to the latest follow-up reports, OH&S activities and the comprehensive co-operation in this sector have developed favourably. Major updates in the Finnish occupational safety legislation in the 21st century have notably effected the realisation of the strategy. Some improvement can be seen in the working conditions in various sub-sectors. However, overall the

positive development seems to have stagnated in the past ten years and much work is still needed to be done to improve working conditions. Furthermore, it should be investigated to what extent the most recent improvements are as a result of the economic recession. In addition, new challenges are also emerging in Finland due to changes in working life (Ministry of Social Affairs and Health 2008, 2010b).

The latest social and health policy strategy, Socially Sustainable Finland 2020, was confirmed by the Ministry of Social Affairs and Health in January 2011. The strategy relies on the idea that a good and healthy work environment supports sustainable development, and workers well-being, and improves the productivity of the companies and society (see Ministry of Social Affairs and Health 2011b). In the policies for the work environment and well-being at work until 2020, the ministerial strategy is specified with regards to those areas of OH&S that deal with the work environment and well-being at work. The vision of the policies includes health, safety and well-being as important common values, which are put into practice in every workplace and for every employee. The policy also aims at improving employees' abilities, their willingness to work, and opportunities to work and, hence, encourages employees to continue for longer in their working life. The concrete objectives related to health and safety are to decrease the number of occupational diseases by 10%, the frequency of occupational accidents by 25%, and physical and mental stress both by 20% between 2010 and 2020 (see Ministry of Social Affairs and Health 2011a).

2.4 Recent trends in occupational accidents

2.4.1 The extent and general trend in occupational accidents

Occupational accidents continue to pose a major burden globally (see Hämäläinen et al. 2009, ILO 2011). According to the latest estimates, there were 317 million occupational accidents causing at least four days of incapacity for work in the world in 2008. Of these, 321,000 were fatal (ILO 2011). The annual economic costs from lost working time and the interruption of production, medical expenses and workers' compensation due to poor OH&S practices are estimated to be 4% of global gross domestic product (ILO 2012). In 2008, the number and rate (per 100,000 workers) of both fatal and non-fatal occupational accidents decreased compared to the year 2003 (ILO 2011). The impact of the economic recession may have affected these trends, as some of the recent advances in terms of promoting OH&S may, however, have been lost during the economic recession, as enterprises struggle to remain productive (e.g. Quinlan et al. 2010). Before 2008, non-fatal occupational accidents increased by 20% between 1998 and 2003, while the corresponding accident rate per 100,000 economically active people fluctuated between 12,218 and 12,966. During the same period, the number of fatal occupational accidents increased, though only slightly (3.6%), and the rate decreased slightly from 16.4 to 13.8 (per 100,000 economically active people) (Hämäläinen 2010, Hämäläinen et al. 2009).

Health and safety in terms of working conditions varies between countries, industries and social groups (ILO 2012). The burden of work-related accidents is particularly heavy in developing countries (Hämäläinen 2010, ILO 2012). Nevertheless, in the global estimates, 6% of both occupational accidents with at least a four-day incapacity for work and fatal occupational accidents occurred in Europe (see Hämäläinen 2010). According to the Labour Force Survey,

approximately 6.9 million (3.2%) workers in the EU-27[1] had an accident at work in 2007. In ESAW, 2.9% of the workers in the EU-27 had an accident at work that resulted in more than three days of incapacity for work and 5580 died due to an accident in 2007 (Eurostat 2010). It is estimated that the costs of occupational accidents and work-related diseases in the EU-15[2] countries account for 2.6–3.8% of gross national product (EU-OSHA 2008). In the Labour Force Survey, the percentage of workers involved in accidents at work decreased in ten European countries[3] from 3.5% to 3.3% between 1999 and 2007. In ESAW, non-fatal accidents at work with more than a three-day incapacity for work decreased from 4.0% to 2.9% and fatal accidents at work decreased from 5275 to 3580 in the EU-15 countries during the same period (Eurostat 2010). Previously, according to ESAW, both the number and incidence rate of non-fatal and fatal accidents at work were reported to have decreased in the EU-15 between 1995 and 2005 (European Commission 2009). Hämäläinen (2010) has also reported decreases in the rates of occupational accidents in Europe between 1998 and 2003. The stricter OH&S legislation, particularly in new EU member states, may be one reason for decreasing occupational accident trends in Europe (e.g. Hämäläinen et al. 2009).

According to the latest estimations, 132,000 employee occupational accidents received compensation through the statutory employment accident insurance scheme in 2011 in Finland. Of these, 110,000 (83%) were accidents at work and 22,000 (17%) were commuting accidents. In addition, 4555 occupational accidents were compensated for agricultural entrepreneurs (OSF 2012e) and 7000 occupational accidents were compensated for other entrepreneurs (FAII 2012a). In 2010, there were 43 fatalities due to accidents at work and 18 due to commuting accidents (OSF 2012d). According to the Work and Health Survey by the Finnish Institute of Occupational Health, an occupational accident occurred with every ninth respondent in 2009. In proportion to the working population, this means that, altogether, 270,000 occupational accidents occurred (Grönqvist et al. 2010). In the Finnish Victim Survey, the proportion of victims of occupational accidents was approximately 5.6% of the working aged population in 2009 (Haikonen & Salminen 2010). According to the Quality of Work Life Survey, the percentage of employees involved in an occupational accident was approximately 5% in 2008 (Lehto & Sutela 2008). The costs of occupational accidents and illnesses to society are estimated to be approximately 2.8 billion Euros (2% of the gross national product) (Ministry of Social Affairs and Health 2004).

During the economic recession at the beginning of 1990s, Finnish employees' risk of non-fatal accidents at work decreased notably until 1996 (OSF 2006). After a slight increase in 1997 and 1998, the number and frequency of accidents at work for which employees received compensation through the statutory employment accident insurance scheme slightly decreased

1 Twenty-seven member states of the EU: Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Germany, Greece, Finland, France, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovenia, Slovakia, Spain, Sweden and the United Kingdom.

2 Fifteen member states of the EU: Austria, Belgium, Denmark, Germany, Greece, Finland, France, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.

3 Data on accidents at work in 1999 and 2007 could be compared for ten countries: Denmark, Spain, Finland, Hungary, Ireland, Italy, Luxembourg, Portugal, Sweden and the United Kingdom (Eurostat 2010).

until 2004, when the number and frequency were 96,299 and 28.3, respectively (FAII 2007a). The number and frequency of employees' commuting accidents remained more or less on the same level, fluctuating though to 15,903 and 4.7, respectively in 2004 (FAII 2007a, OSF 2006).

In 2005, the reporting of occupational accidents, particularly causing less than a four-day incapacity for work, increased due to a change in the employment insurance legislation (see 2004/1358, FAII 2007a). Hence, occupational accident statistics based on statutory accident insurance are not directly comparable between 2004 and 2005. The approximated effect of the increase is 10% between 2004 and 2005. Taking this effect into account, there was only a small increase in employees' occupational accidents in 2005 compared to 2004 (FAII 2007a). Between 2005 and 2008, the number and frequency of occupational accidents that employees were compensated for remained, again, on the same level, increasing slightly. During that period, an average of 135,453 employee accidents at work and 19,184 employee commuting accidents were compensated for yearly. The average frequencies of accidents at work and commuting accidents with at least a four-day incapacity for work were 15.8 and 2.8, respectively (FAII 2011).

In 2009, the number and frequency decreased, along with a decrease in the amount of work due to the economic recession, turning into an increase again in 2010 and 2011 (FAII 2011, 2012b, OSF 2012e). Fatal accidents at work involving employees have decreased in Finland, being at their lowest (1.2 per 100,000 employees) in 2009. In 2010, the incidence rate of fatal accidents at work increased for the first time since 2005. The number of fatal commuting accidents varies greatly between years (OSF 2012e). Between 1993 and 2003, the incidence rate for fatal commuting accidents fluctuated between approximately 1.0 and 2.0 cases per 100,000 employees (OSF 2006).

2.4.2 Emerging issues in occupational accident trends

Although decreasing trends of accidents at work have been reported in Europe, the decrease has not been uniform between worker categories, companies and sectors. For example, comparing the characteristics of the workers, younger and older workers, those with precarious jobs and migrant workers seem to be overexposed to occupational risks. In addition, occupational accidents involving women have been reported to constitute an increasing share of the burden. When comparing companies, small and medium sized companies, in particular, have fewer resources to put complex systems of worker protection in place, while some of them tend to be more affected by the negative impact of health and safety problems. In accident statistics and surveys, decreasing trends were found in most industrial sectors and occupational groups. Most common accidents at work were still, though, in construction, agriculture, hunting and forestry, transport and communication, and manufacturing, particularly among men (European Commission 2009, Eurostat 2010). For women, accidents at work were more common in the sectors of health and social work, and hotels and restaurants, compared to other sectors (Eurostat 2010). The number of accidents at work with more than three days of incapacity for work decreased in the ESAW statistics (European Commission 2009).

In Finland, some similar trends can be seen in recent occupational accident trends. For example, increasing trends of exposure to occupational accidents have recently been reported concerning women (see FAII 2011, Haikonen & Salminen 2010), and younger and older employees (see FAII 2010, 2011). The frequency of accidents at work has recently decreased in construction,

manufacturing and in transportation and storage industries (FAII 2011). However, in the sector of administrative and support service activities, the frequency of accidents at work has recently increased, particularly due to increased working hours in cleaning activities and temporary employment agency activities (FAII 2012a). Most of the occupational accidents occur in the local government sector, manufacturing industry, construction, transportation and storage, wholesale and retail trade and administrative and support service activities (FAII 2011). In terms of occupation class, the highest incidence rates for accidents at work are in building construction work; food manufacturing work; agricultural, forestry, and fishing work; wood work; and road transport work (OSF 2012e). Other recent trends include, for example, an increasing proportion of occupational accidents with less than four days of incapacity for work and an increased proportion for providing services as a working process. The most common deviation is still the deviation of slipping or stumbling – with a fall or fall of persons (FAII 2011).

It should be noted though, that occupational accident statistics and research literature shows inconsistent trends regarding some of these issues. For example, in some studies, the number of accidents increases with age, whereas in other studies it decreases (EU-OSHA 2007). Additionally, results concerning gender and occupational accidents are contradictory and, hence, gender differences in work-related deaths and injuries remain unclear (Lin et al. 2008).

2.5 Changing world of work and occupational health and safety implications

As the world and society are complex and under constant change, so is working life and the factors influencing health and safety (Welander et al. 2000). Working life in Europe is changing at an ever-increasing speed (EU-OSHA 2002b). The society, workplaces, work practices and processes are constantly changing due to the influence of new technology, economic fluctuations; shifting social conditions and changes in the composition of the workforce (EU-OSHA 2002b, 2012, Eurostat 2010). The important changes with an impact on safety and health at work that the European countries are currently facing include, for example, the ageing of the workforce; changing work patterns (work life becoming more fragmented); a growing number of women at work; increasing numbers of migrant workers; and new employment trends including an increase in part-time, precarious, and temporary work, self-employment, outsourcing, and increased employment in small and medium sized enterprises, new forms of organising work (e.g. telework) and structural changes in economic sectors and occupations (increases in work in the service sectors) (see EU-OSHA 2002b, 2012, European Commission 2007, 2009, Eurostat 2010).

These changes in working life also cause changes in the nature of OH&S risks and bring new risks and challenges to be faced at work (see EU-OSHA 2002b, 2012, European Commission 2007, 2009, Eurostat 2010). The OH&S implications of these changes may include an increased risk of occupational accidents, among others (EU-OSHA 2002b). The current Community strategy on health and safety at work (2007–2012) emphasises the importance of anticipating new and emerging risks by on-going observation and information collection in order to control these risks (European Commission 2007). Any occupational risks that are both new and increasing are considered as emerging OH&S risks. A previously non-existent risk caused by new processes, new technologies, new types of workplace, or social or organisational change is considered as a new risk. In addition, a long-existing issue can be considered a new risk if it has

been newly perceived as a risk in terms of social or public perceptions or scientific knowledge. The risk is considered as increasing if either the number of hazards leading to the risk is growing, the exposure to the hazard leading to the risk is increasing or the effect of the hazard on workers' health is getting worse (EU-OSHA 2012).

The European risk observatory has identified emerging issues related to physical, chemical, biological and psychosocial risks (EU-OSHA 2012). The recently identified, top-emerging OH&S risks with implications for occupational accidents include, for example, the complexity of technologies and work processes with complex human–system interfaces, thermal discomfort at industrial workplaces (EU-OSHA 2005), new forms of employment contracts and job insecurity, the OH&S risks for the ageing workforce, work intensification with high workload and work pressure, high emotional demands at work including violence and bullying and poor work–life balance (EU-OSHA 2007). For example, workers in new types of employment contracts (including precarious contracts such as temporary, on-call or part-time contracts, and the trend in companies towards lean production and outsourcing) tend to carry out the most hazardous jobs, work in poorer conditions and receive less safety training, which increases the risk of occupational accidents. Violence and bullying as contributing factors to the increase in emotional demands at work are not completely new issues. However, they are a growing concern, particularly in the service sector (EU-OSHA 2007).

2.6 Some topical occupational health and safety issues and related occupational accidents

2.6.1 Violence at work

Workplace violence can appear in various forms from abusive language, threats and bullying to physical assault and homicide (Chappell & Di Martino 2006, Wassell 2009). In addition, the borderline between acceptable and non-acceptable behaviour is vague (Chappell & Di Martino 2006). What is perceived as violence is subjective and context dependent (Bowie 2002, Chappell & Di Martino 2006, EU-OSHA 2010). Hence, describing and defining this phenomenon is challenging (Chappell & Di Martino 2006). There is no consensus on a general definition (Bowie 2002, Chappell & Di Martino 2006) but different terms (e.g. workplace violence, violence at work, occupational violence) are used, and what is meant by these terms varies (see EU-OSHA 2010).

In the report of the European Commission (Wynne et al. 1997), the following often-used definition aiming at a consensus was proposed: ‘Incidents where persons are abused, threatened, or assaulted in circumstances related to their work, involving an explicit or implicit challenge to their safety, well-being and health’. In the World Health Organisation’s (WHO’s) definition of violence, the intentionality of the act is emphasised. Nevertheless, the presence of an intent to use force does not necessarily mean that there was an intent to cause damage (Krug et al. 2002). Typologies of violence have also been presented in the literature (Krug et al. 2002). Workplace violence can also be categorised according to the relationship between the perpetrator of the violence and the victim to external/intrusive violence (e.g. including criminal-intent incidents), consumer-related violence (e.g. confrontations between staff and a client), relationship violence (e.g. conflicts between co-workers and personal relationship incidents at work) and organisation

violence (e.g. organisational factors contributing to violence at work) (Bowie 2002, Peek-Asa et al. 1997).

In many countries, there is no specific legislation on workplace violence. Nevertheless, there is usually a more general law on safety and health or equal treatment that covers the different aspects of work, of both the physical and psychosocial work environment (EU-OSHA 2010). In the Finnish Occupational Safety and Health Act (2002/738), violence is mentioned separately. The Act requires preventive action to reduce violence and threats of violence in the workplace. According to the Act, if a job involves an apparent threat of violence, the work and working conditions have to be organised so that the threat of violence and violent incidents are, as far as possible, prevented (2002/738). The apparent threat of violence means situations where the risk of becoming a victim of violence is higher than usual. In such cases, the employer is responsible for ensuring that the threat of violence is adequately taken into account with appropriate procedures, safety arrangements and equipment for preventing and restricting violence and with the possibility of calling for help (Pietiläinen 2008).

If a violent incident is considered an occupational accident, the injured person receives compensation from the statutory accident insurance scheme (Pietiläinen 2008). The Finnish Employment Accidents Insurance Act (1948/608) also applies when the injury or illness results from an assault or other intentional act by another person. The Act also applies to situations, for example, robberies, where the consequences are not necessarily physical injuries. These include mental traumas, which, subject to certain conditions, are considered in the same way as assaults and are compensated for as employment accidents (Kukkonen & Karmavalo 2004).

Violence has become a topical OH&S problem in workplaces across countries, receiving increasing attention (see e.g. Chappell & Di Martino 2006, Isotalus 2002, Viitasara 2004, Wassell 2009). Somewhat different trends of violence at work have been reported in the literature. For example, in the USA, workplace homicides have shown a declining trend, though workplace homicides involving women have increased (USDL 2011a). Nevertheless, Hendricks et al. (2007) have pointed out that the decline has not occurred uniformly across demographic and occupational categories. In the European Working Conditions Survey, the trend of exposure to violence has remained broadly stable between 1995 and 2005, although experiences of physical violence have increased from 4% to 6% (Parent-Thirion et al. 2007). According to the latest survey, only 2% of workers in 2010 reported having been subjected to physical violence in the previous year (Eurofound 2012). In Finland, several studies have shown an increasing trend in violence and threat of violence at work during the past decades (see Salminen 2010, Sirén et al. 2010), particularly involving women (see Lehto & Sutela 2008, Sirén et al. 2010). For men, the situation has remained more stable or has even decreased lately (Sirén et al. 2010), though in some sources, an increasing trend has been reported for both men and women between 2003 and 2009 (Kauppinen et al. 2007, Salminen 2010).

According to the accident statistics, in the USA, the number of non-fatal occupational injuries and illnesses requiring days away from work due to assaults and violent acts by person(s) has revolved around 40,000 incidents in recent years. That is approximately 3.2% of all non-fatal occupational injuries and illnesses requiring days away from work in the same years of 2008–2010. The incidence rate of assaults and violent acts by person(s) per 10,000 full-time workers was 3.6 in 2008 and 4.0 in 2010 (See USDL 2010a, 2010b, 2011b). There were 542 homicides in

2009 and 506 in 2010, constituting approximately 11.5% of all fatal occupational injuries in 2009 and 2010 (USDL 2011a). In the EU, violence, aggression and threats (between company employees and from people external to the company) were reported concerning 24,598 non-fatal accidents at work (more than three days lost), constituting 0.85% of all deviations reported. Between 2003 and 2005, there were 88 (1.1% of all deviations) fatal accidents at work related to violence, aggression and threats (see European Commission 2009).

In Finland, violence has been comparatively minor but increasing hazard, especially in workplaces and occupations where workers are not well prepared for violence (Salminen 1997, Isotalus & Saarela 1999). Previously, only Isotalus and Saarela (1999) and Isotalus (2002) have analysed occupational accidents related to violence on the basis of the Finnish occupational accidents and diseases statistics database, covering the years 1994–1999. During 1994–1999, approximately 500 occupational accidents were related to violence per year in Finland. This constituted 0.4% of all occupational accidents (Isotalus 2002). The incidence rate (per 1000 workers) of all occupational accidents related to violence was 0.27 in 1994 and 0.24 in 1996 (Isotalus & Saarela, 1999). On average, two workplace homicides occurred yearly during 1990–1998 in Finland (Isotalus 2002).

Workplace violence risk factors emerge mainly from the features of the work environment but also from a wider context and in particular situations (EU-OSHA 2010). Typically, violence is centred on certain occupational groups involving cash handling and customer, client or patient contact (see e.g. Isotalus 2002, Mayhew 2002, Viitasara 2004). The occupations with the highest risk of workplace violence include, for example, retail sales, law enforcement, teaching, health care, transportation and private security (see e.g. Isotalus 2002, Mayhew 2002, Parent-Thirion et al. 2007, Peek-Asa et al. 2001, USDL 2011b).

There are also gender and age differences in exposure to occupational violence (Chappell & Di Martino 2006, EU-OSHA 2010, Mayhew 2002). The findings in the literature are, nevertheless, inconsistent (see Camerino et al. 2008, Mayhew 2002). In general, men have been considered to have a higher risk (see EU-OSHA 2010), though women tend to experience higher levels of verbal abuse, while men tend to experience more physical violence and threats (see Chappell & Di Martino 2006, Mayhew 2002). Nevertheless, in the USA, occupational fatalities involving women are more often due to homicides than those fatalities involving men (Chappell & Di Martino 2006). Some studies have identified younger workers to be particularly at risk (see e.g. Chappell & Di Martino 2006, Eurostat 2010, McCall & Horwitz 2004, Rauscher 2008), while in other studies, older employees have had an increased risk (see Mayhew 2002). In addition, many other individual, organisational and psychosocial characteristics have been identified in the literature in relation to violence at work (see Camerino et al. 2008). Other risk factors of occupational violence mentioned in the literature include, for example, working alone and in isolated work environments, employment status (e.g. those who are precariously employed often work in high-risk occupations) (Chappell & Di Martino 2006) and working outside normal hours (see Chappell & Di Martino 2006, European Commission 2009).

The existing literature has included reviews of incidence, prevalence and risk factors of workplace violence and have described many approaches to prevention, focusing often on specific workplace settings (Wassell 2009). A number of factors can cause or contribute to the risk of violence at work (Chappell & Di Martino 2006). Interventions to prevent violence at

work include both environmental (e.g. lighting), organisational and administrative (e.g. work practices) and behavioural and interpersonal (e.g. training) interventions (Merchant & Lundell 2001). In addition, a vast literature is available, for example, on contributing factors and processes of violent behaviour (Chappell & Di Martino 2006). Nevertheless, the lack of uniformly accepted definitions makes it difficult to estimate the true extent of occupational violence (Mayhew 2002). In addition, changes in work assignments and employment structures may have created new types of threats and high-risk groups with regard to violence at work (Mayhew 2002). Occupational accidents related to violence should still be studied in order to find out whether there are changes in the incidence and risk occupations and to better understand the different kinds of situations they involve (Isotalus 2002). On-going surveillance and continuing risk analyses are needed to understand the scope and trends of workplace violence, which are essential to the development of efficacious interventions (see EU-OSHA 2010, Runyan 2001).

2.6.2 Temporary agency work

Temporary agency work (TAW) is increasing in Finland and around the world (see CIETT 2009, 2012, Kostamo 2009). The number of temporary agency workers across the world has more than doubled since 1996, the full-time equivalent of agency workers being 10.4 million in 2010 (CIETT 2009, 2012). In Finland, the work done by temporary agency workers in the 21st century has been equivalent to 30,000–40,000 person-work years (Marttinen & Raatikainen 2009), constituting a little over 1% of all employees (1.4 in 2008 and 1.3% in 2011) (Marttinen & Raatikainen 2009, Ministry of Employment and Economy 2012). In 2010, the agency work penetration rates were 1.6% in Europe, 1.5% in Japan and 1.8% in the USA (CIETT 2012).

TAW provides a flexible employment alternative for companies (see Ministry of Employment and Economy 2012, Storrie 2002) but also for employees (see EU-OSHA 2007) in the present day. Traditionally, TAW was used to replace absent staff (Arrowsmith 2008). TAW is also used to meet peaks (CIETT 2012) and, increasingly, TAW is used on a regular basis and it is an important part of personnel recruitment (Burgess et al. 2005, Storrie 2002). For employees, TAW may help in terms of finding a permanent job in the future. Flexible working hours can also help to reconcile an employee's private and working life (EU-OSHA 2007). TAW is highly dependent on economic fluctuations (CIETT 2009, 2012). The structure of the sector and patterns of TAW vary between countries (Arrowsmith 2008).

There are differences between countries in the profile of TAW use and temporary agency workers (see Arrowsmith 2008, Storrie 2002). The majority of temporary agency workers are young, at under 30 (CIETT 2009). In Finland, approximately 40% of temporary agency workers were between 15 and 24 years old in 2009–2011. There were no major differences in gender distributions of agency workers (OSF 2012b). The proportion of temporary agency workers is highest in the hotel, restaurant and catering industry; sales work; the manufacturing industry; and in construction (Kostamo 2009, Marttinen & Raatikainen 2009). The average duration of assignments was 70 days between 2000 and 2008 (Kostamo 2009).

The definition of TAW is similar in most EU member states (Arrowsmith, 2008). In contrast to regular employment, in TAW there are three operating parties: a temporary work agency company, a user company and a worker. In TAW, the contract of employment is made between

the temporary agency worker and the temporary work agency, but the agency worker works, via a commercial contract, in the user company under the instruction and supervision of the user company (Arrowsmith 2008, Keller & Seifert 2005, Storrie 2002).

Nearly all countries in the EU have a clear statutory framework for TAW, with definitions of related concepts. In addition, there are some common requirements concerning, among others, OH&S. Nonetheless, the differences between the form and substance of regulations are obvious. Factors such as legal requirements for using TAW, sectors where the use of TAW is forbidden, duration of assignment etc. can be regulated in some countries and not in others (Arrowsmith 2008).

Specific requirements on the equal treatment of temporary agency workers are given in the EU Directive on Temporary Agency Work (2008/104/EC), which entered into force in December 2008. The provisions of the Directive were transposed into national law in Finland in 2012. In Finland, the provisions concerning employment in general are applied to TAW, including the Finnish Occupational Safety and Health Act (2002/738) (see Ministry of Employment and Economy 2012). In general terms, the user company is obliged to conform to the Act during the work. The user company's responsibilities involve defining and communicating to the temporary work agency the occupational qualifications required for the agency worker and the specific nature of the job before starting the work. The user company should also provide proper orientation for the agency worker. The responsibilities of the temporary work agency are to ensure that the agency worker has adequate skills and experience appropriate to the work and to organise occupational health care services for the agency worker (Finnish Occupational Safety and Health Act, 2002/738). According to the Finnish Employment Accidents Insurance Act, it is the duty of the employer (here, the temporary work agency) to take out the statutory employment accident insurance on behalf of the employee (Finnish Employment Accidents Insurance Act 1948/608).

In practice, managing safety in TAW can be challenging because of special features in TAW (Guidebook for temporary agency work 2011). For example, a lack of clarity in terms of employer responsibilities, a high turnover of assignments and a continuous change of workplaces make the task of ensuring the health and safety of temporary agency workers extremely challenging (Storrie 2002). In addition, the majority of temporary agency workers are young (CIETT 2009, 2012, Storrie 2002), with less previous work experience (see EU-OSHA 2007).

In several studies, non-standard and temporary work is associated with harmful effects on health and safety in terms of occupational accidents, among others (e.g. Guadalupe 2003, Kirschenbaum et al. 2000, Morris 1999, Saha et al. 2004, Saha et al. 2005, Virtanen et al. 2005). Temporary agency workers have also been reported to have an increased accident risk (Fabiano et al. 2008, Mehta & Theodore 2006, Nola et al. 2001, Storrie 2002), although research and evidence focusing only on, or separating out TAW is much scarcer (Fabiano et al. 2008, Nola et al. 2001, Storrie 2002). Fabiano et al. (2008), for example, found the accident frequency (per million working hours) in TAW (91.63) to be over two times higher (2.65) than for the highest risk sector (building) at a national level in Italy, and over four times higher (4.41) than in all sectors. In addition, in Finland, an increasing risk for occupational accidents in TAW has been identified on the basis of the national statistics (see e.g. FAII 2007b, 2009b). For example, inadequate training (Fabiano et al. 2008, Nola et al. 2001), the short duration of work

assignments (Fabiano et al. 2008), a lack of knowledge of the working environment (Nola et al. 2001) and the diminished impact of the safety regime (Mehta & Theodore 2006) have been suggested to be contributory factors to the negative health and safety consequences in TAW. In addition, there are indications in research that work-related risks are transferred to non-permanent employees and subcontractors working with more dangerous tasks in poorer conditions (e.g. EU-OSHA 2007, Mehta & Theodore 2006, Tucker 2002). In addition, job insecurity and a lack of experience and training have been suggested as explanations for the negative health and safety outcomes and increased injury risk in non-standard and temporary work (EU-OSHA 2007).

Nevertheless, the evidence behind the association between temporary work and increased accident risk is ambiguous in the literature. Some studies report no such connection (e.g. Saloniemi & Salminen 2010, Virtanen et al. 2005). However, temporary workers may more easily underreport occupational injuries because of fears of being stigmatised or fired (Guadalupe 2003). Furthermore, some studies conclude that even though there is a link between temporary work and a higher accident risk, the characteristics of the work, individual employees and particularly the working conditions explain the risk more than solely the form of employment (Amuedo-Dorantes 2002, Benavides et al. 2006, Hernanz & Toharia 2006). Further research to identify the mechanisms linking precarious and non-standard or temporary work with negative health and safety outcomes is recommended in several sources (e.g. EU-OSHA 2007, Quinlan et al. 2001, Saha et al. 2004, Virtanen et al. 2005). The significance of working conditions should be assessed more specifically (Benavides et al. 2006).

2.6.3 Local government sector

State and local government sectors are significant employers in many countries. In Finland, the arrangement of welfare services is based on the Nordic Welfare State Model (Rautio 2006). Municipalities have the legislative responsibility for providing basic welfare services for residents, the most important of these services relating to social welfare and health care, education, environment and technical infrastructure. The services can also be provided by regional cooperation between municipalities, organisations or companies and by joint municipal authorities (an organisation set up by two or more local authorities dealing with specified tasks) (Rautio 2006, The Finnish public sector as employer 2006). In addition to the statutory services, municipalities can provide other services such as cultural services (Juntunen & Leinonen 2007).

The size, population and economic factors of Finnish municipalities vary (Juntunen & Leinonen 2007, The Finnish public sector as employer 2006). Currently, there are 336 municipalities in Finland, employing over 430,000 persons; that is, approximately one-fifth of the Finnish labour force (The Association of Finnish Local and Regional Authorities 2012a). One municipality out of four employs more than 500 people, while the biggest municipal employer, the city of Helsinki, has some 36,000 employees. Of the Finnish employed workforce, 33% of women and 9% of men are employed in the local government sector (The Finnish public sector as employer 2006). The average age of municipal personnel is 45 years. The administrative sectors of health care, education and social services employ the majority of local government personnel (83%). Other administrative divisions in the local government sector are municipal enterprises and services (e.g. water and energy supply, waste management and transport services), community

planning and public works (dealing with the necessary infrastructure), general administration (local government management and financial administration), real estate and public order and safety (fire and rescue services etc.) (The Association of Finnish Local and Regional Authorities 2012b, The Finnish public sector as employer 2006).

Research focusing on the public and local government sectors from the OH&S viewpoint includes studies, for example, on municipal employees' well-being (e.g. Manka et al. 2012, Pekka et al. 2011) and public sector or municipal employees' sickness absence (e.g. Laaksonen et al. 2008, Piha et al. 2007, Vingård et al. 2005, Voss et al. 2008). Otherwise, the public safety and health perspective is emphasised in the literature including research, for example, on municipal safety management (e.g. Johansson et al. 2009, Strömgren & Andersson 2010) and on safe communities (e.g. Nilsen et al. 2007a, 2007b). However, current research focusing on occupational safety management and accident prevention in the local government sector is scarce as far as the author can ascertain. Nor are there many publications available on occupational accidents involving the local government sector employees. For example, in the Bureau of Labor Statistics workplace injuries and illnesses statistics, the national public sector estimates were available for the first time only in 2008 (USDL 2009). Nevertheless, the local government sector accounts for a major proportion of all occupational accidents and diseases/injuries and illnesses, at least in Finland and the USA. According to the national statistics, approximately 20% of all occupational accidents and diseases in Finland occur in the local government sector (Nenonen 2012). In the USA, the corresponding proportion of local government total recordable injury and illness cases is approximately 16%. In the USA, local government employees accounted for approximately 11% of the annual average employment (See USDL 2009, 2010c, 2011c). Furthermore, in Finland, the number and frequency of the local government sector occupational accidents and diseases has long remained on approximately the same level (see FAII 2009a, Nenonen 2012).

2.6.4 Slipping, tripping and falling

In the literature, different definitions are used to refer to occupational accidents related to slips, trips and falls (see Leclercq 2005). Moreover, varied terminology is used to refer to these accidents, often without defining them explicitly (see Leclercq 2005, Leclercq et al. 2007). According to the definition by Leclercq and Thoy (2004), the relevant literature includes cases where a person's balance is disturbed while working and, subsequently, the person either recovers their balance or falls, suffering injuries in either case. In addition, a distinction can be made between falls from a higher level to a lower level and falls on the (same) level (see Leclercq & Thoy 2004, Yoon & Lockhart 2006). Abrupt changes in level may be included in 'on the level cases' excluding only falls from a great height (see Leclercq & Thoy 2004). On the other hand, falls on the same level may include only cases where the point of contact with the source of injury is on the same level or above the surface supporting the injured person (see Yoon & Lockhart 2006). Falls to a lower level include, then, cases where the point of contact with the source of injury is below the level of the surface supporting the injured person (see Yoon & Lockhart 2006).

Slips, trips and falls have been recognised as a major problem in workplaces and they compose a substantial proportion of occupational accidents in many countries according to the statistics (see

e.g. Bentley 2009, Yoon & Lockhart 2006). Slipping-, tripping- and falling-related occupational accidents and injuries continue to pose a significant occupational safety problem with consequent human suffering and economic losses (see e.g. Decker et al. 2009, Lockhart et al. 2005). For example, in the USA, UK and Sweden, occupational injuries related to slipping, tripping and falling comprise between 20 to 40% of occupational injuries (see Courtney et al. 2001, Kemmlert & Lundholm 2001, Yoon & Lockhart 2006). Of non-fatal accidents at work in the EU, the deviation of 'slipping, stumbling and falling, fall of persons' accounted for 22.5% of all deviations in 2005 (European Commission 2009). According to the Finnish occupational accident statistics, nearly 30% of all occupational accidents are related to slipping or stumbling with a fall or falling (Grönqvist & Hirvonen 2009). In addition, increasing trends of slip-, trip- and fall-related occupational accidents have been identified, at least in Finland (Grönqvist & Hirvonen 2009) and the UK (see Bentley & Haslam 2001). In the USA alone, the annual direct costs of fall-related occupational injuries have been estimated to be over 6 billion US dollars (Courtney et al. 2001) and costs to the US economy nearly 10 billion US dollars yearly (Yoon & Lockhart 2006). In Finland, slipping-, stumbling- and falling-related accidents, including occupational accidents and accidents at home and during leisure time cause yearly direct national economic costs of 400 million Euros (Vartiainen et al. 2009).

The causes of slips, trips and falls are various and complex (Gao et al. 2008, Lockhart et al., 2005). In general, slips, trips and falls are caused by multiple interacting environmental, individual and task and equipment factors affected by organisational/system and extra-organisational influences (see Bentley 2009, Bentley & Haslam 2001, Grönqvist 1995, Leclercq 2005, Redfern et al. 2001). Slips, trips and falls occur as a result of unintended or unexpected changes in the contact at the interface between footwear and the underfoot surface (see Decker et al. 2009, Gao & Abeysekera 2004). Accordingly, underfoot conditions (see e.g. Bell et al. 2008, Bentley & Haslam 2001, Kemmlert & Lundholm 2001, Lipscomb et al. 2006), footwear (see e.g. Bentley & Haslam 2001, Bentley et al. 2005) and gait patterns (see e.g. Cham & Redfern 2002, Gao et al. 2008, Yoon & Lockhart 2006) have been identified as major factors influencing the risk of slips, trips and falls. Low friction and slipperiness or poor grip between footwear and the underfoot surface can be considered as primary risk factors (see e.g. Bentley & Haslam 2001, Courtney et al. 2001, Gao et al. 2008). Courtney et al. (2001), for example, discovered that slipperiness was a contributing factor in 40 to 50% of fall-related injuries. Consequently, research related to slips, trips and falls has focused on such topics as, for example, human gait, coefficient of friction, kinetics and kinematics, adaptions to gait in anticipation of slippery conditions, and recovery and recovery strategies (see McGorry et al. 2010).

A broad range of other risk factors mentioned in the literature include, for example, activity at the time of accident, ageing, attention/distractions, fatigue, hazard perception, occupation and urgency (see Bentley 2009, Bentley & Haslam 2001, Courtney et al. 2001, Gao et al. 2008, Yoon & Lockhart 2006). Slips, trips and falls have been reported to be common, for example, in construction (e.g. Chi et al. 2005, Courtney et al. 2001, Haslam et al. 2005, Lipscomb et al. 2006, Yoon & Lockhart 2006), dairy farming (Bentley et al. 2005), fishing (e.g. Jensen & Laursen 2011), forestry (e.g. Bentley & Haslam 2001), health care and nursing (Bell et al. 2008), mail delivery (Bentley & Haslam 2001), mining (Courtney et al. 2001), the public utilities industry (Yoon & Lockhart 2006), the service sector (Courtney et al. 2001), transportation and in the wholesale and retail trade industry (Yoon & Lockhart 2006).

Despite considerable advances in understanding the aetiology of slips, trips and falls (Bentley 2009), further research with detailed analyses (Bentley 2009, Leclercq & Thoy 2004), focusing more generally on balance disturbances (Leclercq 2005) and analysing the wider incident process (Bentley 2009) are still needed. Leclercq et al. (2007), for example, argue that the research and prevention efforts have focused on slip-resistance measurements and on the prevention of slips on slippery floors, although slipping or slippery surfaces do not trigger all slips, trips and falls, but they occur in varied circumstances. There is a need to focus more generally on balance disturbances (Leclercq 2005). Furthermore, relatively few research and practical measures are available for the prevention of accidents on the level in proportion to the diversity of circumstances covered by them and the importance of the human and financial issues they represent (Leclercq et al. 2007). According to Bentley (2009), again, the literature offers much in terms of understanding the role of certain discrete risk factors but further research is needed to understand the broader work system and the actual incident process for workplace slips, trips and falls.

2.7 Introduction to web services and usefulness evaluation

2.7.1 Definition of web service

Increasing interest has focused on e-services during recent years (e.g. Bauer & Hammerschmidt 2004, Järvinen & Lehtinen 2005). Nevertheless, the related terms and definitions used vary between fields of approach (Baida et al. 2004, Järvinen & Lehtinen 2005). The characteristics of e-services and e-service concepts differ, for example, in terms of what kinds of electronic networks are considered as e-services and how much interaction there is between the user and service provider or other users (see Järvinen & Lehtinen 2005). By examining the characteristics of e-services, Järvinen and Lehtinen (2005) have proposed the following definition: 'An e-Service is a benefit providing object of transaction that can be characterised as an intangible process that is at least partially produced, marketed and consumed in a simultaneous interaction through electronic networks'. A web service is a more concise and established term, having its roots in computer sciences. Web services are software applications that are used over the Internet (Baida et al. 2004). The quality of the web service is increasingly recognised as an essential factor in providing a successful web service and use experience (see Bauer & Hammerschmidt 2004, Tervakari et al. 2007). Nevertheless, there is still relatively little research in this field (Bauer & Hammerschmidt 2004).

2.7.2 Usefulness and user experience, definitions and evaluation

Human–computer interaction (HCI) is a field of science studying the design, evaluation and implementation of interactive information systems and related phenomena. HCI research includes several different main research lines (e.g. ergonomics, information systems research and user-interface research) with distinguishable and common features. Common to all approaches is to see the human as a user of technology, with technology being understood from the viewpoint of human activity. The aim is to make technology more suitable, or usable, for the purposes of its users (Oulasvirta 2011).

Nielsen (1993) defines usefulness as one category of the system's practical acceptability among the factors of the cost and reliability of the system etc. In general, usefulness is the issue of whether the system can be used to achieve some desired goal. Usefulness can be divided into utility and usability. Utility means the functionality of the system; that is, its ability to do what is needed. Usability concerns the question of how well users can use that functionality. In addition, using the product must constitute an accurate, efficient and satisfying experience for users (Nielsen 1993). According to the standard SFS-EN ISO 9241-11 (2000), usability can be defined as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context. Effectiveness means the extent to which a goal, or task, is achieved. Efficiency is the amount of effort required to accomplish the goal. Satisfaction is the level of comfort users have when using the product (Jordan 1998). Furthermore, usability can be seen to consist of different usability characteristics such as being easy to learn, easy to remember, subjectively pleasing etc. (e.g. Nielsen 1993).

In improving usability, the goal is to make the cooperation between the user and the product more efficient and pleasant for the user (Nielsen 1993). It is important to note that the usability of a product always depends on the context of use (SFS-EN ISO 9241-11 2000). Usability cannot be considered as an always-existing characteristic of a product. The purpose of use defines what kind of usability the product must have. It is important from the usability point of view to consider the users' experience and previous knowledge about products when the products are designed (Sinkkonen et al. 2006). Several studies have examined how users' background affects user satisfaction and user experience. For example, such user characteristics as age, gender (Jordan 1998, Zviran et al. 2005), education and organisational level (Zviran et al. 2005) may affect users' experience and satisfaction with the products. The users also differ in their knowledge about computers in general, their expertise in using the specific system and in understanding of the task domain (see Jordan 1998, Nielsen 1993).

The importance of evaluation is emphasised in user-centred design (Jordan 1998, Preece et al. 2002). Several criteria, methods and models are available, which can be used in usefulness evaluation. There are a number of standards related purely to usability (see International standards for HCI and usability 2012). Furthermore, in many countries, including Finland, guidelines, assessment criteria and assessments have been created for the purpose of improving the quality of public web services (Asikainen et al. 2003). Evaluation methods can be divided in different ways (Preece et al. 2002). Roughly, methods can be categorised into expert methods, where experts gather the information, and empirical methods, where information is gathered from actual users (see Jordan 1998, Nielsen 1993, Preece et al. 2002). The experiences of real users are often emphasised in evaluating the usefulness and usability of the products or systems (see Jordan 1998, Nielsen 1993, Preece 2002). The purpose of evaluation and the stage of the product in the lifecycle will underpin decisions on the chosen evaluation method (see Jordan 1998, Preece et al. 2002). For example, questionnaires (see e.g. Jordan 1998) and scenarios (see e.g. Nielsen 1993) are often-used methods in usability research.

Over the last decade, the concept of user experience has been rapidly disseminated and accepted in the HCI community as a viable alternative to traditional, task- and work-related, usability paradigm in HCI (see Hassenzahl & Tractinsky 2006, Law et al 2009). The concept of user experience is understood very differently among the HCI professionals, and different definitions

have been proposed to describe user experience (Law et al. 2009). The variety of meanings associated with user experience range from traditional usability to hedonic, affective or experiential aspects of technology use (Hassenzahl & Tractinsky 2006). According to Law et al. (2009) the notion of user experience differs depending on, for example, who are experiencing agent/subject of interest, what is the something/object that is experienced, how the experience is brought about and when the object is being experienced.

What the user experience professionals seem to agree on is that user experience is dynamic, context-dependent and subjective stemming from a broad range of potential benefits users may derive from a product (Law et al. 2009). User experience was recently defined in ISO-standard (SFS-EN-ISO 9241-210 2010) to compose of person's perceptions and responses, which arise on the basis of using or anticipating the use of a product, system or service. User experience includes all the users' emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviours and accomplishments that occur before, during, and after the use (SFS-EN-ISO 9241-210 2010). Although, user experience in itself stems from individual's experiences, the community forms the social context that affects user experience together with other contextual factors, and a group can share the experience (Law et al. 2009).

Usability and user experience are overlapping concepts. According to the standard 9241-210 (SFS-EN-ISO 9241-210 2010), usability criteria can be used to assess aspects of user experience. On the other hand, usability can include perceptual and emotional aspects typically associated with user experience if it is considered from the perspective of the users' personal goals (SFS-EN-ISO 9241-210 2010). What user experience can offer to the traditional usability framework is the expanded focus on perspectives of affect, sensation and value. In addition, the user experience focuses on creating quality experiences rather than just preventing usability problems (see Hassenzahl & Tractinsky 2006, Law et al. 2009). The methods used in traditional usability research, such as surveys, are applicable in user experience studies as well (see Rohrer 2008).

In this research, user experience is in general understood as defined in the standard 9241-210 (SFS-EN-ISO 9241-210 2010). It is acknowledged and considered that user experience includes both usefulness and pleasurability aspects. Nevertheless, the focus is on usefulness aspects. The term user experience is used to emphasise the user viewpoint employed to usefulness in the research. Moreover, the usefulness criteria are used to assess user experience.

3 SCOPE AND OBJECTIVES OF THE RESEARCH

Figure 2 summarises the review in section 2 and presents the theoretical framework behind this research. The related key definitions are listed and defined at the beginning of this introductory essay. The major starting point behind this research is the assumption that topical and reliable information on occupational accidents that have occurred forms an important basis for safety promotion and accident prevention. The Framework Directive (89/391/EEC) requires employers to report occupational accidents to the responsible authorities in accordance with national laws and practices. In Finland, the reporting and registering system is insurance-based. These national occupational accident databases used for official statistics are an important data source, providing a statistical picture of health and safety at work at the country level. The relevant research literature provides occupational accident information to guide safety promotion and safety performance measurement in practice and also provides information that can be used to set requirements for accident data and accident data collection.

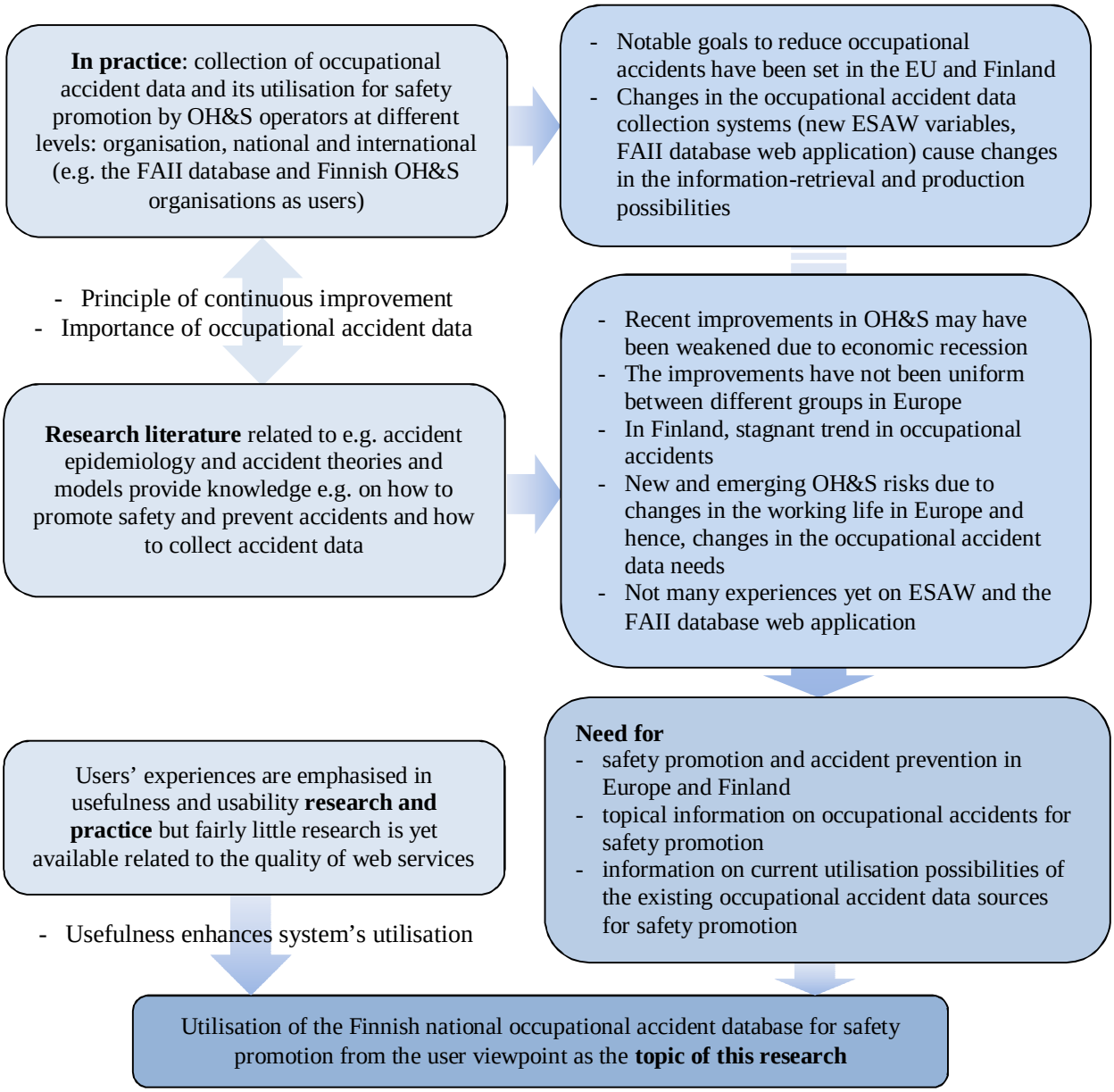

Figure 2. Summary of the theoretical framework of this research.

Topical information concerning occupational accidents is needed in general to support the improvement of safety and health at work on a continuous basis. Nevertheless, there are a number of other timely, current issues affecting the need for safety promotion and supportive occupational accident information in Europe and Finland. Overall, a strategic will to improve OH&S in the EU and in Finland has been expressed, for example, as notable goals set to reduce occupational accidents. Although improvements have been reported in safety and health at work in European countries, these have not fallen uniformly upon the workforce and companies. Furthermore, the improvements may have been weakened due to the economic recession. Moreover, more research is needed, particularly related to the new and emerging risks that European countries are facing due to changes in the working life.

At the same time, there are not yet many experiences on how well the existing occupational accident databases provide information related to the topical OH&S issues, particularly after the implementation of the ESAW methodology in the EU member states and, additionally, the FAII database web application in Finland. Requirements for occupational accident data such as timeliness and reliability have been defined in the field of safety research. Furthermore, occupational accident classifications such as ESAW are based on accident theories and models presented in the literature. Although occupational accident databases can be considered as systems with human–computer interaction, less attention may have been paid to the research and practices in the field of usability. Furthermore, not much research is currently available related to the quality of web services such as the FAII database web application. Another basic assumption behind this research is that usefulness of the occupational accident databases enhances their utilisation and utilisation possibilities. In addition, as in usability research and practice, the user viewpoint is emphasised.

This research discusses the utilisation of the Finnish occupational accidents and diseases statistics database, the FAII database, for safety promotion. The research aims to indirectly enhance the utilisation and utilisation possibilities of the FAII database for safety promotion. This aim is approached with the following two main objectives:

1. Utilise the FAII database in order to provide information concerning occupational accidents related to selected topical OH&S issue cases for safety promotion.
2. Explore and describe the utilisation and usefulness of the FAII database for safety promotion.

The objectives of the research are accompanied by the following research questions:

1. What is the extent of occupational accidents related to the selected OH&S issue cases and what are the factors contributing to these accidents?
2. What are the utilisation and usefulness aspects of the FAII database for safety promotion like and how could they be improved?

The OH&S issue cases included in this research involve the following topics:

1. Accidents at work related to violence
2. Accidents at work during temporary agency work (TAW)
3. Occupational accidents in the local government sector
4. Slipping, stumbling and falling (SSF) accidents at work.

These OH&S issue cases were selected based on both empirical and theoretical reasons. As mentioned above, occupational accident information is provided for the purposes of different FAII database user organisations. Hence, there has been an empirical request to provide information on occupational accidents related to each of these OH&S issues. Nevertheless, these OH&S issue cases were selected particularly due to the following reasons:

- These OH&S issue cases were considered particularly relevant from the safety promotion viewpoint. The number and/or risk of accidents related to these OH&S issues are high and/or increasing. The relevance of and need for information on accidents related to these OH&S issue cases is also recognised in the literature and the cases are, hence, also of international interest.
- It was known that retrieving and providing information on occupational accidents related to these OH&S issue cases from the FAII database involves some challenging aspects.

In this research, the focus is on the FAII database user (see section 2.2.3) viewpoint. Information concerning occupational accidents related to the selected OH&S issue cases is provided following requests from different FAII database user organisations. The utilisation and usefulness of the FAII database for safety promotion are also discussed from the user viewpoint.

This research focuses on occupational accidents, and particularly on accidents at work related to the selected OH&S issue cases. Occupational diseases were excluded and commuting accidents were included only in the case of the local government sector because of their relevance from an accident prevention viewpoint. In other cases, commuting accidents were excluded. This scope was chosen because in the OH&S issue cases selected for this research, accidents at work were considered more relevant relative to safety promotion than commuting accidents and occupational diseases. In addition, partly different classifications are used to code accidents at work, commuting accidents and occupational diseases in the FAII database. More classification variables are used to describe accidents at work than commuting accidents and occupational diseases. Hence, the FAII database contains more information on accidents at work than commuting accidents and occupational diseases. In addition, some of the ESAW variables are applied only to accidents at work. Moreover, in the cases of violence-related accidents at work and SSF accidents at work, the classification variables used enabled information retrieval concerning only accidents at work.

Related to the selected OH&S issue cases, information is provided on employee accidents at work and/or commuting accidents compensated for through the Finnish statutory employment accident insurance scheme (1948/608). Occupational accidents compensated for through the farmers' employment accident insurance and self-employed person's voluntary employment accident insurance schemes are not included in this research because of the different insurance bases.

4 RESEARCH DESIGN

4.1 Research paradigm and strategy

In the design of this research, the aim of choosing the most suitable research strategy and methods to meet the objectives of the research is emphasised over a commitment to a certain philosophical research paradigm. Creswell (2009) calls this position about philosophical worldviews a pragmatic worldview. According to Creswell (2009), pragmatism is not committed to any one system of philosophy and reality. Pragmatists emphasise the intended consequences of the research and research problem and look to the different approaches available to understand the problem (Creswell 2009, Morgan 2007, Patton 1990). The pragmatic worldview gives the philosophical underpinning for mixed-methods research. In mixed-methods research, different types of approaches, materials and methods (qualitative and quantitative) are, in one way or another, combined or associated (Creswell 2009). The application and mixing of both qualitative and quantitative worldviews and methods was also seen as necessary in this research in order to achieve the dual objectives of the research.

A fundamental long-term debate has revolved around the idea that qualitative research and quantitative research are bound to two distinct and partially contradictory paradigms (Patton 1990, Ronkainen et al. 2011). Nevertheless, many researchers (e.g. Patton 1990, Robson 2002) are of the opinion that the same research question or problem can be approached through different designs, from several viewpoints and from different methodological principles. Ronkainen et al. (2011), for example, argue that this dichotomy has, on several occasions, been proven to be epistemologically fallacious and unsustainable from the viewpoint of carrying out research in practice. What is essential, is selecting a research design appropriate for the purposes of the specific inquiry situations under consideration (Patton 1990, Ronkainen et al. 2011).

The existing research strategies are often categorised according to what kind of research they are suitable for. Yin (2003), however, argues that different strategies should be viewed inclusively and pluralistically. According to Yin (2003), what distinguishes the strategies is rather the type of research question, the control an investigator has over events and the focus on contemporary, as opposed to historical phenomena. In the literature, the case study is often recommended as a research approach when research questions are of the type what, how and why; when the researcher has limited control over events related to the phenomenon; when empirical research related to the topic is scarce; or when the target of the research is a phenomenon of the present time (Eriksson & Koistinen 2005, Yin 2003). According to Platt (1992), case-study research is a preferred strategy when the research problem and circumstances of the research are more important than the ideological paradigmatic commitment. Moreover, although case-study research is often associated with qualitative research, it can also be entirely or partly quantitative research (Ronkainen et al. 2011). Hence, the case study is applicable in research leaning towards pragmatic worldviews and mixed-methods research. Apart from the pragmatic worldview and mixed-methods research strategy, the case-study research strategy was considered as an appropriate basis for this research because the criteria suggested in the literature for the selection of the case study were met.

As defined in section 3, this research aims to provide information on selected OH&S issue cases on the basis of the FAII database, and to investigate the utilisation and usefulness of the database for safety promotion from the user viewpoint. The research questions defined for this research are of the form (what and how) that is suitable for a case-study research strategy. In addition, the researcher has, to a lesser degree, control over the events related to OH&S issue cases, and to the utilisation and usefulness as the phenomena of interest. In addition, as described in sections 1 and 2, further research is needed to provide a more continuous framework related to the OH&S issues this research focuses on, and the utilisation and usefulness of the existing occupational accident databases for safety promotion. Furthermore, the OH&S issue cases viewed in the research are of topical interest and the aim is to provide recent information on these issues. In addition, the utilisation and usefulness are charted at the present moment. Hence, the focus is on contemporary phenomena.

Case-study research is often inductive, aiming to extend, develop and build on existing incomplete theory, although it can also be used for deductive theory-testing purposes (Barratt et al. 2011, Laine et al. 2007). In this research, the existing literature is used to guide data collection and analysis. Nevertheless, certain specific theories are not chosen to be tested, but the data is first analysed and then compared with previous studies to supplement existing theories. Hence, the logic of inference in this research is closer to an inductive rather than a deductive approach.

4.2 Materials and methods

4.2.1 Composition of the research and original publications

This research is based on five independent research projects carried out at the Tampere University of Technology between 2005 and 2011 (see Aaltonen et al. 2010, Hintikka 2008, Hintikka 2007, Hintikka & Saarela 2007, Hyytinen & Nenonen 2011). The data collected in the original research projects is utilised to extent appropriate relative to the objectives of this research. In addition, some of the data collected and the analyses carried out in the original research projects are supplemented for the purposes of this research.

The data collection comprises two phases: a user questionnaire and data collection related to the selected OH&S issue cases defined in section 3. In addition, the research consists of five research papers. The relationship between methods of data collection, related objectives and the original publications is presented in Figure 3. The FAII database users' experiences on the utilisation and usefulness of the database and its web application for their purposes were charted with a questionnaire. The aim was to get a general view on the utilisation and usefulness of the FAII database and its web application from the users' viewpoint. A questionnaire was selected because it is suitable for data collection from users in usability and usefulness assessment and because, with a questionnaire, a wide range of users can be easily reached (Jordan 1998, Nielsen 1993, Preece et al. 2002). The data collection and analysis related to the questionnaire is described in more detail in section 4.2.3. In the data collection related to the OH&S issue cases, the FAII database was utilised to carry out an accident analysis in order to provide information on occupational accidents related to the OH&S issue in question. At the same time as the accident analysis was carried out, a scenario analysis was used to chart the utilisation and

usefulness of the FAII database in retrieving and providing information on accidents related to the OH&S issue in question. The aim of the scenario analysis was to supplement the questionnaire data with a more in-depth view on the utilisation and usefulness through the OH&S issue cases. The scenario-analysis method was chosen because it enables the formation of a comprehensive picture of the system use in a certain context and the related users' experiences (see Bohman & Anderson 2004, Lim & Sato 2003, Rosson & Carroll 2008, Tervakari et al. 2007, Väyrynen et al. 2004). In addition, the method was suitable to be used in pursuance of the accident analysis. The data collection and analysis related to the OH&S issue cases are described in more detail in section 4.2.4.

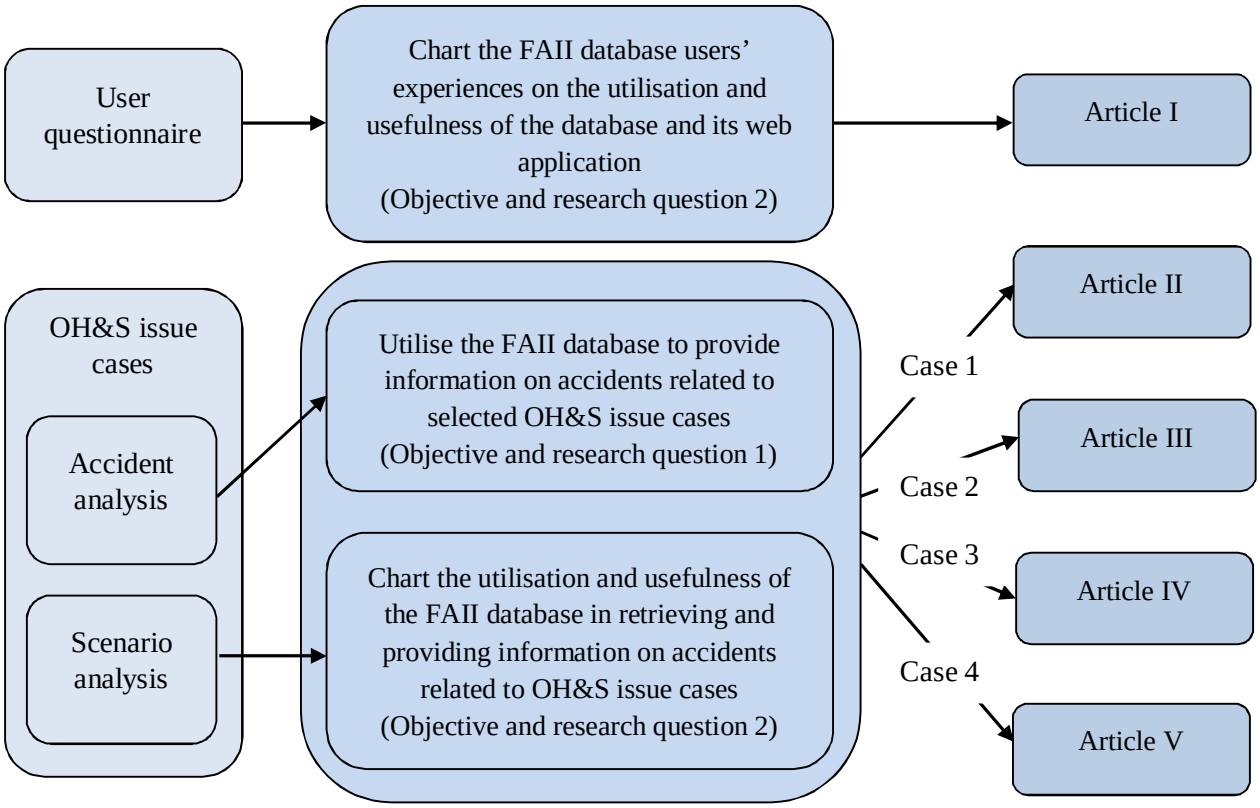

Figure 3. Relationships between data-collection methods, related objectives and the original publications (details listed below).

Article I. Hintikka, N. & Anttila, S. 2008. User experience of Finnish occupational accidents and diseases database. Proceedings of the International Conference on Occupational Risk Prevention ORP, May 2008, Coruña, Spain.

Article II. Hintikka, N. & Saarela, K.L. 2010. Accidents at work related to violence – Analysis of Finnish national accident statistics database. Safety Science 48, 517–525.

Article III. Hintikka, N. 2011. Accidents at work during temporary agency work in Finland – Comparisons between certain major industries and other industries. Safety Science 49, 473–483.

Article IV. Nenonen, N. 2011. Occupational accidents in the Finnish local government sector: Utilisation of national statistics. International Journal of Injury Control and Safety Promotion 18, 321–329.

Article V. Nenonen, N. 2013. Analysing factors related to slipping, stumbling and falling accidents at work: Application of data mining methods to Finnish occupational accidents and diseases database. Applied Ergonomics 44, 215–224.

Data sets related to the questionnaire and each of the OH&S issue cases were first separately analysed and compared to the relevant literature. The results related to each of the datasets are presented in one of the five research articles that this research consists of (Figure 3). The

preliminary results of the user questionnaire are presented in the first article. In the rest of the articles (II–V), the results of the accident analysis and scenario analysis related to the OH&S issue cases are presented. Each of these articles focuses on one of the OH&S issue cases. The articles provide an intensive description of the OH&S issue case in question based on within-case analyses. In the within-case analysis, the idea is to become as familiar with the case as possible (Eisenhardt 1989). In each of these articles, information on accidents related to the OH&S issue in question is presented. The articles also describe how the FAII database was utilised to retrieve and provide this information. In addition, observations made on the utilisation and usefulness of the FAII database related to the OH&S issue in question are discussed. This introductory essay presents the final results of the user questionnaire, the main results of the accident analysis and cross-case conclusions made on the basis of the scenario analysis. In the cross-case comparisons, similarities or differences are looked for between cases, groups of cases or different data (Eisenhardt 1989). In the introductory essay, the distinctive findings from each data collection and analysis are aggregated and compared with each other and with the previous literature to arrive at the final conclusions.

4.2.2 Case-study design

Research carried out under the title of the case study encompasses a variety of scientific fields and, therefore, the philosophical starting points and methodological choices, and the material used vary in case studies. Hence, defining case-study research comprehensively is difficult (Eriksson & Koistinen 2005). According to Yin's (2003) commonly referred to definition, a case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context when the boundaries between the phenomenon and context are not clearly evident. Yin (2003) continues by stating that case-study research often includes more variables than data points, and that is why multiple sources of evidence are often used, and why a case study benefits from predefined theoretical propositions in data collection and analysis. Yin's (2003) definition aggregates the features associated with case studies in the literature well. Eriksson and Koistinen (2005), for example, name the objective of examining one or more cases in order to define, analyse and solve the case, as one fundamental consistency between case studies. Laine et al. (2007) again conclude that holistic analyses of naturally occurring cases, the use of diverse methods, utilisation of previous research and unclear boundaries between the case and the context are typical of many case studies.

The case can be defined according to time, place or other criteria (Creswell 2009). A case can be, for example, an event, individual, group or an organisation, which can then be interpreted from different points of view, for example, as communities, projects, processes or as a manifestation of some phenomenon or theory (see Eriksson & Koistinen 2005, Laine et al. 2007, Ronkainen et al. 2011). In case-study research, it is essential to be able to define what the case represents and to what context it is related (Ronkainen et al. 2011). The case should manifest, besides itself, something general, which serves as the target of the research (Laine et al. 2007, Ronkainen et al. 2011). The target defines what features of the case are of special interest in the study (Laine et al. 2007). According to Yin (2003), case-study design can consist of one (single-case design) or several (multiple-case design) cases. These designs can both consist of either a single unit of analysis (holistic design) or multiple units of analyses (embedded design). Selection of an

appropriate unit of analysis is related to the definition of the case and research question (Yin 2003).

In the design of this research, two case-study designs are distinguishable (Figure 4). Firstly, the overall data collection of the research conforms to an embedded single-case design (see the upper design in Figure 4). In this design, the FAII database as a case represents an occupational accident data-collection system, particularly an official national-level system. Secondly, inside the overall case design, data collection related to the OH&S issue cases this research focuses on (defined in section 3) forms an embedded multiple-case design (see the lower design in Figure 4). In this design, each of the selected OH&S issue cases comprises one of the cases in the multiple-case design. The OH&S issue cases represent occupational accidents and accident data in the database. In both designs, the objectives of the research and related research serve as the target for the research and units of analyses. The occupational accident data-collection systems form the context for both case designs.

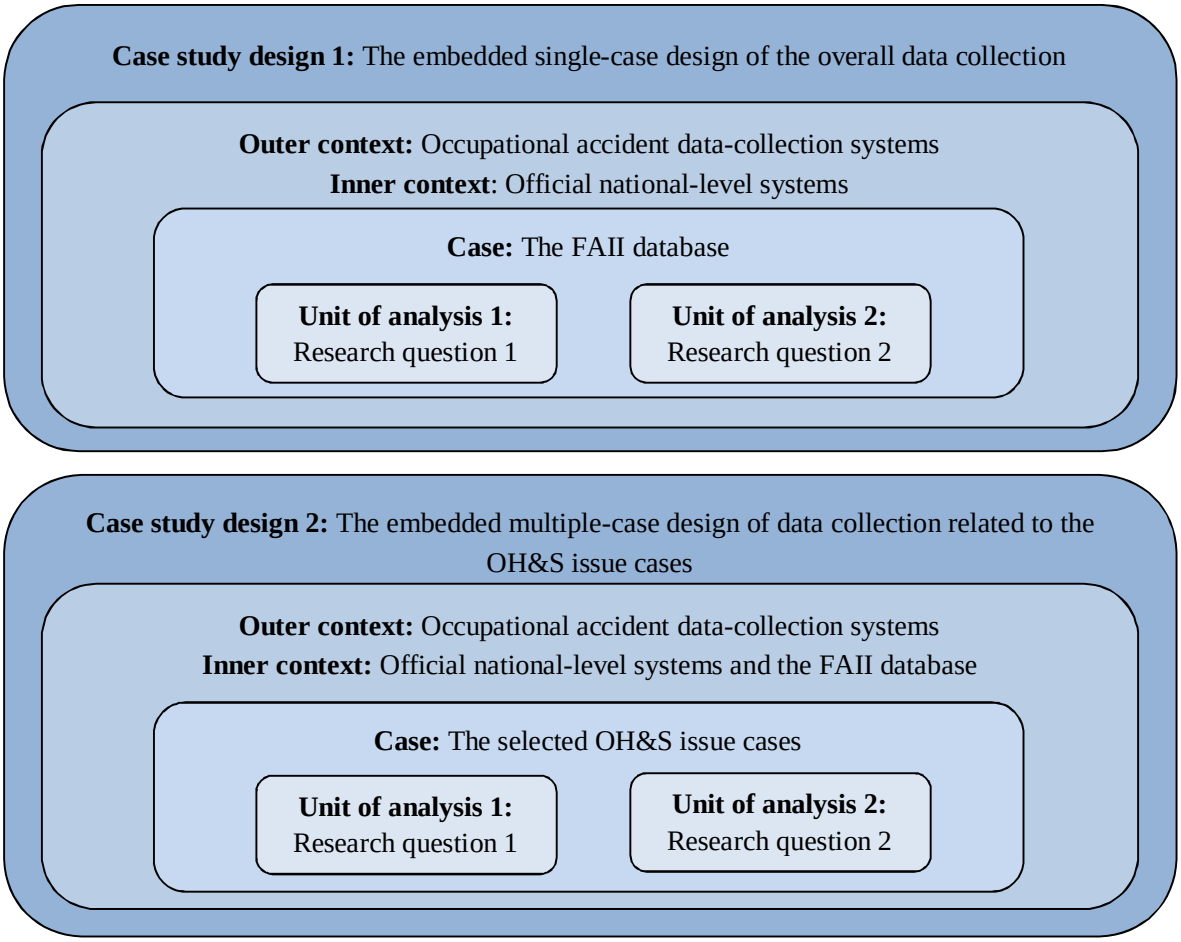

Figure 4. The two case-study designs that are distinguishable in this research (modified from Yin 2003).

4.2.3 Composition and analysis of the FAII database user questionnaire

In order to obtain an overview of the utilisation and usefulness of the FAII database and its web application, a questionnaire was compiled and directed to the users. The questionnaire was constructed based on the requests of the FAII. In addition, relevant literature was utilised in composing the questionnaire. The questionnaire consisted of questions related to the FAII database web-application use, questions charting users' satisfaction with the database web

application and its use, questions related to possible problems in using the application and suggestions for improvement. In addition, some questions on users' background were included.

The questions asked varied depending on how often the respondents had used the application. The frequency of the application use and questions related to respondents' background were asked of all respondents. Reasons for not using the application at all or more often were asked only from respondents who had not used the application at all or who had used the application less frequently (a couple of times a year or less) than the active users (weekly or monthly). The other questions were asked only of respondents who had used the application. The original questionnaire included more questions than were used in this research. Some of the most detailed questions (e.g. which variables you use most often when making searches and in which order the variables should be listed when you make searches with them) were excluded. Although these questions were relevant in the original research project, they were not considered essential for the purposes of this research. The questions in the questionnaire used in this research are presented in appendix A.

Users' satisfaction with the FAII database web application was charted through 28, 5-point Likert-scale, statements. The items covered such usefulness characteristics of the FAII database web application as its appearance, content, general user experience, guidance and directions, information retrieval, presentation of search results, technical functionality and use of classification variables. The items related to the same characteristics were combined into new variables by taking the averages of the scores on items related to the same usefulness characteristics. The internal consistency of the new variables was examined with Cronbach's alpha. For most of the new variables, the values of the Cronbach's alpha exceeded the acceptable (> 0.6) level (see Metsämuuronen 2006). Only for one variable, the use of classification variables, did the Cronbach's alpha fall below 0.6. Nevertheless, it was decided that this variable should also be used, since it was considered as useful and reliable enough. Furthermore, low values of alpha may also be due to random error (Heikkilä 2005), to a small number of statements used to calculate the mean variable or to the conciseness of the scale used (Metsämuuronen 2006) and, therefore, the low values may not necessarily be due to low reliability. The Cronbach's alphas of the new usefulness characteristic variables created and statements included in each variable are listed in appendix B.

Otherwise, the data was mainly analysed descriptively by comparing relative frequencies. In addition, the Chi-square test of independence, the Fisher's exact test, the Kruskal-Wallis test and the Mann-Whitney U test/Wilcoxon rank-sum test were used to identify dependencies between different variables. The initial data analyses were carried out with SPSS 15.0 and SAS Enterprise Guide 4.3 was used to carry out the supplementary analyses for this introductory essay.

The questionnaire was distributed as a web questionnaire to all known users of the FAII database. Before delivering the questionnaire, it was tested and commented on by the representatives of the FAII and some of the users. The contacts for the users were received from the FAII and the FAII contact persons at the 34 organisations that had rights to use the FAII database web application at the time the questionnaire was realised. In eight organisations, only the contact of the contact person was available. In those cases, the invitation to take part in answering the questionnaire was sent to the contact person. The questionnaire was distributed to 206 users. In total, 127 answers were received, yielding a response rate of 62%. The proportions

of the questionnaire invitations sent to different organisations, and the organisations the respondents and non-respondents represented are compared in Table 1.

Table 1. Questionnaire invitations sent, responses received and non-respondents by organisation.

Organisation [a]	**Questionnaire invitations sent n=206**	**Responses received n=125** [b]	**Non-respondents n=79**
Occupational Safety and Health (OSH) Authorities			
Occupational Safety and Health (OSH) Department of the Ministry of Social Affairs and Health or Finnish Safety and Chemicals Agency	6%	3%	10%
Occupational Safety and Health (OSH) Inspectorates [c]	38%	40%	35%
Research and Service Institutions			
Insurance companies	12%	14%	10%
Other research and service institutions [d]	31%	26%	38%
Other Organisations			
Labour market organisations	7%	10%	4%
The Centre for Occupational Safety	5%	7%	3%

[a] The classification of organisations is adopted from the Ministry of Social Affairs and Health (2004).

[b] Two of the 127 respondents had not stated their organisation.

[c] Since the beginning of 2010, the functions of the OSH Inspectorates are carried out at the OSH divisions of the Regional State Administrative Agencies (see Ministry of Social Affairs and Health 2010a).

[d] Finnish Institute of Occupational Health, Technical Research Centre of Finland, the Finnish Work Environment Fund, universities and other institutions of higher education.

There are some differences when comparing the organisation distribution of the respondents between the organisations to which the questionnaire invitations were sent and the organisations of the respondents and non-respondents. The proportions of responses received from other research and service institutions (26% of the responses) and the OSH Department of the Ministry of Social Affairs and Health and Finnish Safety and Chemicals Agency (3%) were smaller than the proportions of the questionnaire invitations sent to these organisations and the proportions of the non-respondents from these organisations. From other organisations, slightly more responses were received than invitations were sent. Nevertheless, the differences identified in the organisation distributions of the respondents and non-respondents were not statistically significant ($n_{Non\text{-}respondents}=79$, $n_{Repondents}=125$, $p = 0.059$). Furthermore, responses were received from all organisations to which questionnaire invitations were sent. The other background information of the respondents is summarised in Table 2.

Table 2. Respondents' background information.

Variables	**Categories**	**% of respondents**
Gender (n=126)	Female	38%
	Male	62%
Age (n=124) [a]	Under 45	28%
	45–54	34%
	Over 54	38%
FAII database web-application user training (n=127)	Non-trained	29%
	Trained	71%
Frequency of search engine use (n=82)	Daily	34%
	Less frequently than daily	66%

[a] The age of respondents varied between 27 and 63 with a mean of 49, standard deviation of 9 and mode of 59.

4.2.4 Data collection and analysis related to the occupational health and safety issue cases

Accident analysis

In the accident analysis, the FAII database was utilised to retrieve and provide information on occupational accidents related to each selected OH&S issue case (defined in section 3). Each of the OH&S issue cases had their own specific objectives according to which the data was retrieved and provided. The objectives set for each OH&S issue case affected the selection of the data to be analysed and data-analysis methods. Nevertheless, the premise of data collection was to utilise the most recent data available at the time the analyses were carried out. In addition to the occupational accident data retrieved from the FAII database, corresponding data on the number of employees and working hours was used as reference data. Furthermore, different subsets of the main data and supplementary data were used in specific analyses such as trend analysis, if required. The main objectives and data used in the accident analysis are summarised in Table 3.

The classifications and variables used in the FAII database at the time of the research (see FAII 2009a) were utilised to extent suitable to retrieve and analyse occupational accidents related to the OH&S issue cases. The classifications utilised in this research included age band, gender, classification of economic activities (see Statistics Finland 2012), the FAII classification of occupations (see FAII 2004), incapacity for work (in calendar days, the day the accident occurred being excluded) and the Finnish implementation of ESAW variables describing the circumstances, causes and consequences of accidents at work (see FAII 2002). The ESAW variables used in the accident analysis are shown in appendix C.

Accidents at work related to TAW were retrieved using class 745 (Labour recruitment and provision of personnel) of the classification of economic activities. Occupational accidents in the local government sector were retrieved with a separate category used in the FAII database to code the local government sector (Z). The class is considered as one of the main classes of the classification of the economic activities. For information retrieval concerning SSF accidents at work, the ESAW-variable Deviation 50 (slipping or stumbling – with fall, fall of persons) was used. Accidents at work related to violence could, however, not be retrieved directly with the existing classifications. Therefore, an accident description analysis was employed. Accident descriptions were grouped into either violence-related descriptions or those that were not related to violence. In order to decrease the subjectivity of manual classification, it was carried out according to predefined criteria compiled on the basis of previous literature in collaboration with the steering group of the original research project. The steering group included Finnish OH&S experts from different organisations. The intentional nature of the actions and situations clearly indicating violence (e.g. robbery) were used as the grouping criteria. Furthermore, if the accident description was difficult to classify, it was double-checked with the steering group.

Table 3. Summary of the main objectives and data used in the accident analysis related to each OH&S issue case.

Objectives	Year of analysis	Data from the FAII database	Reference data
Case 1: Accidents at work related to violence			
(1) Analyse accidents at work related to violence in order to determine their current number, incidence, risk groups (gender, age, occupation class), and severity and situations typical of violence-related accidents at work. (2) Discuss the opportunities for information retrieval on accidents at work related to violence with the currently used classification codes consistent with the Finnish implementation of the ESAW methodology.	2003 and 2006	Data on accidents at work (n=211,926) possibly related to violence (n=10,947) including accidents at work related to violence (n=3441).	Number of employees (n=4190.2 thousand employees) by gender, age band and occupation class[a].
Case 2: Accidents at work during temporary agency work (TAW)			
Analyse and compare accidents at work in TAW with those occurring in other industries to determine their current number, frequency, risk groups (gender, age, occupation class), and particularly their circumstances, causes and consequences.	2006 and 2007	Data on accidents at work (n=234,537) including accidents at work in TAW (n=5278).	Number of working hours (n=6,879,090 thousand hours) including number of working hours in TAW (n=69,468 thousand hours) by gender, age band and occupation class[a].
Case 3: Occupational accidents in the local government sector			
(1) Analyse occupational accidents in the local government sector, particularly to calculate occupation class-specific accident incidence rates to determine their current number, incidence, risk groups (gender, age, occupation class) and severity. (2) Discuss the challenges and possibilities of providing occupation class-specific accident incidence rates in the local government sector.	2004	Data on occupational accidents (n=112,237) including occupational accidents in the local government sector (n=17,961).	Number of local government sector employees (n=347,275–433,000) by gender, age band and occupation class[b].
Case 4: Slipping, stumbling and falling (SSF) accidents at work			
Discuss the applicability of data-mining (DM) methods in analysing data from the FAII database on the basis of SSF accidents at work as a case. Decision-tree and association-rules methods of DM are applied to model and analyse (1) the factors influencing whether accidents at work are related to SSF or not, and (2) the relationships between the circumstances and the consequences of accidents at work related to SSF.	2006 and 2007	Data on accidents at work (n=222,932) including SSF-related accidents at work (n=48,869).	No reference data used.

[a] The data was acquired from the Labour Force Survey (see OSF 2012a).

[b] The data was acquired from the Local government sector wages and salaries statistics (see OSF 2012c).

The Microsoft office environment, SAS Enterprise Guide 4.1 and Enterprise Miner analysis solution in SAS 9.1 were used to analyse the data. The data was analysed mainly by calculating frequency distributions, accident frequencies, and accident frequencies and incidence rates. In order to take into account variations in the size of the workforce or in the amount of work done, the number of accidents is often compared with the number of employees or hours worked. These ratios are called accident incidence and frequency rates. Accident frequency refers to the ratio of accidents per hours worked. The accident incidence rate, again, refers to the ratio of the number of accidents and employees (Boyle 2003). In this research, they are calculated per million working hours and per thousand employees, respectively. Hence, accident frequency and incidence rates were calculated as follows.

$$\text{Accident frequency rate} = \frac{\text{Number of accidents}}{\text{Number of hours worked}} 10^6 \quad (1)$$

$$\text{Accident incidence rate} = \frac{\text{Number of accidents}}{\text{Number of employees}} 10^3 \quad (2)$$

In addition, some other methods of analysis were applied in a case-specific manner. The effectiveness of the information retrieval for accidents at work related to violence was assessed in terms of performance measures of recall and precision. Information retrieval can be defined as a method or process enabling access to relevant data from a large set of stored data. An information-retrieval system is a system supporting information retrieval. Precision and recall are measures used to evaluate the result of information retrieval. Recall describes how many of all relevant documents are found in the search result. Precision describes how many of the documents in the search result are relevant. Let *a* be the number of relevant documents in the search result, *b* the number of irrelevant documents in the search result and *c* the number of relevant documents not found in the search result. The recall and precision are then defined as follows (see Büttcher et al. 2010, Ingwersen 1992, Meadow et al. 2007):

$$\text{Recall} = \frac{a}{a+c} \quad (3)$$

$$\text{Precision} = \frac{a}{a+b} \quad (4)$$

Chi-square test values and the Fischer's exact test were used to identify statistically significant differences between accidents at work in TAW and other sectors. In order to calculate occupation class-specific accident incidence rates in the local government sector, two different occupation classifications were matched. The conversion was undertaken according to the principles of the FAII occupation classification and in cooperation with the steering group of the original research project. The steering group consisted of representatives of various organisations who had expertise in occupational safety and the Finnish local government sector.

Decision-tree and association-rules methods of data mining were used to analyse accidents at work related to SSF. Data mining is the analysis of (often large) observational data sets to find unsuspected relationships and to summarise the data in novel ways that are both understandable and useful to the data owner (Hand et al. 2001). The tree model and association rules are commonly used methods of data mining. In tree models, the analyst first chooses a response

variable and input variables that are used to predict the behaviour of the response variable (Väisänen 2010). Then the data is split iteratively into discrete subsets according to a set of rules identified in the data, so that each subset is as homogenous as possible (see Giudici 2003, Han et al. 2012). The first subset division is formed according to the input variables that best determines the distribution of the response variable (Väisänen 2010). Association rules, again, are used to discover interesting associations or correlation relationships among large amounts of data (Han et al. 2012). Concepts of support, confidence and lift are used to identify important association rules out of all the generated rules (Giudici 2003, Wang et al. 2009). The general form of association rules is the implication $A \Rightarrow B$ (Han et al. 2012). An association rule is then the conditional probability that C=1, given that A=1 and B=1 (Hand et al. 2001). Support is a measure of how often A and B appear together in the dataset; it is the percentage of transactions containing both A and B. Confidence is the conditional probability in which the percentage of transactions containing A also contain B (Han et al. 2012). Lift indicates how many times more probable it is that, for example, products A and B are purchased together instead of either of them being purchased separately (Väisänen 2010). Lift is the ratio of confidence in terms of the occurrence of B alone in the dataset. This is compared because a high value of lift may be due to the originally high existence of item B (Wang et al. 2009). Support, confidence and lift are defined as follows (Han et al. 2012, Wang et al. 2009):

$$\text{Support}(A \Rightarrow B) = P(A \cup B) \tag{5}$$

$$\text{Confidence}\,(A \Rightarrow B) = P(B \mid A) = \frac{P(A \cup B)}{P(A)} \tag{6}$$

$$\text{Lift}(A \Rightarrow B) = \frac{P(B \mid A)}{P(B)} = \frac{\text{Confidence}\,(A \Rightarrow B)}{P(B)} \tag{7}$$

Scenario analysis

The scenario analysis is a method of usability research used, for example, in the design and evaluation of systems such as web applications. Scenarios have diverse uses in usability research throughout the system development life cycle and they may also be used for evaluation (Lim & Sato 2003, Rosson & Carroll 2008). Scenarios allow for the discovery of challenges and potentials related to use (see Väyrynen et al. 2004). When scenarios are used for evaluation purposes, an expert or a real user uses the system being analysed according to a predefined setting, a scenario. At the same time, observations are made on experiences related to use and actions and processes required in order to reach the goal (see Bohman & Andersson 2004, Lim & Sato 2003, Rosson & Carroll 2008, Tervakari et al. 2007). Scenarios are usually short descriptions of particular situations of system use (Tervakari et al. 2007). For example, the goal of the system use, the user of the system and the context of use may be specified in the setting (see Bohman & Andersson 2004, Lim & Sato 2003, Rosson & Carroll 2008, Tervakari et al. 2007). The observations made are usually recorded in written narratives. Alternatively, audio or video taping may be used (Tervakari et al. 2007). As a result of scenario analysis, a narrative description of processes and experiences related to system use is formed (see Lim & Sato 2003, Tervakari et al. 2007). Instead of focusing on the functional viewpoint, scenarios are usually user and task oriented (Rosson & Carroll 2008).

In this research, scenarios were used for evaluation purposes. The utilisation and usefulness of the FAII database in retrieving and providing information on accidents related to OH&S issue cases (defined in section 3) were charted with a scenario analysis to obtain an in depth view. The objectives defined for the accident analysis of each OH&S issue case each formed one scenario setting for the scenario analysis. The researcher used the FAII database according to these objectives in terms of the role of the user. While utilising the FAII database to provide information related to the OH&S issue in question, the researcher was also in the role of the data analyst, making observations related to information retrieval and achieving the objectives set for each OH&S issue case. The aim was to make observations on whether information related to these OH&S issue cases could be retrieved from the FAII database, how and how well the information could be retrieved and what kinds of possible challenges were involved. Observations were also made and discussed in the steering groups of each original research project related to the OH&S issue cases. The steering groups consisted mainly of the representatives of different organisations operating in the field of OH&S in Finland, for whose purposes the information was retrieved. Most of the members of the steering groups were also users of the FAII database. The observations made in the scenario analysis were first described and discussed from the viewpoint of each OH&S issue in question. Then, in order to make cross-case comparisons, the observations made concerning each OH&S issue case were aggregated and thematised according to themes arising from the data.

5 RESULTS

5.1 Occupational accidents related to the occupational health and safety issue cases

5.1.1 Case 1: Accidents at work related to violence

There were 3441 accidents at work related to violence in Finland together in 2003 and in 2006. This is 1.6% of all accidents at work (n=211,926) in Finland in the same years combined. The incidence rate (per thousand employees) of violence-related accidents at work calculated for 2003 and 2006 together was 0.8. The number of violence-related workplace accidents increased from 1464 in 2003 to 1977 in 2006, yielding a growth rate of 35%. A change in legislation increased the number of occupational accidents and diseases resulting in less than four days of incapacity for work reported to the insurance companies and, hence, the FAII database in 2005. The growth effect of this change is, however, approximated to be only 10%. Furthermore, in 2003, violence-related accidents at work constituted 1.5% of all accidents at work in Finland, whilst in 2006, the corresponding proportion was 1.7%. The incidence rate of violence-related accidents at work was 0.7 in 2003 and in 2006 it was 0.9.

Violence-related accidents at work more often involved women than men in Finland in 2003 and 2006. Both the share and incidence rate of violence-related accidents at work were greater for women (a share of 61.6% and incidence rate of 1.0) than men (38.4% and 0.6). By age band (Figure 5), the highest number of violence-related workplace accidents was for both men (34.5% of violence-related workplace accidents involving men) and women (26.6%), in the age band of 25–34 years. For women, the number of violence-related workplace accidents was, however, also almost as high in this age band as it was in the age bands of 35–44 (25.3%) and 45–54 (25.0%) years.

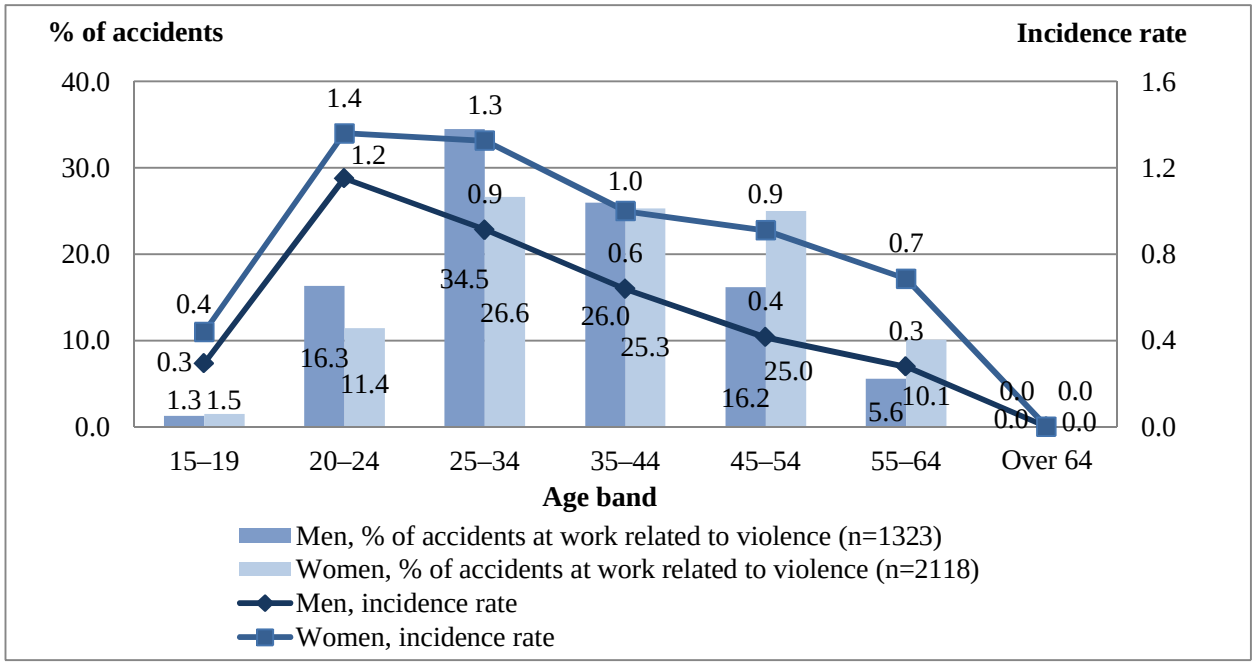

Figure 5. Accidents at work related to violence and their incidence rates (per thousand employees) by gender and age band in Finland in 2003 and 2006 taken together.

The incidence rate calculated by age band was at its highest for both men and women in the age bands of 20–24 years (1.2 for men and 1.4 for women) and 25–34 years (0.9 for men and 1.3 for women). In these age bands, the incidence rates were also higher than the incidence rates of all violence-related workplace accidents calculated for men and women in general. In these age bands, the incidence rates were also higher for both men and women than violence-related incidence rates calculated for men and women in general. The incidence rate decreased with age, although this rate decreased more rapidly for men than for women. Women had a higher incidence rate than men in all age bands except for the age band of over 64 years. None of the workplace accidents related to violence involved employees over 64 years old and only a few involved employees in the age band of 15–19 years.

In Table 4, the proportions and incidence rates of violence-related accidents at work in Finland in 2003 and 2006 are viewed by occupation class. For men, the share of violence-related workplace accidents was highest in public safety and protection work (40.8%), medical and nursing work (10.2%), road transport work (8.8%) and table-waiting work (8.8%). For women, the highest shares of violence-related workplace accidents were in medical and nursing work (33.7%), social work (19.4%), pedagogic work (11.9%), child day-care work (9.1%) and wholesaling and retailing work (7.1%). The highest incidence rates men had were in table-waiting work (13.5) and in public safety and protection work (11.2). For women, the highest incidence rates were in public safety and protection work (10.4) and traffic supervision and service work (8.0). There were, however, other occupation classes as well, in which the incidence rates were higher than in general for violence-related workplace accidents (see Table 4).

Table 4. Accidents at work related to violence and their incidence rates (per thousand employees) by gender and occupation class in Finland in 2003 and 2006 taken together. [a]

Occupation class	% of accidents at work related to violence		Incidence rate	
	Men (n=1323)	Women (n=2118)	Men	Women
Pedagogic work (03)	3.6%	11.9%	0.6	1.3
Medical and nursing work (10)	10.2%	33.7%	4.1	2.6
Therapeutical work (11)	0.5%	1.0%	1.2	0.9
Social work (15)	4.5%	19.4%	4.2	3.9
Child day-care work (16)	0.6%	9.1%	5.7	2.2
Leisure-time activities guidance work (18)	1.4%	1.7%	3.3	4.2
Managerial, administrative and clerical work (24)	1.7%	1.2%	0.2	0.1
Wholesaling and retailing work (34)	3.6%	7.1%	0.7	1.0
Road transport work (54)	8.8%	1.1%	1.1	5.5
Traffic supervision and service work (55)	2.8%	2.3%	2.4	8.0
Mail delivery and sorting work (57)	1.2%	0.3%	0.6	0.3
Public safety and protection work (90)	40.8%	3.4%	11.2	10.4
Hotel and restaurant services work (91)	5.1%	3.0%	3.1	0.7
Table-waiting work (92)	8.8%	1.3%	13.5	0.6
Building caretaking and cleaning work (94)	1.5%	1.3%	0.4	0.2
Other classes together	4.8%	2.6%	0.04	0.07
In total	100.0%	100.0%	0.6	1.0

[a] Occupation classes with the highest numbers and incidence rates of violence-related accidents at work.

In 2006, none of the violence-related accidents at work were fatal. For men, 63.1% of the violence-related workplace accidents resulted in less than four days, 29.4 % in 4–30 days and 7.5% in over 30 days of incapacity for work in 2006. The corresponding proportions for women were 61.7%, 33.1% and 5.3%, respectively[4].

Violence-related workplace accidents involved different situations[5]. In 2006, in 52.5% of the cases the injured person was gripped, pushed, bitten, scratched, kicked or hit by an object thrown by another person (52.5% of the cases). The other situations in which the violence-related accidents occurred involved situations where the injured was hit by another person (23.1%), was chasing or catching another person (12.7%), was restraining someone (13.1%), was attacked or assaulted (10.7%), was removing a person from one place to another (7.4%), was a victim or witness to a robbery or theft (5.4%), was intervening in or trying to settle a violent event (3.7%) or had to wrestle with another person. The situations the violence-related accidents at work most often involved were different across the occupation classes. For example, in public safety and protection work, violence-related accidents at work most often involved chasing or catching (52.6%), while in medical and nursing work, gripping, pushing, biting, scratching etc. were most common (61.2%).

5.1.2 Case 2: Accidents at work during temporary agency work

In 2006 and 2007, 5278 accidents at work occurred in TAW in Finland. This constitutes 2.3% of all accidents at work in Finland from 2006–2007 (n=234,537). The share of working hours in TAW was 1.0% of all working hours in Finland from 2006 and 2007. The accident frequency (per million working hours) calculated for all accidents at work in TAW in 2006–2007 was 76.0. The accident frequency calculated for all other industries except TAW in Finland from 2006–2007 was 33.7. In TAW, the number of accidents at work causing at least four days of incapacity for work has gradually increased from 306 in 1998, to 1150 in 2006 and 1528 in 2007. The frequency of workplace accidents with the same incapacity for work fluctuated between 25.7 and 29.8 in TAW until 2005, but then increased to 34.2 in 2006 and 40.6 in 2007.

In Table 5, the proportions of accidents at work and accident frequencies by gender, age band and occupation class are compared between TAW and other industries in Finland from 2006–2007. Both the number and frequency of accidents indicated that, in TAW, workplace accidents more often involved men (share of workplace accidents 77.4% and frequency 132.0) than women (22.6% and 31.0) and younger than older temporary agency workers. By age band, the highest shares of workplace accidents were in the age bands of 20–24 (32.9%) and 25–34 (28.0%) years. The highest incidence rates were in the age bands of 19–20 (100.9), 20–24 (103.8) and 25–34 (80.0) years. In addition, the number and frequency of workplace accidents involving temporary agency workers were highest in the occupation classes of building

[4] In the data used in this research, information on the days of incapacity for work was available only concerning the year 2006.

[5] The situations presented here are the same ones used as criteria to group accident descriptions that are either related to violence at work or are not related to violence at work. The grouping criteria were compiled based on previous literature. The proportion of different situations was analysed concerning the year 2006 to supplement the previously analysed year 2003 data.

construction work (26.1% and 377.5); in engineering and structural metalwork (19.9% and 227.1); and in packing, wrapping, warehousing and stevedoring work (16.6% and 128.0). The frequency of workplace accidents was also higher than the frequency of all workplace accidents in TAW in the occupation classes of table-waiting work (125.9), hotel and restaurant services work (88.6), building caretaking and cleaning work (85.7) and road transport work (81.1).

Table 5. Accidents at work and their frequencies (per million working hours) in TAW and other industries by gender, age band and occupation class in Finland from 2006–2007. [a, b]

Variable and category	% of accidents at work		Accident frequency	
	TAW (n=5278)	Other industries (n=229,259)	TAW	Other industries
Gender				
Men	77.4%	71.6%	132.0	45.2
Women	22.6%	28.4%	31.0	20.5
Age band				
15–19	7.3%	3.7%	100.9	53.4
20–24	32.9%	12.6%	103.8	49.9
25–34	28.0%	23.7%	80.0	35.5
35–44	15.8%	23.7%	66.0	31.3
45–54	11.1%	23.2%	47.5	29.6
Over 54	5.0%	13.2%	47.4	29.9
Occupation class				
Managerial, administrative and clerical work (24)	3.1%	3.5%	7.7	10.2
Wholesaling and retailing work (34)	2.7%	4.0%	52.3	26.2
Road transport work (54)	2.6%	5.7%	81.1	59.6
Building construction work (62)	26.1%	10.5%	377.5	116.3
Engineering and structural metalwork (75)	19.9%	18.7%	227.1	96.0
Electrical work (76)	2.6%	3.7%	53.0	55.1
Packing, wrapping, warehousing and stevedoring work (88)	16.6%	4.5%	128.0	66.3
Hotel and restaurant services work (91)	5.8%	2.8%	88.6	38.8
Table-waiting work (92)	6.6%	1.4%	125.9	42.2
Building caretaking and cleaning work (94)	3.9%	5.2%	85.7	51.5
Other occupation classes together	10.1%	39.8%	30.2	22.9
In total	100.0%	100.0%	76.0	33.7

[a] In other industries, all other industries, except TAW, are included together.

[b] The table includes occupation classes where most of the workplace accidents occur in TAW.

Compared to the other industries, accident frequencies were mostly higher in TAW than in other industries for both genders and in all age bands and occupation classes. Only in managerial, administrative and clerical work and in electrical work were the accident frequencies higher in other industries than in TAW. The workplace accident frequencies presented in Table 5 were all statistically significantly different (at the 0.1% level) between TAW and other industries. The greatest differences in the frequencies between TAW and other industries were for men, in the age band of 25–34 years, and in the occupation classes of building construction work, table-waiting work and engineering and structural metalwork.

Several statistically significant differences were identified between TAW and other industries in terms of the circumstances, causes and consequences of accidents at work. The variable

categories with statistically significant differences (at the 1% level) and the distribution of accidents at work in TAW and other industries are summarised in Table 6. Although the differences were statistically significant, some of the differences in the shares between TAW and other industries were quite small. In some categories, the differences were, nevertheless, quite notable.

Table 6. Circumstances, causes and consequences of accidents at work in TAW and in other industries in Finland from 2006–2007. [a, b]

Variable and category		% of accidents at work	
		TAW (n=4490–4698)	**Other industries** (n=130,134–135,633)
Working Process	11–19 Production, manufacturing, processing, storing	41.4%	32.8%
	21–29 Excavation, construction, repair, demolition	20.4%	12.5%
	51–59 Ancillary work tasks related to codes 10–40	14.4%	28.4%
	61–69 Movement, sport and artistic activity	10.1%	13.1%
Specific Physical Activity	20 Work with hand-held tools	16.2%	18.6%
	40 Handling of objects	25.3%	23.4%
	50 Carrying by hand	22.2%	16.9%
	60 Movement	22.3%	28.5%
	70 Presence	3.3%	2.5%
Deviation	20 Overflow, overturn, leak, flow, vaporisation,	10.8%	12.2%
	30 Breakage, bursting, splitting, slipping, fall, collapse of material agent	14.1%	11.9%
	50 Slipping or stumbling – with fall, fall of persons	16.4%	21.0%
	70 Body movement under or with physical stress	17.5%	16.0%
	99 Other deviations	5.1%	3.9%
Contact – Mode of injury	30 Impact with or against a stationary object (the victim is in motion)	16.7%	22.0%
	50 Sharp, pointed, rough or coarse material agent	22.7%	21.0%
	60 Trapped, crushed etc.	11.2%	9.3%
Material Agent of Contact – Mode of injury	1100–1399 Buildings, structures, surfaces	20.5%	25.0%
	2100–2899 Tools and machines	25.5%	23.2%
	3100–3200 Transportation vehicles	1.3%	2.9%
	4100–4400 Material, supplies and equipment	42.1%	38.4%
Type of Injury	060 Burns, scalds and frostbite	3.7%	2.8%
Part of Body Injured	11–19 Head	16.7%	19.5%
	31–39 Back, including spine and vertebra in the back	13.0%	11.1%
	41–49 Torso and organs	2.5%	3.6%
	51–59 Upper extremities	42.0%	39.7%
	71–78 Whole body and multiple sites	1.1%	1.8%
Incapacity for Work	> 30 days	6.1%	7.8%
	4–30 days	44.8%	39.7%
	< 4 days	49.1%	52.5%

[a] The table includes variable categories in which statistically significant differences (on a 1% level) between TAW and other industries were identified.

[b] Other industries include all other industries, except TAW. However, only occupation classes where most of the accidents at work occur in TAW (see Table 5) are included both in TAW and in other industries to improve the comparability of the groups.

In TAW, accidents at work occurred, for example, more often in working processes related to production, manufacturing, processing or storing and to excavation, construction, repair or demolition than in other industries (see Table 6). The specific physical activities of handling objects and carrying by hand were more common in TAW than in other industries. In addition, in TAW, material, supplies and equipment and tools and machines were more common as material agents and upper extremities as the injured body part. On the other hand, in TAW, accidents at work occurred less often in other ancillary work tasks during activities coded with working process codes 10–40 than in other industries. In addition, the specific physical activity of movement, the deviation of slipping or stumbling, the contact involving impact with or against a stationary object, and the material agent of buildings, structures and surfaces were less common in TAW compared to other industries. In TAW, workplace accidents resulted more often in 4–30 days of incapacity for work than in other industries. Less often, accidents at work in TAW were serious, causing over 30 days of incapacity for work, and minor, causing less than four days of incapacity for work. In both 2006 and 2007, one of the workplace accidents involving temporary agency workers was fatal. In Finland, there were, in total, 47 fatal accidents at work in 2006 and 38 in 2007.

5.1.3 Case 3: Occupational accidents in the local government sector

In 2004, there were 17,961 occupational accidents in the Finnish local government sector. This totals 16.0% of all occupational accidents compensated for in Finland in 2004 (n=112,237). In 2004, there were 433,000 employees in the Finnish local government sector, constituting approximately one-fifth of the Finnish labour force. Accidents at work constituted 77.5% (n=13,923) and commuting accidents 22.5% (n=4038) of all occupational accidents in the local government sector in 2004. In general, in Finland, the proportion of accidents at work was 85.8% and the proportion of commuting accidents was 14.2% during the same year.

In the local government sector, 53.4% (7437) of accidents at work and 60.0% (2420) of commuting accidents caused at least four days of incapacity for work. In the local government sector, 46.6% of accidents at work caused less than four days of incapacity for work, 44.7% resulted in 4–30 days of incapacity and 8.7% resulted in over 30 days of incapacity. In general, in Finland, the corresponding proportions were similar: 46.8%, 44.4% and 8.8%, respectively. In the local government sector, the shares of commuting accidents causing 4–30 days (44.4%) and over 30 days (15.6%) of incapacity for work were, however, higher than in general in Finland (38.7% and 14.0%, respectively). The shares of commuting accidents with less than four days of incapacity were 46.6% in the local government sector and 40.1% for Finland as a whole. In 2004, four of the local government sector commuting accidents and three of the workplace accidents were fatal. There were 43 fatal accidents at work and 20 fatal commuting accidents in Finland in 2004.

In the Finnish local government sector, the number of both accidents at work and commuting accidents causing at least four days of incapacity for work was higher for women (63.6% of accidents at work and 87.4% of commuting accidents) than for men. Compared to the gender distribution of employees, the percentage of accidents at work involving men (36.4%) was, however, higher than the percentage of male employees (23.6%). The percentage of commuting accidents involving women (87.4%), again, was higher than the percentage of female employees

(76.4%). Considering the age band, the employees in the age band of 45–54 had the highest number of both workplace accidents (34.2%) and commuting accidents (34.4%) (Figure 6). However, the number of employees was also the highest in the same age band (36.1%). Only in the age groups of those under 25 and over 54 was the proportion of occupational accidents greater than the proportion of employees.

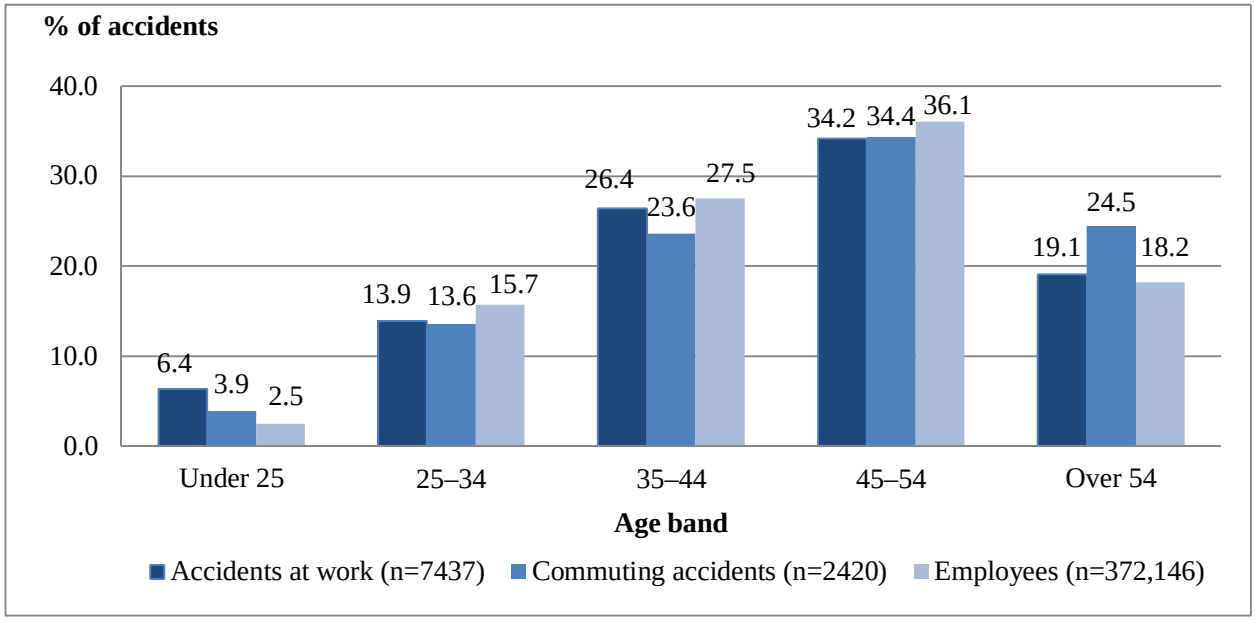

Figure 6. Occupational accidents causing at least four days of incapacity for work and employees in the Finnish local government sector in 2004 by age band.

Table 7 shows the distribution of occupational accidents and their incidence rates by occupation class in the Finnish local government sector in 2004. The highest proportion of occupational accidents was in medical and nursing work (19.8% of accidents at work and 29.5% of commuting accidents). The highest incidence rates (per thousand workers) of accidents at work were in farming and animal husbandry work (165.7), engineering and structural metalwork (128.7), electrical work (125.4) and stationary engine and machine operation work in the energy and water supply sector (124.8). For commuting accidents, the highest incidence rates were in electrical work (20.3), engineering and structural metalwork (15.9) and leisure-time activities guidance work (12.9). The incidence rate of accidents at work causing at least four days of incapacity for work, calculated for all local government sector occupation classes together, was 21.4 and the corresponding incidence rate for commuting accidents was 7.0.

Table 7. Occupational accidents causing at least four days of incapacity for work and their incidence rates (per thousand employees) in the Finnish local government sector in 2004 by occupation class. [a]

Occupation class	% of occupational accident		Incidence rate	
	Accident at work (n=7437)	Commuting accident (n=2420)	Accident at work	Commuting accident
Pedagogic work (03)	6.5%	8.0%	6.6	2.6
Medical and nursing work (10)	19.8%	29.5%	16.8	8.1
Veterinary, environmental and health protection work (14)	0.4%	0.3%	27.4	6.2
Social work (15)	9.4%	9.5%	23.1	7.6
Child day-care work (16)	8.4%	10.5%	22.0	9.0
Leisure-time activities guidance work (18)	0.8%	0.5%	59.6	12.9
Managerial, administrative and clerical work (24)	2.2%	10.5%	4.9	7.8
Farming and animal husbandry work (40)	7.6%	1.4%	165.7	10.3
Horticultural work (41)	1.9%	0.7%	58.6	6.9
Road transport work (54)	1.7%	1.2%	42.6	9.6
Building construction work (62)	4.6%	1.3%	65.0	6.0
Land and waterway construction work (63)	1.2%	0.2%	76.4	4.4
Engineering and structural metalwork (75)	3.1%	1.2%	128.7	15.9
Public safety and protection work (90)	3.8%	0.8%	59.8	4.0
Hotel and restaurant services work (91)	7.05	5.9%	37.3	10.2
Building caretaking and cleaning work (94)	11.6%	11.2%	34.3	10.8
Other classes together	10.2	7.4%	18.9	4.5
In total	100.1	100.0%	21.4	7.0

[a] Occupation classes with at least one thousand employees and the highest number of accidents or incidence rates.

5.1.4 Case 4: Slipping, stumbling and falling accidents at work

Of all accidents at work in Finland from 2006–2007 (n=222,932), altogether, 22% (n=48,869) were related to SSF. Most SSF accidents at work involved men (66%), age bands of 25–54 years (71%), and manufacturing machinery operation and related work (27%). The working process in SSF accidents at work was most often movement, sport and artistic activities (27%). The specific physical activity was movement (78%); the contact was impact with or against a stationary object (77%); the type of injury was dislocations, sprains and strains (51%); the parts of the body injured were lower extremities (45%); and the incapacity for work was 4 to 30 days (47%). Altogether, 16 SSF accidents at work were fatal from 2006–2007.

The results of the tree-model analysis, indicating whether accidents at work were related to SSF, are shown in Figure 7. The specific physical activity and incapacity for work turned out to be the most important variables; that is, those appearing first in the model. Of the specific physical activity categories, the number of SSF accidents at work was the highest in the category of movement. The share of SSF accidents (56%) was also higher in this category than the share of other accidents (44%). In accidents at work related to movement, both the number and share of SSF-related accidents were higher than other accidents when the accident resulted in 4 to 30 days of incapacity for work (61% SSF-related workplace accidents and 39% for others) or for over 30 days of incapacity (74% and 26%). In accidents at work related to movement and causing less

than four days of incapacity for work, the share of SSF-related workplace accidents was higher than other accidents in managerial, administrative and clerical work (61%). However, the highest number of SSF-related workplace accidents was in agricultural, forestry and fishing work. Correspondingly, while the incapacity for work was 4 to 30 days, the share of SSF-related workplace accidents increased along with age (from 57% to 67%), though the number was highest in the age band of 25–34 years.

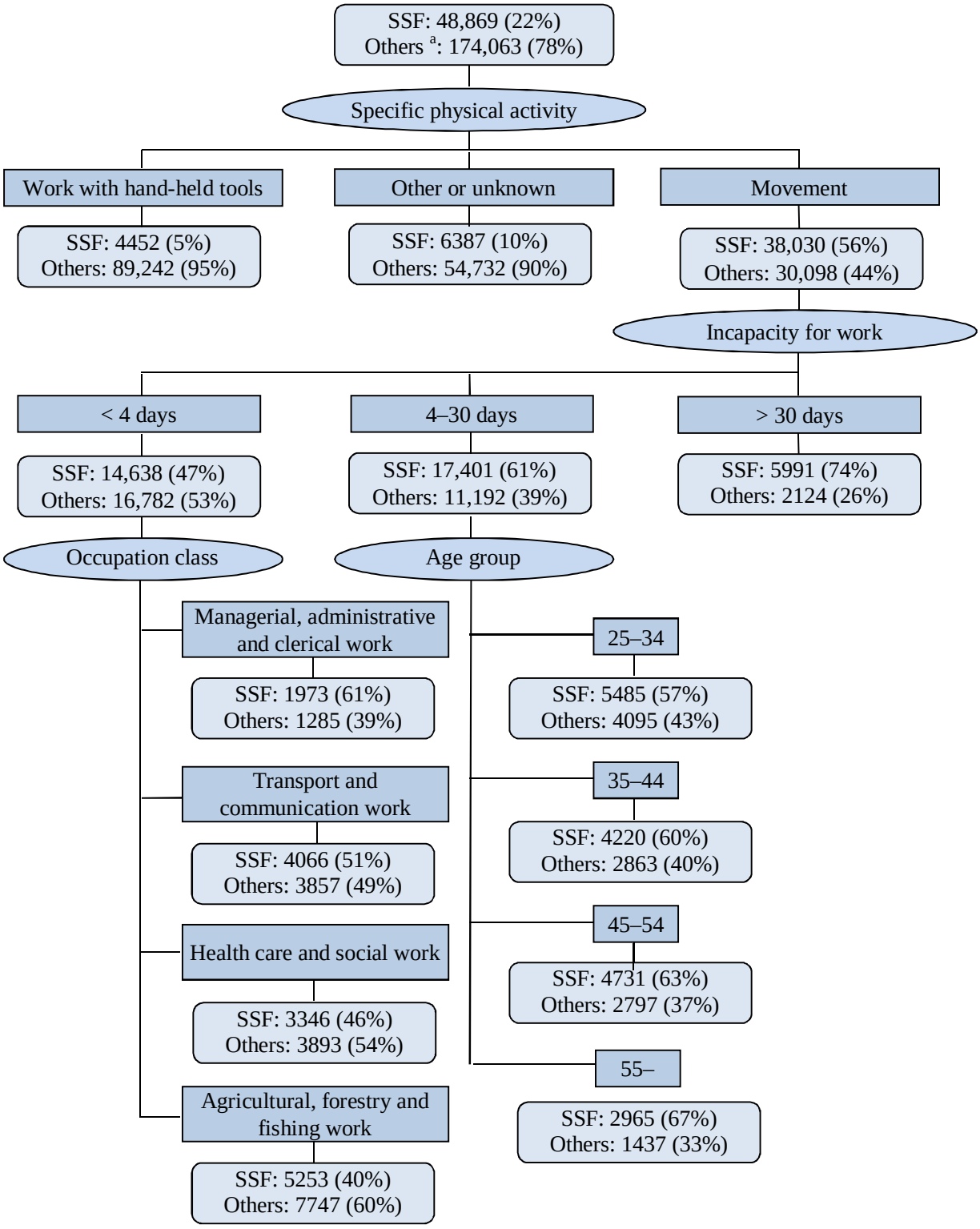

Figure 7. Tree model of slipping, stumbling and falling accidents at work in Finland from 2006–2007.
[a] Others refers to other accidents at work than those related to slipping, stumbling and falling.

Altogether, 257 association rules were generated. Based on their support, confidence and lift, 20 rules were chosen to be examined in more detail (Table 8). The support for rules 1–14 varied between 21.05% and 61.48% and confidence varied between 78.11% and 90.71%. The lift of all rules was greater than 1, meaning that the left side of the rule positively affects the appearance of the right side of the rule. For rules 1–14, the lift was, however, close to 1.00. For rules 15–20, the lift was higher (between 2.01 and 3.86). These rules apply, nevertheless, to a relatively small proportion of SSF accidents at work, as the support for these rules was between 4.8% and 6.2% and the confidence level was between 42.8% and 55.9%.

Table 8. Association rules for circumstances and consequences of slipping, stumbling and falling accidents at work in Finland from 2006–2007. [a]

ID	Association rule	Support	Confidence	Lift
1	Impact with or against a stationary object → Movement	61.5%	79.7%	1.02
2	Dislocations, sprains and strains → Movement	40.1%	79.3%	1.02
3	Lower extremities → Movement	36.8%	82.4%	1.06
4	Incapacity for work less than 4 days → Movement	30.0%	80.2%	1.03
5	Incapacity for work less than 4 days → Impact with or against a stationary object	29.3%	78.4%	1.02
6	Upper extremities → Impact with or against a stationary object	21.4%	83.9%	1.09
7	Concussions and internal injuries → Impact with or against a stationary object	20.7%	90.7%	1.18
8	Impact with or against a stationary object & Dislocations, sprains and strains → Movement	27.4%	81.6%	1.05
9	Impact with or against a stationary object & Incapacity for work 4–30 days → Movement	27.3%	78.5%	1.01
10	Impact with or against a stationary object & Lower extremities → Movement	25.9%	83.5%	1.07
11	Impact with or against a stationary object & Incapacity for work less than 4 days → Movement	24.1%	82.2%	1.06
12	Movement & Incapacity for work less than 4 days → Impact with or against a stationary object	24.1%	80.5%	1.04
13	Lower extremities & Dislocations, sprains and strains → Movement	24.1%	83.7%	1.08
14	Dislocations, sprains and strains & Incapacity for work 4–30 days → Movement	21.1%	78.1%	1.00
15	Impact with or against a stationary object & Incapacity for work over 30 days → Bone fractures	5.6%	43.0%	3.86
16	Bone fractures → Movement & Incapacity for work over 30 days	4.8%	42.8%	3.49
17	Bone fractures → Incapacity for work over 30 days	6.2%	55.9%	3.47
18	Impact with or against a stationary object & Bone fractures → Incapacity for work over 30 days	5.6%	55.9%	3.47
19	One fracture & Movement → Incapacity for work over 30 days	4.8%	55.9%	3.47
20	Physical or mental stress → Lower extremities & Dislocations, sprains and strains	8.0%	57.9%	2.01

[a] Association rules with support over 20% and confidence over 70% or lift higher than 2.

In rules 1–14, the following factors appear repeatedly: movement as the specific physical activity (in 11 of 14 rules), impact with or against a stationary object as contact (9 of 14), dislocations, sprains and strains as the type of injury (4 of 14), lower extremities as the part of the body injured (3 of 14) and less than 4 days or 4–30 days as the duration of incapacity for work (6 of 14). Rule one had the highest support. According to the rule, the contact of SSF accident at work is impact with or against a stationary object and the specific physical activity is movement with a probability of 6.5%. Rule 7, however, had the highest confidence, indicating that if the type of injury in an SSF accident at work is concussions and internal injuries, the probability that the contact is an impact with or against a stationary object is 90.7%. In rules 15–20, bone fractures as a type of injury (5 mentions in 6 rules) and over 30 days as the duration of the incapacity for work (5 mentions) were common in rules 15–20. In addition to rules 1–14, the specific physical activity of movement and impact with or against a stationary object as contact – mode of injury also appeared in rules 15–20.

5.2 Utilisation and usefulness of the FAII database and its web application for safety promotion

5.2.1 The FAII database user questionnaire

Frequency and purpose of use and reasons for non-use

From all respondents (n=127), 83 (65%) had used the FAII database web application and 44 (35%) had not used the application at all. There were 17 active users using the FAII web application weekly or monthly (13% of all respondents) and 66 less active users using the application a couple of times a year or less (52%). The frequency of the FAII database web-application use was statistically significantly dependent on whether the respondent had participated in the FAII database web-application user training or not ($n_{non\text{-}trained}$=37, $n_{trained}$=90, p = 0.001). From the respondents who had been trained to use the application, 17% were active users, 59% were less active users and 24% had not used the application. There were 5% of active users, 35% of less active users and 59% of non-users in respondents who had not been trained to use the application.Other statistically significant dependencies were not identified between the frequency of use and the other background variables. There were, however, slightly more active users in insurance companies (35% of all respondents from insurance companies) than in the representatives of other organisations (14%), OSH authorities (9%) and other research and service institutions (9%). The shares of less active users were highest in other research and service institutions (64%) and in other organisations (62%), while the proportion of non-users was largest in OSH authorities (44%). In insurance companies, there were 35% less active and 29% non-users. These differences were, nevertheless, not statistically significant ($n_{Insurance\ companies}$=17, $n_{OSH\ authorities}$=54, $n_{Other\ organisations}$=21, $n_{Research\ and\ service\ institutions}$=33, p = 0.084).

The active and less active users retrieved information from the FAII database web application for several purposes (Table 9). Most commonly, the respondents mentioned that they used the application to monitor the trend for occupational accidents and diseases (40%) in general or concerning certain industries or occupations. There were some differences in purposes of use between different respondent groups. For example, the gender (n_{female}=22, n_{male}=45, p = 0.009) and age ($n_{<45}$=21, $n_{45–54}$=18, $n_{>54}$=26, p = 0.029) of the respondents had a statistically significant

effect on whether the respondent mentioned gathering material for reports as their purpose of use. The proportion of female respondents who mentioned this purpose was 41%, while the corresponding proportion of male respondents was 11%. The respondents between 45 and 54 years (44%) mentioned this purpose more often than the respondents under 45 years (14%) or over 54 years (12%). The frequency of the FAII database web-application use also affected statistically significantly on whether the respondent mentioned gathering reference data as a purpose of use (n_{active}=14, $n_{less\ active}$=53, p = 0.027). Of the active users, 36%, and of less active users, 9% mentioned this reason.

Table 9. The most commonly mentioned purposes of the FAII database web-application use (n=67).

Purpose of use	**% of respondents**
Follow-up information (general trend, certain industries and occupation groups)	40%
Background material to direct and support planning and activities (e.g. inspections, research, projects)	33%
Material for training, teaching, negotiations, meetings, informing	30%
Material for reports and reporting, publications, articles	21%
Material for analyses (e.g. risk assessments, research material, summaries)	16%
Reference data to support and complement other data	15%
Information on certain types of occupational accidents or diseases (e.g. accidents related to electricity, certain machines, or violence) or accident descriptions	13%

In addition, the organisation of the respondent affected statistically significantly on whether or not the respondent used the application to gather follow-up information (p = 0.014), to gather background material to direct and support planning and activities (p = 0.017) and whether the respondent used the application to retrieve reference data or not (p = 0.007) ($n_{Insurance\ companies}$=8, $n_{OSH\ authorities}$=24, $n_{Other\ organisations}$=13, $n_{Research\ and\ service\ institutions}$=22). Of the respondents from other organisations, 77% used the application to gather follow-up information, whilst of the respondents from insurance companies, 50% did so, for research and service institutions it was 32%, and from OSH authorities, 25% used the application for the same purpose. However, 54% of the respondents from OSH authorities and 32% from research and service institutions used the application to gather background material to direct and support planning and activities. Of the respondents from insurance companies, 13% used the application for this purpose, while of the respondents from other organisations, 8% used the application for the same purpose. None of the respondents from other organisations had used the application to gather reference data to support and complement other data, while 50% of the respondents from insurance companies, 21% of the respondents from OSH authorities and 5% from research and service institutions mentioned this purpose of use. Other statistically significant differences were not found concerning respondents' background and the purpose of use.

The most common reasons the less active users and non-users mentioned for not using the application more often or at all are gathered in Table 10. Most often, the respondents mentioned that they had not needed the application (48%). In addition, the respondents had often not remembered about being able to use the application (15%) or someone else used the application for them (13%). Of the respondents, 16% had stated some other reason as the most important reason. As for other reasons, the respondents mentioned, for example, that the information needed had not been found by using the application or the application had not functioned when they wanted to use it. Other reasons mentioned were that the respondent had not had work assignments at the time for which they would have needed the application, they had not known

about the possibility of using the application, they did not remember the application's web address, they did not have user identification for the application, they had not participated in user training or they had not had the time to use the application.

Table 10. The most important reasons for not using the FAII database web application (n=110).

Reason for non-use	% of respondents
I have not needed the application	48%
I have not remembered that I am able to use the application	15%
Someone else is using the application for me	13%
I have not known how to use the application or it has been difficult to use the application	7%
Other reason	16%

The reasons for non-use were mainly similarly distributed when comparing the responses between respondents' background factors. Only the organisation that the respondent represented affected statistically significantly on reasons for non-use ($n_{\text{Insurance companies}}=11$, $n_{\text{OSH authorities}}=49$, $n_{\text{Other organisations}}=18$, $n_{\text{Research and service institutions}}=30$, $p = 0.004$). The respondents from the research and service institutions (56% of the respondents from research and service institutions) or from OSH authorities (55%) mentioned more often that they had not needed the application than the respondents from other organisations (17%). The respondents from other organisations most often mentioned they had not known how to use or it had been difficult to use the application (28%), whilst only 2% of both the respondents representing OSH authorities or research and service institutions mentioned this reason. In the research and service institutions, 20%, in OSH authorities, 12%, and in other organisations, 11% of the respondents had not remembered about being able to use the application. In other organisations, 22% mentioned that someone else used the application for them, while from research and service institutions, 12%, and from OSH authorities, 10% of the respondents mentioned this reason. Another reason was mentioned by 22% of other organisation representatives, 20% of OSH authority representatives and 10% of research and service institution representatives. The other background factors did not have a statistically significant effect on reasons why the respondents had not used the application at all or more often. In addition, non-users mentioned more often (20%) that they had not remembered that they were able to use the application than the less active users (11%). For less active users (17%), someone else used the application more often than for non-users (7%). These differences were, however, not statistically significant ($p = 0.432$).

Users' satisfaction

Active and less active users' satisfaction with different usefulness characteristics of the FAII database web application is summarised in Table 11. In general, the respondents were more satisfied than dissatisfied with every aspect of the application that was rated, except for general user experience. On a scale from 1 (very dissatisfied) to 5 (very satisfied), the average satisfaction of the usefulness characteristics was 3.2. The respondents were most satisfied with the content of the FAII database and its web application. The respondents were most discontent with the general user experience. The standard deviation was highest with the presentation of search results and technical functionality and lowest with the appearance.

Some statistically significant differences were identified when analysing the effect of respondents' background on user satisfaction regarding different characteristics. The satisfaction

with the content differed significantly between trained and non-trained respondents ($n_{non-trained}$=13, $n_{trained}$=62, p = 0.008). The average satisfaction with the content was 3.5 for trained respondents and 2.9 for non-trained respondents. Other statistically significant differences were identified concerning satisfaction with guidance and directions between active and less active users (n_{active}=17, $n_{less\ active}$=57, p = 0.036) and satisfaction with the presentation of search results between genders (n_{female}=22, n_{male}=49, p = 0.016). The average satisfaction of active users with guidance and directions was 3.5, while the average satisfaction of less active users was 3.0. Moreover, the average satisfaction with the presentation of search results for female and male respondents were 3.5 and 3.0, respectively. Otherwise, there were no major differences in the satisfaction, although there were some statistically indicative results, for example, regarding the age of the respondents and satisfaction with the general user experience. The average satisfaction level of respondents less than 45 years was 2.8, for respondents in the age band of 45–54 it was 3.2 and for respondents over 54 years it was 2.9.

Table 11. Users' satisfaction with the usefulness characteristics of the FAII database web application.

Usefulness characteristics	No. of respondents	Average score	Min	Max
Content	75	3.4	1.5	5.0
Technical functionality	77	3.3	1.0	5.0
Appearance	76	3.2	2.2	5.0
Information retrieval	75	3.2	1.5	5.0
Guidance and directions	74	3.1	1.0	4.5
Presentation of search results	71	3.1	1.0	5.0
Use of classification variables	69	3.1	1.0	5.0
General user experience	76	3.0	1.6	5.0

Problems related to use and suggestions for improvement

The majority (73%) of the active and less active users (n=77) had rarely had problems in using the FAII database web application. Of the respondents, 18% had not had any problems and 9% mentioned having problems often. The background of the respondents did not affect the frequency with which the respondents had encountered problems, nor were there any statistically significant differences between respondents' background and the frequency they mentioned in terms of encountering problems in using the application.

As problems, the respondents (n=36) most often mentioned that undertaking searches and information retrieval had been difficult or not successful (15 mentions) or they had had problems with the technical functionality of the application (13 mentions). The respondents further explained that it was difficult to remember how to use the application because they used the application only rarely. Some of the respondents had not yet had the chance to participate in user training. Some mentioned that they had had difficulties related to choosing the correct search criteria in order to find relevant information. The respondents also found the terms used in defining the search in the application difficult to understand. The respondents mentioned such technical problems as interruptions in use, slowness of the application, short operating time and changes in the functions of the application without the users being informed of those changes. Other problems the respondents mentioned encountering were related to finding the desired information (5 mentions), utilisation and further processing of the information-retrieval result reports (4 mentions) and remembering or finding their user identifier codes (3 mentions). Two of

the respondents mentioned that it would be good to have a refresher user-training course. Two respondents did not remember what kind of problems they had had. One responder had not had problems but was wondering if it would be possible to get even more out of the application.

When asking what kind of information that was desired but that the users had not been able to retrieve, the respondents (n=32) most commonly mentioned (12 mentions) that they would have needed information on some specific industry, occupation or type of accident (e.g. accidents related to ladders, accidents caused by electric arcs and accidents related to violence), which could not be retrieved using the existing classification variables and codes. Almost as frequently, the respondents requested data on working hours or accident frequencies in general or concerning different industries and occupations (9 mentions). Five of the respondents requested more recent and up-to-date information. Three respondents mentioned having needed more reliable regional information. In other single mentions (altogether 6), for example, longer accident descriptions, organisation size as a classification variable and comparisons between different industrial and occupational classes were hoped for. One responder pointed out that comparing data from the application with data from other sources was difficult because the classifications used may be different in different sources and may also be changed in over time. Two respondents did not remember what information they had not been able to retrieve from the application.

The respondents' (n=23) comments on how the FAII database web application should be improved were mainly related to the further development of the information-retrieval possibilities (8 mentions), improvement in the ease of use and learnability (6 mentions) and offering they mentioned the need for more instructions and guidance (6 mentions). The respondents suggested that the information-retrieval possibilities could be further improved by providing more classification variables with more specific codes to be used to do searches. Some respondents, for example, called for more specific classifications in order to be able to separate some industries, occupations or types of accident from other industries, occupations or accident types. Some respondents would have wanted to have all variables that were possible available when carrying out searches, also the old variables, which were no longer in use following the implementation of ESAW, and the ones that were not available to users in their particular organisation. A search function, which could be used to search for accident descriptions, was also mentioned. In addition, one respondent hoped for more ready-made search functions and another pointed out that the data on search-result reports could be exported more easily.

Other suggestions for improvement were related to the improvement of the content (4 mentions) and clarity (4 mentions) of the application. The respondents wished that the data was more up to date and the accident descriptions were more informative. It was suggested that the clarity of the application should be improved, for example, by using bigger fonts and making the most important functions and data (e.g. when the database is last updated) more visible. Two respondents commented on the user identifier code. The other one hoped for easier user identifier codes and the other one hoped for personal, instead of organisation-specific user identifiers. One respondent also mentioned that the application could contain links to other useful web pages. The responses that were related to problems, information not being found, and suggestions for further improvement were not compared or statistically tested between respondents' background characteristics because of the qualitative nature of the data and the small number of respondents.

5.2.2 Cross-case conclusions from the occupational health and safety issue cases

Thematics arising from the occupational health and safety issue cases

Several observations were made concerning the utilisation and usefulness, while information on occupational accidents related to selected OH&S issue cases was retrieved from the FAII database. Four main themes, however, emerged, around which the observations mainly revolved: classification and coding of occupational accidents related to OH&S issue cases, comparability of accident data with employee or working hour data, continuity of accident data and classifications and the application of particular information-retrieval and data analysis methods. The observations related to each thematic are summarised in Table 12 and described in more detail in the following sections.

Classification and coding of occupational accidents related to the occupational health and safety issue cases

In the current classifications used to code occupational accidents in the FAII database, a separate category is included for the local government sector (Z: The local government sector). This class is considered as one of the main classes of the classification of the economic activities. The current classification system also includes a code of its own to classify SSF accidents at work (ESAW-variable Deviation 50 Slipping or stumbling – with fall, fall of persons). Hence, retrieving occupational accident information for the local government (case 3) and SSF accidents at work (case 4) was possible by straightforwardly using these codes. The code used for SSF accidents at work does, however, not distinguish between slips, stumbles and falls to a lower level and on the same level, but the same code is used for both. The factors related to SSF accidents at work on the same level and to a lower level are likely to be quite different. Hence, it might be useful to be able to separate these cases from each other with a separate code, since this would give more detailed information for accident prevention.

The classifications used do not contain a variable or category that could be used to identify TAW. In this research, accidents at work involving temporary agency workers (case 2) were retrieved from the FAII database with the classification of economic activities in use at the time of the data analysis. Namely, class 745 (Labour recruitment and provision of personnel), including employment office activities, labour hire activities and other provisions of labour and personnel was used. It should be noted, though, that the class used does not only contain TAW. The economic activities are classified according to the main economic activity of the employer. In the case of temporary agency workers, the employer is the temporary work agency, not the user company where the agency worker actually works. Hence, temporary agency workers are included in the same class with the other employees of the private personnel service companies or in the employment office of state and municipal agencies transacting temporary work activities. Due to the nature of the work, most of the accidents at work in class 745 occur in TAW, although it is impossible to estimate the exact proportion. Hence, the class can be used to approximate accidents at work in TAW. Noteworthy is also that this classification includes only private employment agencies and employment agencies of state and municipal authorities. Therefore, the so-called unofficial provision of personnel between companies operating in other industries (e.g. construction or manufacturing) is not covered. In addition, temporary agency workers with a foreign employer are not included in the class.

Table 12. Thematised summary of observations from OH&S issue cases.

Thematics of observations	**Case 1:** Accidents at work related to violence	**Case 2:** Accidents at work during temporary agency work	**Case 3:** Occupational accidents in the local government sector	**Case 4:** Slipping, stumbling and falling accidents at work
Classification and coding of occupational accidents related to the OH&S issue cases	Three different codes can be used to code violence-related accidents at work but the same codes are used to code other accidents as well (e.g. accidents caused by animals or deviant presence of the victim).	A category exists including occupational accidents in TAW but also other employees of personnel services organisation are included.	The classification system includes its own code for occupational accidents in the local government sector.	A code of its own exists for SSF accidents at work but the code does not distinguish between ‘on the level’ and ‘to a lower level’.
Comparability of accident data with employee or working hour data	Occupation classifications used in the accident and employee data are not entirely identical.	Occupation classifications used in the accident and working hour data are not entirely identical.	Completely different occupation classifications are used in the accident and employee data.	No observations because comparisons were not made but similar problematics exist, as in cases 1 and 2.
Continuity of accident data and classifications	Due to a legal change, reporting of occupational accidents and diseases increased in general in the FAII database in 2005. Occupation classification used in the FAII database was updated in 2004. The coding of violence-related accidents changed along with the implementation of ESAW methodology in 2003; the change probably improved their coverage in the FAII database.	Due to a legal change, reporting of occupational accidents and diseases increased in general in the FAII database in 2005. The other observations made in case 1 are also valid, although they did not come up in case 2.	No observations because trend analyses were not carried out but the same points of discontinuity as in cases 1 and 2 are valid.	No observations because trend analyses were not carried out but the same points of discontinuity as in cases 1 and 2 are valid.
Application of particular information-retrieval and data analysis methods	Accident descriptions may provide information that is not available with the classification codes, although, they are often short and lack relevant information. The existing classifications may be used to approximate the number of violence-related accidents at work.	The working hours for activities other than TAW are included in the same class and cause some error in accident frequencies.	Accident data may be compared with employee data by matching the different occupation classifications.	The application of data-mining methods was considered successful, though they revealed nothing unexpected, nevertheless, they have potential as supplementary analysis methods to illustrate the data new in ways deviating from the usual pattern.

Moreover, the current classification system used in the FAII database does not contain one separate variable or category to code accidents at work related to violence. Instead, three different ESAW variables include codes that can be used: Deviation 80 Violence (caused by human or animal), shocking situation, deviant presence; Contact – Mode of injury 80 Bite or kick, etc. by human or animal; and Material Agent of Contact – Mode of injury 5100 Humans, animals, plants. However, these codes are used to code for other accidents as well, for example, accidents caused by animals or by the deviant presence of the victim. Hence, accidents at work related to violence could not be separated out from other accidents with the classification codes currently in use. In this research, an accident description analysis was employed in order to identify violence-related accidents. Descriptions of accidents at work – coded with one or more of the codes that can be used for violence-related accidents – were retrieved from the FAII database and, according to predefined criteria, manually grouped as accidents at work related to violence and as accidents at work not related to violence.

Comparability of accident data with employee or working hour data

In order to determine how common occupational accidents are compared to the working population, incidence rates or frequencies are often calculated. Data on the number of working hours or employees is not collected in pursuance of accident data collection in the FAII database. Hence, external data sources providing this data need to be utilised if incidence rates or frequencies are to be calculated. The differences, for example, in data-collection methods, classifications and definitions used in different data sources bring issues of comparability into question.

In this research, the number of accidents was compared to the number of employees or working hours in all other cases except for SSF accidents at work. However, similar problematics would exist in the case of SSF accidents at work, as in the case of accidents at work related to violence and TAW. In these cases, the employee and working hour data used in the comparisons were obtained from the Labour Force Survey conducted by Statistics Finland. In the case of the local government sector, the comparison data concerning the number of local government sector employees was acquired from the local government sector wages and salaries statistics, also gathered by Statistics Finland. In these statistics, data is collected on a different basis than in the FAII database. Whereas the collection of accident data is statutory-based insurance claims' data, the data in the Labour Force Survey is collected by telephone interviews with a random sample. The data on the local government sector statistics is collected by inquiries to municipalities and is based on the payroll system of the municipalities. This data, however, is the best available and it enables a comparison to be made when using national-level data. In this research, the most important observations related to the comparability concerned the occupation class specific comparisons.

The major challenge in the calculation of occupation class specific incidence rates or frequencies is that the FAII uses its own occupation classification, which is also used to determine the occupational accident risk and, thus, the payment of the statutory accident insurance. The FAII occupation classification is based on, but not entirely identical to Finland's National Classification of Occupations from 1987. In the Labour Force Survey of Statistics Finland, data on Finnish employees and working hours is available using the 1987 National Classification of Occupations. Although the FAII occupation classification and the National Classification of

Occupations from 1987 are not entirely identical, the content of the occupation classes discussed in the cases of violence–related accidents at work and TAW were mainly similar. A couple of differences were, nevertheless, identified. The FAII occupation classification only includes class 24 (managerial, administrative and clerical work), which corresponds to classes 20–24 in the National Classification of Occupations from 1987. In the FAII occupation classification, hotel etc. receptionists are included in class 92 (table-waiting work), while in the 1987 occupation classification they are included in class 91 (hotel and restaurant services work). Principals of universities are included in class 24 in the FAII classification and in class 03 (pedagogic work) in the 1987 classification. In addition, the FAII occupation class 94 (building caretaking and cleaning work) includes rehabilitative work, which is not included in this class in the 1987 occupation classification.

In the case of the local government sector, the challenges related to these calculations were, nevertheless, even more evident. In the local government sector wages and salaries statistics, the employee's occupation is described in terms of occupation title used in the local government sector and according to the Classification of Occupations of Statistics Finland (2001). These are not directly comparable with the FAII occupation classification. In this research, the two data sources were, hence, first matched in order to be able to calculate the occupation class specific incidence rates. The occupation titles used in the local government sector, from the local government sector wages and salaries statistics, were examined individually and converted into a corresponding class in the FAII occupation classification.

Continuity of accident data and classifications

Another issue that required attention in the OH&S issue cases of this research was the points of discontinuity due to changes in the accident data and classifications used. For example, according to the results of this research, it seems that the number of accidents at work related to violence has increased. However, it is difficult to estimate the trend accurately in the long term because the coding of violence-related accidents at work changed along with the implementation of the ESAW methodology in 2003. Previously, a separate code called violent crime was used to code accidents at work related to violence. The name of the previously used code has probably steered the coding so that this code has been used to code only the more severe violence-related accidents that are clearly indicative of crime, while other codes have most probably been used for other less severe cases. The current codes, again, are also used to code accidents at work related to violence with no indication of crime. The current codes may have also encouraged the reporting of less severe accidents at work related to violence. As an advantage of the new codes, it can be argued that the accidents at work related to violence are now more comprehensively covered in the FAII database. In the case of violence-related accidents at work, the classification of occupations has also been updated. The only change identified in this research was that in the 2003 data, the occupation class 91 was called accommodation establishment and commercial and institutional household work including hotel receptionists, while in 2006, data class 91 is called hotel and restaurant services work, and hotel receptionists are included in class 92 (table-waiting work).

In addition, due to a legal change, reporting of occupational accidents and diseases increased in general in the FAII database in 2005. It is, however, known that this change focuses mainly on occupational accidents and diseases resulting in less than four days of incapacity for work, and

the approximated general increase is 10%. In the case of TAW, only accidents at work resulting in at least 4 days of incapacity for work were included in the trend analysis to avoid this effect. In the case of violence-related accidents at work, the approximated increase was taken into account in the interpretation of the results.

Application of particular information-retrieval and data-analysis methods

Manual grouping of accident descriptions, carried out in the case of violence-related accidents at work, is time consuming and subjective. Although the subjectivity can be diminished using grouping criteria and group work, the success of the grouping also depends on the quality (length and informativeness) of accident descriptions. Some of the accident descriptions were impossible to group because they were too short or lacked sufficient information. In addition, accident descriptions do not exist for all accidents at work in the FAII database. For violence-related accidents at work, accident descriptions were available in 96% of the cases. Nevertheless, also in the case of other OH&S issues, accident descriptions provide an opportunity to retrieve the kind of information from the database that cannot be retrieved using only the classifications. The distinction between 'to a lower level' and 'on the level' SSF accidents at work could, for example, be gained from the accident descriptions. The accident descriptions can also be used to give examples of typical accidents, as was done in the case of violence-related accidents at work.

In this research, it was discovered that the number of violence-related workplace accidents can also be estimated using the existing classification codes. In both 2003 and 2006, approximately 30% of accident descriptions were grouped as violence-related. In addition, the best recall (0.65) and precision (0.59) were gained with the combination of all three codes used in coding accidents at work related to violence. This indicates that 65% of all violence-related accidents at work can be found using these search terms. However, the search result still includes 41% of other workplace accidents that can be coded with these codes. This kind of approximation may very well be sufficient if the objective is to follow only the trend in occupational accidents. However, any further information concerning, for example, causes and consequences of accidents, cannot be retrieved this way. Retrieving more precise information than was possible with the current classification codes on violence-, TAW- or SSF-related accidents at work would be easier if separate codes were used for these accidents. The ESAW methodology classification guidelines enable the use of more specific codes for accidents at work related to violence and those related to SSF. In the Finnish implementation, these codes are, however, not in use.

As previously described, the class used to approximate TAW in this research also included other activities than TAW. The number of working hours of personnel working in personnel services companies or employment offices is probably more notable than the number of accidents at work compared to the corresponding numbers in TAW. Hence, the approximation is probably more notable in the working hour data than in the accident data. In the occupation classification used in the working hour data, activities other than TAW are probably classified under class 22 (personnel and employment affairs work). Excluding class 22 would better approximate TAW. This was, however, not possible in the data used in this research.

In the case of the local government sector, the occupation classifications used in the FAII database and in the local government sector were matched together in order to calculate incidence rates. The major challenge in this conversion was the number of occupation titles used

in the local government sector (over 5000 in the data used in this research). In addition, some of the occupation titles used in the local government sector were difficult to direct towards a certain occupation class in the FAII classification because they were very general and could describe various occupations (e.g. assistant). Nevertheless, compared to other sources, the number of employees in occupation classes where most of the local government sector employees work appeared to be similar in the conversion made in this research. Furthermore, the occupation class specific incidence rates also appeared to be reasonable. Hence, the conversion that was undertaken seemed successful, though more reliable for the occupation classes with more employees than for the ones with less employees.

In the case of SSF accidents at work, methods of data mining such as classification tree and association rules were used to analyse the data. The application of these methods was considered successful since the results were in line with the previous research. Regardless of the potential, the methods utilised here did not reveal anything very surprising or unexpected. Nevertheless, because of the capability to illustrate a large dataset and relationships between variables easily, data mining methods were seen as a useful supplementary method in analysing occupational accident data.

6 DISCUSSION

6.1 Review of the key results

6.1.1 Occupational accidents related to the occupational health and safety issue cases

Accidents at work related to violence

According to the results of this research, accidents at work related to violence constitute a fairly small proportion of all accidents at work in Finland. The incidence rate is not very high either. Nevertheless, the results also indicate that the number and proportion of violence-related accidents at work has noticeably increased compared to the previous research made based on the FAII database (Isotalus 2002, Isotalus & Saarela 1999). Violence-related accidents at work involving women and especially younger women have increased notably. Otherwise, the results are mostly similar with the previous studies. Increased trends of violence and the threat of violence experienced at work in general and involving women have also been reported in the Finnish surveys (see Lehto & Sutela 2008, Salminen 2010, Sirén et al. 2010). The results of this research support those studies in which the increased risk of workplace violence involving women (e.g. Fisher & Gunnison 2001, McCall & Horwitz 2004) and younger employees (e.g. McCall & Horwitz 2004, Rauscher 2008) has been identified. Chappell and Di Martino (2006) and Mayhew (2002) argue that there appears to be evidence that both the incidence and severity of workplace violence is increasing, though opposite trends have also been reported recently (Hendricks et al. 2007, USDL 2011a).

In Finland, violence at work has been a minor problem, especially when compared to the USA and particularly considering fatalities. Interestingly, the proportion of violence-related accidents at work of all occupational accidents and diseases in Finland seems to be higher than the proportion of violence, aggression and threats of non-fatal accidents at work in the EU in general (0.85%) (see European Commission 2009) and approaches the proportion of assaults and violent acts in non-fatal injuries and illnesses in the USA (3.2%) (see USDL 2010a, 2010b, 2011b). In Finland, the share of accidents at work related to violence as a proportion of all occupational accidents and diseases has increased from 0.4% in 1994–1996 (Isotalus 2002) to 1.3% in 2003 and 2006 combined. In the data used in this research, there were no fatal accidents at work related to violence. Nonetheless, there have recently been at least three violent workplace fatalities because of the school shootings in 2007 and 2008. In addition, in 2007, one fatality occurred to a police officer who was run over by a vehicle.

Increased awareness (e.g. Chappell & Di Martino 2006), changes in the occupational structure from industrial occupations to service work, where violence is more common (e.g. Heiskanen 2005, Mayhew 2002) and an increased level of reporting (e.g. Sirén et al. 2007) are likely to explain the increasing trend of workplace violence. For example, the implementation of the new Finnish Occupational Safety and Health Act (2002/738) may have affected the trends in reported violence at work (Heiskanen 2005, Salminen 2004b). The fact that violence at work is separately taken into account in the new act may have enhanced preventive actions (see Salminen et al. 2007). Consequently, awareness of workplace violence and its different forms and, hence, the

level of reporting may also have increased. Non-physical workplace violence is also recognised and violence at work is not limited to specified industries or occupations (Chappell & Di Martino 2006). In the FAII database, the implementation of the ESAW methodology may have reinforced the reporting of especially less severe cases of violence-related accidents at work. The name of the previously used code (violent crime) may have encouraged the reporting of mainly crime-related violent accidents (Isotalus & Saarela 1999). The results of this research and the Finnish surveys (see Kauppinen et al. 2007, Lehto & Sutela 2008, Salminen 2010, Sirén et al. 2010) showed both increased workplace violence, particularly in the female-dominated occupations of the service sector, which also are less often associated with crime. Violence experienced at work varies according to the occupation and work assignment, which affects the measures required for prevention. Hence, it is important to recognise the increase in workplace violence that has been experienced in the service sector, and the requirements necessary for accident prevention in the situations typical of violence in these occupations need to be geared towards accident prevention.

Accidents at work during temporary agency work

As the results of this research show, the share of accidents at work involving temporary agency workers is fairly small compared to the number of all accidents at work. Nevertheless, the results also indicate that in TAW, the frequency of accidents at work is substantially higher than in other industries, supporting other studies in which an increased accident risk has been identified in TAW (see Fabiano et al. 2008, Mehta & Theodore 2006, Nola et al. 2001, Storrie 2002) or in other temporary or non-standard work (see e.g. Virtanen et al. 2005). However, it should be noted that the characteristics of the work, individual employees and working conditions may explain the risk more than solely the form of employment (Amuedo-Dorantes 2002, Benavides et al. 2006, Hernanz & Toharia 2006).

In this research, the accident frequency calculated for TAW (76.0) was not quite as high as the one calculated by Fabiano et al. (2008) in Italy (91.63). Additionally, compared to all industries, the accident frequency in this research was 2.2 times higher, while in Fabiano et al. (2008) the frequency was 4.4 times higher. Nevertheless, the workplace accident frequency in Finnish TAW showed a rapidly increasing trend in this research, and the increasing trend seems to still be continuing, according to the most recent accident statistics (FAII 2012a). The increased use of TAW in traditionally more accident-prone industries such as building construction work; engineering and structural metalwork; and packing, wrapping, warehousing and stevedoring work probably explains the increased accident risk in TAW in Finland. Apart from these occupation classes, workplace accident frequencies in TAW also seemed particularly high in table-waiting and hotel and restaurant services work compared to other industries. The use of TAW, and hence the trend in accident frequency, is exposed to economic fluctuations. Nevertheless, the challenge in TAW is to take into account accident risks typical of the different industries and occupations in which TAW is used.

The workplace accident frequency in TAW was also higher than in other industries when analysing by gender, age and occupation class. Only in managerial, administrative and clerical work and in electrical work were the workplace accident frequencies higher in other industries than in TAW. In managerial, administrative and clerical work, the working hours for activities other than TAW probably decreases the accident frequency (see section 5.2.2). In Finland, qualifications for persons allowed to perform electrical work are strictly defined in the legislation

(see 1996/516), which might explain the similarity of workplace accident frequencies in TAW and in other industries. This result clearly demonstrates the impact of professional qualification requirements on safety.

The comparison of accidents at work between TAW and other industries indicates that TAW is more likely to be used in certain work assignments, which then is reflected in the circumstances, causes and consequences of accidents. In TAW, accidents at work are more common in working processes related to, for example, production, manufacturing, excavation and construction. In addition, in TAW, accidents at work often involve manual work such as carrying by hand. Less often, workplace accidents involving temporary agency workers occur in ancillary work tasks. Moreover, workplace accidents in TAW are less often related to movement than in other industries. In contrast to the results of Fabiano et al. (2008), severe accidents (in terms of incapacity for work) were less common in TAW than in other industries. However, the incapacity for work of less than four days was also less common in TAW. These results could indicate that, in Finland, TAW is not used at least in most high-risk work assignments or those requiring more expertise. Additionally, temporary agency workers are often young. Many studies have concluded that occupational accidents involving younger employees result more often in a shorter period of incapacity for work than those involving older employees and vice versa (e.g. Hintikka & Saarela 2006, Salminen 2004a). In this research, the youngest temporary agency workers in the age band of 15–24 had the highest accident frequencies. Nevertheless, compared to other industries, temporary agency workers in the age band of 25–34 had the relatively highest frequency of accidents.

Furthermore, deficiencies in, or a lack of orientation and safety training that temporary agency workers receive may play an important role in explaining their heightened workplace accident frequency in Finland. Room for improvement has been identified in orientation to work and safety training in TAW in Finland, especially concerning exceptional situations such as emergencies and accidents (Hyytinen 2010, Luukkonen 2010, Saarela et al. 2012). In TAW, the work assignments often come with short notice, requiring the temporary agency worker to start the work quickly. In addition, often the turnover of work assignments is high and the duration short. Hence, the orientation may easily be skipped or kept short, particularly in work assignments requiring less expertise. As temporary agency workers are often young and have less experience of working life, the importance of orientation and safety training should, however, be emphasised.

Occupational accidents in the local government sector

The comparison of the occupational accidents in the Finnish local government sector with international literature is difficult because, to the researcher's knowledge, there are no studies available concerning occupational accidents in the local government sector and they are rarely presented separately in the official statistics. According to the Bureau of Labor Statistics (USDL 2009), the public sector estimates were available for the first time in 2008 in the US workplace injuries and illnesses statistics. Nevertheless, compared to the USA, the local government sector seems to account for a slightly higher proportion of occupational accident/injuries and diseases/illnesses in Finland (20%) than in the USA (16%) (see Nenonen 2012, USDL 2009, 2010c, 2011c). In Finland, however, the local government sector employees constitute a higher share of the working labour force (20%) (The Association of Finnish Local and Regional

Authorities 2012b) than they do of the annual average employment in the USA (11%) (see USDL 2009, 2010c, 2011c). In addition, in the Finnish local government sector, the frequency of both accidents at work and commuting accidents is lower than in general in Finland and lower than in many of the main industries (see FAII 2009a, Nenonen 2012). In the USA, the injury and illness rate per 100 full-time workers has been notably higher for local government workers than for state government and private industry workers (USDL 2009, 2010c, 2011c). Nevertheless, as the results of this research showed, occupational accidents in the local government sector constitute a significant proportion of all occupational accidents in Finland. Moreover, the number and frequency of occupational accidents has stayed more or less in the same level over the last decade (see FAII 2009a, Nenonen 2012).

A comparison with a recent follow-up study (Nenonen 2012) shows that neither have there been any major changes in terms of whom the occupational accidents involve and what they are like. The decrease in the number of occupational accidents causing from four to 30 days of incapacity for work can be seen as a positive development (Nenonen 2012). It seems that the major challenge in the Finnish local government sector is to be able to enhance occupational accident prevention in general. One explanatory factor may be that municipal employees have been reported to experience more hurry at work compared to other employer sectors in Finland (see Ministry of Social Affairs and Health 2010b).

The gender and age distribution of the municipal employees, in addition to the occupations and work assignments typical of the local government sector can also be seen in occupational accident statistics. Many of the local government sector occupational accidents involve women, older employees and occupation classes with most of the employees, with medical and nursing work standing out as the largest occupational group. In addition, in the local government sector, the share and severity of commuting accidents is higher than in general in Finland, particularly for women (See also Nenonen 2012). Many of the common occupations in the Finnish local government sector require movement between several different work locations. For example, home visits are common in medical and nursing work and social work. Relief farm workers, again, may work on various farms. In addition, female employees may walk or cycle to and from work instead of driving, which might explain the difference in commuting accident risk between genders. Compared to the gender and age distribution of the local government employees, the youngest and oldest age groups seem to have an increased risk of occupational accidents (see also Nenonen 2012). The proportions of occupational accidents involving female, and younger and older employees have also been reported in general terms in Finland (see FAII 2010, 2011).

Finnish local government sector employees work in a wide variety of occupations and work assignments. Hence, effective accident prevention requires information concerning not only the local government sector as whole, but the different municipal occupations such as the incidence rates calculated in this research. Compared to Finland in general (see OSF 2006), both similarities and differences can be found in the incidence rates. In addition, somewhat different occupation classes stand out than when examining only the number of occupational accidents. For example, the accident incidence rates in occupation classes with most employees (medical and nursing work, social work etc.) are lower than in general in the local government sector and they are on the same scale in general in Finland. Of the biggest occupational groups, the highest incidence rate was in farming and animal husbandry work. The rate was also higher than in

general in Finland. In construction work, however, the incidence rate was lower in the local government sector than in general in Finland. The nature of work in some of the occupation classes may be somewhat different in the local government than in general in Finland. For example, in the local government sector, the occupation class of farming and animal husbandry work consists mainly of relief farm workers.

Slipping, stumbling and falling accidents at work

SSF accidents at work constitute a considerable number of workplace accidents in Finland (22%). The percentage of SSF accidents of all accidents at work is on the same scale as was found in other studies (see e.g. Courtney et al. 2001, European Commission 2009). Grönqvist and Hirvonen (2009) reported previously a higher percentage (30%) in Finland. Nevertheless, in this research, commuting accidents were excluded, which probably explains the difference. In addition, SSF accidents at work are more likely to result in longer periods of incapacity for work than other workplace accidents (see also Courtney et al. 2001, Yoon & Lockhart 2006). The fact that the class includes falls to a lower level may increase the severity. SSF accidents at work, particularly those that take place on the same level, may be perceived to be less severe and, hence, less important, particularly if the risk of another kind of accident is more clearly associated with the work assignment of the given environment. Leclercq and Thoy (2004), for example, argue slips, trips and falls are considered commonplace and, hence, are rarely analysed in detail. This may also be one reason why slips, trips and falls continue to constitute a major proportion of occupational accidents.

As can be expected, the most important factor influencing whether accidents at work are related to SSF was the specific physical activity of movement. Additionally, injuries were often caused by the impact with or against a stationary object. Yoon and Lockhart (2006) have reported similar results. As was also mentioned in the previous literature (e.g. Courtney et al. 2001, Yoon & Lockhart, 2006), the typical consequences were dislocations, sprains and strains, or with more severe accidents, bone fractures.

According to the results, the age and occupation class also seem to have an influence on whether the accident at work is related to SSF and on the severity of such workplace accidents. For example, the proportion of SSF accidents increased along with age with accidents at work related to movement and those causing four to 30 days of work incapacity. This is an important result, considering that the number of older employees is increasing in the workforce. Older employees have also been identified as a risk group by many other researchers (e.g. Bell et al. 2008, Courtney et al. 2001, Kemmlert & Lundholm 2001, Laflamme & Menckel 1995, Lipscomb et al. 2006, Yoon & Lockhart 2006). Occupation groups associated with slipping, tripping and falling accidents seem to vary in the literature. In this research, for accidents at work causing less than four days of incapacity for work (and related to movement), the deviation of SSF was more common in occupations where severe accidents are generally less common, such as managerial, administrative and clerical work, and was less common in occupations with commonly higher accident risks such as agricultural, forestry and fishing work. Hence, it can be argued that the more severe SSF accidents occur in traditionally more accident-prone occupations. The fact that occupation also effects whether the accident is a fall on the level or to a lower level (see Yoon & Lockhart 2006) may explain this. Falling-related accidents may be more common in accident-prone occupations (e.g. construction) compared to occupations that are less prone to accidents.

Furthermore, interestingly, none of the lifts of the association rules composed was especially high, indicating that the circumstances associated with SSF accidents at work also exist in other kinds of accidents at work. This may reflect the fact that slip-, trip- and fall-related accidents at work occur in highly varied circumstances (Leclercq & Thuoy 2004), even inside the same occupation (see Bell et al. 2008). In fact, the variety of contributing factors and circumstances that are associated with slips, trips and falls may be one of the key issues that makes the prevention of slips, trips and falls so challenging.

6.1.2 Utilisation and usefulness of the FAII database and its web application for safety promotion

Based on the user questionnaire, the proportions of less active users and respondents who had not used the FAII database web application at all were relatively high and there were unexpectedly few active users. The major reason for not using the application at all or more often was that the respondents had not needed the application. This is, however, understandable, since the need to use the application depends on the respondents' organisation and work assignments. Surprisingly, gender and age also affected some of the responses concerning purpose of use. This may, however, be a reflection of how respondents' gender and age vary by organisation. Nevertheless, some of the respondents stated, as a reason for non-use, that they had not remembered about the existence of the application. Hence, users' awareness of the existence of the application could be improved.

According to the questionnaire, the users were more satisfied than dissatisfied with the database and its web application. The respondents were most satisfied with the content of the application, indicating that they regarded the existence of this kind of information source as important. In addition, information retrieval concerning the selected OH&S issue cases can be considered successful, since the desired information could be provided in all of the cases, though in some of the cases it was less straightforward than in others. Nevertheless, some targets for further improvement of the FAII database and its web application can also be identified on the basis of both the questionnaire and OH&S issue cases. Furthermore, the results from the user questionnaire and OH&S issue cases mainly support and complement each other.

Some of the questionnaire respondents mentioned as a reason for non-use that it had been difficult to use the application. In addition, the respondents were least satisfied with the general user experience of the application. Furthermore, quite a large percentage of the respondents had sometimes had problems when using the application, though only rarely. The problems were mainly due to difficulties in carrying out searches. Respondents also most often suggested that there is a need to further improve the information-retrieval possibilities and ease of use and learnability of the application and that there is a need for more instructions and guidance. Hence, the utilisation of the database and its web application could be enhanced and supported by improving the ease of use of the application and supporting users' skills to use the application, for example, by providing more guidance, directions and training. Some of the respondents also mentioned having had problems with the technical functionality of the application. These problems were probably rather trivial, since in general, the respondents were quite satisfied with the technical functionality and there was a lot of variation in satisfaction levels.

The respondents to the questionnaire also had some more specific suggestions as to how information retrieval from the FAII database could be improved. The respondents often mentioned that they had needed information that could not be retrieved using the existing classification variables and codes. New tools for information retrieval and production such as more variables and more specific classification codes, a search function for accident descriptions and data on working hours or accident frequencies were hoped for. These results are in line with the major thematics arising from the OH&S issue case results. The OH&S issue cases used in this research demonstrate clearly that, in some cases, retrieving information on occupational accidents from the FAII database may not be straightforward (e.g. accidents at work in TAW or those related to SSF) or even possible with the existing classifications (violence-related accidents at work). Nevertheless, in some cases, such as in the local government sector, the information is readily available with the classifications. Comparison of occupational accident data with employee or working hour data, again, requires use of external data sources. Differences in methods of data collection and classifications used in different sources bring issues of reliability into question. For example, in the case of the local government sector, the occupation classifications used in different data sources were completely different. The importance of occupation classification specific data was emphasised in the OH&S issue cases, since occupational accidents related to these OH&S issue cases seemed to vary depending on occupation class. In line with other research, the results from the OH&S issue cases also showed that additional methods such as accident description analysis (see e.g. Rajala & Väyrynen 2010) and methods of data mining (see e.g. Persona et al. 2006) are useful in supplementing information retrieval based on classification variables.

Continuity of the data and classifications used in the FAII database was also one of the main thematics emerging from the OH&S issue cases. In the questionnaire, this issue was not emphasised. This could be because the continuity of data is more of a feature you may need to be aware of when interpreting the data and not so much something that would affect the information retrieval as such. In addition, the points of discontinuity are taken into account in the FAII database as much as possible. The data may, for example, be coded backwards if new variables are adopted. Additionally, it may be that not all users are aware of the points of discontinuity.

As previous research suggests (see e.g. Jordan 1998, Nielsen 1993, Zviran et al. 2005), users' background characteristics affected the experienced usefulness. Most interestingly, in this research, less active users were less satisfied with guidance and directions than the active users. Moreover, trained users were more satisfied with the content of the application than non-trained users. The trained users might better understand the background of the database and its web application and, hence, the possibilities and limitations related to its utilisation. In addition, the trained respondents used the application more often than non-trained respondents. Hence, particularly less active users would benefit immediately from improved ease of use and further guidance and directions, as mentioned above. The active users would benefit particularly from more advanced information-retrieval and processing possibilities, as discussed above. Furthermore, it is good that the organisation-specific needs are taken into account in the application, since the respondents' organisation affected the purpose of the application use.

It should also be noted that the targets for improvement identified here have a different feasibility in practise. Users' awareness of the database and its web application, ease of use of

the application and users' skills may be fairly easily improved, for example, by adding communication, training and instructions. Implementing new information-retrieval possibilities such as a search function for accident descriptions is a question of technical feasibility. Some of the improvement targets are related to the characteristics of the whole reporting and registering system. For example, the implementation of new classification variables or codes is bound to the classification systems in use. The implementation of accident frequencies or incidence rates again is dependent on the existence of reliable and comparable reference data.

6.2 Contribution of the research

As one of the main contributions to the previous literature, this research provides recent information on occupational accidents related to selected topical OH&S issue cases. The OH&S issue cases included accidents at work related to violence, accidents at work during TAW, occupational accidents in the local government sector and SSF accidents at work. There is a body of research available on violence at work; however, particularly accidents related to violence at work are less discussed in the literature. Previous research related to SSF accidents at work is also available. Nevertheless, follow-up information – such as that provided in this research – is needed in order to view the current trends in both violence-related and SSF accidents at work. On the contrary, research and publications providing information on accidents involving temporary agency and local government sector workers are scarce. Hence, information provided on these OH&S issue cases in this research has particular novelty value.

As another main contribution, this research adds knowledge to the scientific community on the utilisation possibilities of the existing occupational accident data-collection systems for safety promotion in the case of the Finnish national-level system. More precisely, this research provides new information on the utilisation and usefulness of the FAII database and its web application from the user viewpoint in general and in the case of the selected OH&S issues. The employment of the usability research approach and the user viewpoint gives a novel perspective to this research. In addition, the research provides examples of novel ways to retrieve occupational accident information from the database. Particularly, the methods of data mining exploited in this research are so far less common in occupational accident analyses. The results related to the usefulness of the FAII database and its web application may also be useful in the currently less studied field of web-application usefulness research. Nevertheless, the direct application possibilities of the results are limited to the FAII database and are a rather specific target of evaluation.

In practise, different organisations operating in the field of OH&S can use the information on occupational accidents related to the OH&S issue cases provided in this research to monitor and guide safety promotion and accident prevention. The information provided helps to form a picture of the trends and significance of accidents related to these OH&S issues and to enable the focusing and selection of preventative actions. In addition, companies and organisations in which these OH&S issue cases are relevant can use the information provided, for example, as comparison data and compare their own situations to those in general in Finland. The main results concerning accidents related to the OH&S issue cases have been published in Finnish research reports and the researcher has presented them in seminars, training sessions, press releases and other publications such as trade journals. The results have also already been referred

to and used by other parties, for example, in training courses and training materials, guidebooks, other reports and working groups (see e.g. Hyytinen & Nenonen 2011, Kalliolinna 2009, Ministry of Employment and the Economy 2012, Ministry of Justice 2008, Piispa & Hulkko 2010, Siiki et al. 2009). Some of the results have, for example, been utilised in training directed at occupational safety representatives and in working groups striving to estimate and improve legal provisions.

These results concerning the utilisation and usefulness of the FAII database and its web application can be used directly to further improve the database and its web application and to enhance their utilisation in practise. In fact, many steps have already been taken in order to improve the database and the application, and the improvement work is still on-going (see FAII 2012b). For example, the information-retrieval examples from this research have been used in user training, the instruction material available for users in the web application has been updated and a search function for accident descriptions is now available. Similarly, a tool to calculate accident frequencies is already available and will be accompanied by a tool to calculate accident incidence rates. There are also some updates concerning the classification variables. For example, a new variable indicating the country in which the occupational accident happened is now available for users in the web application. The results may also provide tips on the utilisation and improvement of the utilisation possibilities of other accident databases, though the differences between databases need to be taken in consideration. The results could be useful at least in databases similar to the FAII database; that is, in European national-level databases in which the ESAW methodology is in use and, particularly, in databases compiled on the bases of statutory employment accident insurance. Some of these results could be suitable, for example, for the purposes of the fatal workplace accidents investigation reports' register, also maintained by the FAII. This register also has a web-based user interface. In addition, among other variables, the ESAW variables are in use in the register. Hence, ultimately, this research indirectly supports the work done to prevent occupational accidents and promote safety in practise, and so contributes to the development of safer and healthier work environments.

6.3 Achievement of objectives

Research can be considered successful if it provides trustworthy answers to research questions (see Heikkilä 2005). Accordant with the first main objective of this research, the Finnish national occupational accident database, the FAII database, was utilised in order to provide information on occupational accidents related to selected OH&S issue cases for safety promotion. Information retrieval was successful concerning all OH&S issues, although in some cases less straightforward than in others. The research provided the most recent information available on the extent and factors related to these occupational accidents. Furthermore, based on this information, the significance of these accidents and the most important challenges from the viewpoint of prevention and safety promotion were discussed. With regard to the second main objective of this research, the research provided information on the utilisation and usefulness of the FAII database and its web application from the user perspective. The research charted users' experiences on the utilisation and usefulness in general. In addition, utilisation and usefulness were viewed in relation to the selected OH&S issue cases, providing case examples of information retrieval. This data was compared to explore and describe the current utilisation

possibilities and to discuss the possibilities for further enhancement of the utilisation and usefulness of the database and its web application. Hence, the objectives of this research can be considered to have been achieved.

6.4 Validity and reliability

Such measures as validity and reliability are traditionally used to describe the trustworthiness of research (Metsämuuronen 2006, Ronkainen et al. 2011). The validity of the research means the ability of the research or measurement to describe the phenomenon being studied (Ronkainen et al. 2011). It is a question of whether or not research examines or measures what is meant to be studied (Metsämuuronen 2006). Validity is often divided into internal and external validity (Metsämuuronen 2006, Ronkainen et al. 2011). Internal validity refers to the internal logic and consistency of research (Ronkainen et al. 2011) including such considerations as to whether the terms and definitions used are correct, if the theory is chosen correctly, if the instrument is well compiled and if the instrument measures what was supposed to be measured (Metsämuuronen 2006). External validity means whether research can be generalised and, if so, to what groups (Metsämuuronen 2006).

Reliability refers to the accuracy of the results (Ronkainen et al. 2011) and repeatability of the research (Metsämuuronen 2006). Repeatability is a question of whether the research would provide similar results if it was repeated (Metsämuuronen 2006). In order to ensure the validity and reliability of the research in general, methods seen as suitable as possible for the purposes of the research were selected and the choices made in data collection and analysis were carefully explained. Ronkainen et al. (2011) point out that different methods have different limitations and critical points that have to be taken into account when using these methods. Nevertheless, different studies can provide rival and contradictory interpretations on the same phenomenon, while still being of equal quality. Hence, different research cannot be evaluated similarly, and when evaluating research, it should be asked how good the research is in terms of similar research (see Ronkainen et al. 2011). In the following sections, the strengths and weaknesses of the methodological choices made in this research with regards to achieving the objectives are discussed in terms of validity and reliability.

6.4.1 Occupational accidents related to the occupational health and safety issue cases

An accident analysis was carried out to achieve the first objective of providing information on occupational accidents related to the selected OH&S issue cases. Accordant with the scope and objectives of the research, the accident analysis was carried out based on the FAII database. Hence, the accident analysis can be considered to be an archival analysis, where secondary data collected originally for other purposes than the purposes of this research was used (see Corti 2003, Yin 2003). In general, the disadvantage of archival research is that researcher has no control over how the data was collected and, therefore, what can be analysed depends on what is available in the data source (Corti 2003).

Although accident data is vital as a final check of the OH&S performance, it is considered a lagging indicator suffering from the related limitations such as the level of reporting, reporting delay and the possible delay between the causal factors, for example, OH&S management failures and the actual accident (see BS 18004 2008). Insurance-based accident registers are

generally considered to have a good coverage (see Jacinto & Aspinwall 2004) because they provide an economic incentive for reporting accidents (European Commission 2009). Receiving compensation means that the accident is notified to the insurer and, therefore, that the reporting levels are generally very high in insurance-based systems (European Commission 2009).

Coverage of the FAII database is also considered to be good (see Jacinto & Aspinwall 2004, Karjalainen et al. 2000). Nevertheless, the data coverage is restricted to what is covered in the insurance scheme (European Commission 2009). In Finland, it is mainly self-employed workers who have not taken out the voluntary insurance that are not covered. Furthermore, if accidents for some reason are not reported or compensated for, they are not covered in the FAII database. It should be noted, particularly, that a daily allowance from the employment accident insurance is paid only if the incapacity for work lasts for at least three consecutive days, excluding the day the accident occurred. Therefore, not all occupational accidents with less than three days of incapacity for work are likely to be reported and their coverage is less reliable. On the contrary, the coverage of occupational accidents leading to at least three days of incapacity for work is very good, and almost all are covered (see Jacinto & Aspinwall 2004, Karjalainen et al. 2000). In addition, a certain delay is unavoidable in reporting, in the registering process and in defining the severity (days of incapacity for work) of the accident correctly. In this research, the latest years for which the data was reliably available at the time of the analyses were chosen for analysis. Taking into account these limitations, the FAII database can be considered as giving a comprehensive picture of occupational accidents on a national level in Finland. Hence, the occupational accident information provided in this research can be generalised to the situation in Finland in general.

In general, the reporting and registering of occupational accidents into the FAII database is a systematic process. The data is collected into the FAII database with a standard notification form. In addition, the data is recorded accordant with standard definitions and classifications. Moreover, there are instructions on how to report accidents, compile the form and use the classifications. Nevertheless, the reporting of accidents is based on subjective perceptions and interpretations of those involved in the accident and reporting. The quality of the short accident descriptions, for example, varies (see Hintikka 2007, Ollanketo 2006). There may also be some errors in coding the accident data. These errors are, nevertheless, trivial when considering the amount of data available and, in general, the data can be considered accurate (see Ollanketo 2006). In this research, the definitions and classifications used in the FAII database were applied to retrieve and analyse occupational accident data, increasing the internal validity and accuracy of the results in general. Additionally, if similar analyses were repeated using the same definitions and classifications, similar results should be gained.

The data-analysis methods used to retrieve and provide occupational accident information were selected case-specifically and were carefully applied to meet the case-specific objectives. There are, though, some OH&S issue case-specific limitations related to the validity and reliability, which should be noted. Subjectivity related to the manual classification of violence-related accidents at work from accident descriptions affects the reliability of the classification. In the case of the local government sector, there is subjectivity involved, because in order to calculate occupation class specific accident incidence rates, two different occupation classifications were matched. The application of predefined criteria and cooperation with the steering group in both

cases improves the internal validity and accuracy of classification and matching of the occupation classification. Predefined criteria also allow for the repetition of the classification of violence-related accidents. In addition, the conversion of occupation classifications can be used again. The approximation of TAW with a class of economic activities classification which includes also some other economic activities limits the accuracy of results concerning.

In this research, occupational accidents related to the selected OH&S issue cases were not studied with other data, which could have been used to compare the results. Nor were multiple analysis methods used to analyse the same data, except in the case of SSF accidents at work, where descriptive statistical analyses provided similar results as data mining methods. Nevertheless, the fact that information provided on occupational accidents in this research was mainly in line with the results of other studies, supports the validity and reliability of the research. It is necessary to take into account that these comparisons are, though, only indicative, since the terminology used in research varies and sometimes the terms used are not clearly described. Moreover, due to the exiguity of other publications on occupational accidents in the local government sector and accidents at work in TAW, only some comparisons were possible in these cases. The ESAW variables improve the possibility of making comparisons between EU countries, as more research is being published using these variables.

6.4.2 Utilisation and usefulness of the FAII database and its web application for safety promotion

In this research, the utilisation and usefulness of the FAII database and its web application were charted in general with a user questionnaire, and in detail, related to the selected OH&S issue cases with a scenario analysis. Both methods are suitable and useful for usefulness evaluation and viewing users' experiences. In addition, the methods complement each other well. In questionnaires, it should be noted that studying user opinion is an indirect method and, hence, does not necessarily reflect the actual behaviour of people (Nielsen 1993). Scenarios provide information on actual use of the FAII database. The disadvantage of scenarios is that they do not necessarily provide a comprehensive picture of the system being evaluated (Tervakari et al. 2007), whereas questionnaires allow data to be gathered widely from a large user population (Jordan 1998). The questionnaire and scenario analysis provided similar results concerning the major challenges in utilising the FAII database, supporting the internal validity and accuracy of the results in general.

The FAII database user questionnaire

In this research, the questionnaire was directed to all known users. Hence, sampling was no issue in terms of error in this questionnaire. The response rate to the questionnaire was good (62%). The respondents also represented well different organisations. It was not possible to compare the other background characteristics of the respondents to the original population. Nevertheless, all categories of the background characteristics were represented in the responses. Hence, there should not be any notable error in the coverage of the questionnaire due to the population it was directed at. Additionally, the coverage and representativeness of the questionnaire respondents can be considered as relatively good. Therefore, the results of the questionnaire can be considered to be generalizable to all users. An accurate definition of the target population,

representativeness of the respondents and the high response rate also support the accuracy and internal validity of the questionnaire.

However, there are some issues related to the coverage and non-response to the questionnaire, which may cause limitations in the accuracy and validity. Error in the coverage can arise if the population to be studied is not well enough understood or if there is no timely record of the population (Heikkilä 2005). Users' contacts were collected from the FAII's records, which were supplemented by asking for the contacts from the FAII contact persons at the organisations that had rights to use the FAII database web application. Most of the contact persons replied, but not all. Although contacts of most of the users were probably received, it is possible that contacts of some of the users were not received. Furthermore, among the persons to whom the questionnaire was directed, some responded that they were no longer users of the system. Hence, it is possible that among the respondents or non-respondents there were also other former users. Nevertheless, it is not likely that there were many former users, because when the contacts of the users were asked from the user organisations, those who reported that they were no longer users were removed from the user list. Furthermore, these persons are still former users of the application and, in that sense, capable of giving reasonable responses to the questionnaire.

Non-response may cause distortion in the representativeness of the respondents compared to the population being studied (see Heikkilä 2005). In this research, the non-response was not studied further because the coverage, response rate and representativeness of the respondents were considered good enough for the purposes of the research. Moreover, responses were received from all users, active users, less active and non-users. According to the results of the questionnaire, a major reason for not using the application was that the respondents had not needed the application. Hence, it is possible that one of the reasons for non-response may also be due to the non-respondent not using the application. Furthermore, the active users are probably more likely to answer the questionnaire, considering it as more important than less active users and non-users. This would mean that the respondents to the questionnaire may not be representative in terms of frequency of use and that there could actually be even more users than the results would show. Of course, this cannot be known with certainty, and the non-response may also be due to other reasons. For example, some of the users may have been too busy to answer the questionnaire, although the users were given several weeks to answer and they were reminded of the questionnaire.

In order to be valid, the questionnaire should measure the right issues unambiguously and the questions should cover the whole research problem (Heikkilä 2005, Jordan 1998, Robson 2002). There are many pre-prepared questionnaires available for usability evaluation. The use of pre-prepared instruments is recommended because the validity and reliability of these instruments has usually already been examined and described (Metsämuuronen 2006). These questionnaires may also provide a good measure of overall usability (Jordan 1998). In this research, it was decided not to use a pre-prepared questionnaire, which brings issues of reliability and internal validity into question. Nevertheless, when addressing issues relating to a specific product, as in this research, it is reasonable to design the questionnaire to meet these issues (Jordan 1998).

To strengthen the accuracy, internal validity and repeatability of the questionnaire, previous literature and pre-prepared usability surveys were, however, utilised in compiling the questionnaire. In addition, the FAII's requests were taken into account. Furthermore, closed and

open-ended questions were included in order to cover users' experiences as widely as possible. The reliability and internal validity of the questionnaire can also be improved by piloting it before delivery (Robson 2002), as was done in this research. Hence, not using a pre-prepared questionnaire was not seen a threat to the quality of the questionnaire but as an advantage to gain more precise information related particularly to the FAII database and its web application. However, it should be noted that, for the same reasons, the questionnaire is not directly suitable, although it is modifiable, for studying the utilisation and usefulness of other accident databases.

In order to avoid threats to accuracy and internal validity, the analysis of the data was carried out carefully, choosing methods as suitable as possible for the material in question. Users' satisfaction related to different usefulness characteristics of the database and its web application were charted with several questions related to each usefulness characteristic. The internal consistency of these variables was examined with Cronbach's alpha and they were considered usable (see section 4.3.2). There are both critical and positive opinions about combining ordinal scale variables (Heikkilä 2005). In this research, combinations were, nevertheless, used because they were considered useful in order to present the data in a condense form. There were, however, some other shortcomings related to data analysis. Although the response rate was good, some of the sub-groups were quite small when studying statistical differences in the responses between different user groups. Additionally, although responses were received for all the questions, not all respondents responded to all questions. This may be because, overall, the questionnaire was quite long. In addition, some of the questions might have been difficult to answer for some of the respondents, since many of them had not used the application very often and, therefore, may have not had many experiences in using the application. Due to the low response rate to some of the questions, it was not possible to study dependencies between different user groups with regards to these questions.

Scenario analysis

In scenario analysis, the major issue limiting the generalizability of the results is the number of OH&S issue cases studied. Nevertheless, the application of multiple-case design improves the external validity, as it is often considered more compelling and robust (see Eisenhardt 1989, Eisenhardt & Graebner 2007, Yin 2003). In addition, although a sufficient number of cases cannot be unambiguously determined (Yin 2003), the minimum number of four to ten cases, as recommended by Eisenhardt (1989), was included in this research. Indeed, the examination of cross-case comparisons showed that apart from case-specific thematics, thematics that were also generalizable to the whole database arose from scenario analysis. Hence, to some extent the results can be generalised to the whole database. In addition to the observations of the researcher, those of the steering groups were taken into account in scenario analysis. As the steering groups did not compose a representative sample of users, the viewpoints of organisations being represented may have been emphasised. Nevertheless, the scenario analysis was carried out in general from the perspective of the users and not from the perspective of one user organisation, which increases the generalizability of the results.

In scenario analysis, the objective was to describe the information-retrieval and production process and to record the most important observations, particularly related to challenges and possibilities in utilisation and usefulness of the FAII database in providing information related to the OH&S issue cases. The major limitation to the scenario analysis is that the data collection

was based on this documentation and no predefined framework for data collection was used. The application of a predefined framework might have provided more accurate and repeatable results. However, at the same time, it might have also narrowed the findings made. Apart from improving the generalizability of the results, cooperation with the steering groups also decreases the subjectivity of the results by allowing more observations than only those of the researcher. In addition, similarities found between cases in data analysis support the accuracy of the results. The narrative descriptions of the information-retrieval and production processes related to each OH&S issue case that were compiled as a result of the scenario analysis enable the repetition of similar analyses in the future. However, due to the lack of a detailed evaluation framework, the repetition might provide somewhat different results, unless the thematics that have arisen from the analyses were used as a framework.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 General conclusions

In order to turn around the trend in occupational accidents into a new decline and meet the goals that have been set to reduce occupational accidents, timely information is needed, particularly concerning topical issues in the field of OH&S to support accident prevention and safety promotion. The ability of the existing occupational accident databases to provide relevant information on accidents that have occurred is essential for effective accident prevention and safety promotion. In this research, the Finnish occupational accidents and diseases statistics database, the FAII database, was utilised to provide information concerning occupational accidents related to selected topical OH&S issue cases. The OH&S issue cases included accidents at work related to violence; accidents at work during temporary agency work; occupational accidents in the local government sector; and slipping, stumbling and falling accidents at work. In addition, the utilisation and usefulness of the database and its web application for safety promotion were explored based on the OH&S issue cases and a user questionnaire.

These results can be used to directly guide safety promotion and to further improve the database and its web application. Safety promotion work can be further supported by enhancing the utilisation and usefulness of the database and its web application. Nevertheless, this research has only provided information, and it is important that the information is still utilised in practice. In fact, several OH&S organisations have already paid attention to the occupational accident information provided herein. In addition, many steps have already been taken in the FAII in order to improve the database and its web application, and the improvement work is currently on-going. Furthermore, further action and research should be focused on developing and applying effective prevention interventions. A repetition of similar accident analyses is also recommended in order to follow-up on the trends of occupational accidents related to these OH&S issues in the future. Additionally, users' experiences could be followed up with a short questionnaire or through other methods of usability assessment.

7.2 Occupational accidents related to the occupational health and safety issue cases

The information provided in this research on occupational accidents related to the selected OH&S issues was mainly in line with other studies. However, the rarity of the research relating to occupational accidents involving local government and temporary agency workers enabled only some comparisons to be made regarding these issues. The results of this research support the assumption that the OH&S issue cases viewed in this research are particularly relevant from the viewpoint of safety promotion. The relevance of the OH&S issue cases, nevertheless, arises from slightly different reasons. Accidents at work related to violence and TAW both constitute a fairly small share of all accidents at work in Finland. Nevertheless, the number and incidence of both seem to be increasing across countries. In addition, in TAW, the accident frequency is significantly higher than in other industrial sectors. Occupational accidents in the local government sector and slipping, stumbling and falling accidents at work, again, have, for a long time, both accounted for a major proportion of accidents compared to the total amount of

occupational accidents and accidents at work. Slips, trips and falls have been internationally recognised as continuing to pose a major occupational safety problem. Local government sector occupational accidents are less discussed in the literature but, for example, in US national statistics, they comprise a notable proportion with a high incidence rate. Hence, focusing accident prevention on these OH&S issues may potentially affiliate the efforts to turn the stationary or still-growing number of occupational accidents into a new declining trend in Finland and in other countries with similar trends.

In general, it seems that the prevention of occupational accidents related to the OH&S issue cases studied in this research may have been ineffective because some of them may have been traditionally considered as commonplace and less severe and, hence, they may have received less attention. In addition, the fact that these accidents involve a variety of sectors and occupations poses challenges to accident prevention and, therefore, no sector-specific traditions have been properly established for accident prevention. Furthermore, these accidents may also involve a variety of situations and contributing factors. Hence, further research is needed that goes deeper into identifying the underlying causes and establishing the relationships between them. The accident models and theories have already shifted from searching for a single or immediate cause to the recognition of multiple causes and underlying causes such as management and organisation factors. The need for data, including that in official databases, allowing for this kind of more comprehensive analysis also concerning non-major accidents is increasingly discussed in the literature (see e.g. Bentley 2009, Jacinto et al. 2009, Wassell 2009).

The current major challenge in preventing accidents at work related to violence and violence at work in general is to take into account its increasing trend, particularly among women, younger women and those in the service sector. These trends are likely to reflect the increased awareness and expanded definition of workplace violence. In TAW, its increased use in traditionally more accident-prone industries such as building construction work; engineering and structural metalwork and packing, wrapping, warehousing and stevedoring work is likely to explain the increased accident risk. The results also showed that in TAW, accidents at work are more common in manual work activities such as carrying by hand, in production, manufacturing, excavation and construction than in other sectors. These results may indicate that TAW often involves work assignments requiring less expertise. These kinds of accidents could easily be prevented with proper and safe working practices. Furthermore, temporary agency workers are often young with little previous working experience. Hence, the importance of proper orientation and safety training, even in assignments coming with short notice and requiring less expertise, is emphasised to prevent accidents at work in TAW.

In the cases of both the local government sector and slips, stumbles and falls, the factors contributing to accidents have not changed notably recently. In the local government sector, occupational accidents strongly reflect the gender, age and occupation distribution of the local government sector. Many of the local government sector occupational accidents involve women, older employees and occupation classes with most of the employees, with medical and nursing work standing out as the largest occupational group. Of the biggest occupation groups, relief farm workers, again, have the highest workplace accident incidence rate. In addition, in the local government sector, the share and severity of commuting accidents is higher than in general in Finland, particularly for women. A variety of factors seem to affect the risk of slipping,

stumbling and falling accidents at work. The major factors associated with these accidents included the specific physical activity of movement and impact with or against a stationary object. In addition, the proportion and severity of slip-, stumble- and fall-related accidents increased along with age and varied according to occupation. It seems that the major challenge regarding both the local government sector and slips, stumbles and falls, is to be able to enhance occupational accident prevention in general. It may be that these accidents are often considered commonplace and less severe, which may be one reason why the prevention of these accidents has not been more successful.

In general, the variety of factors contributing to occupational accidents related to these OH&S issues and the variety of occupations that these occupational accidents involve pose challenges to accident prevention. In the local government sector and in TAW this means, for example, that the same municipal or work agency may have to take into account different accident risks associated with different occupations. In the case of violence at work and slips, trips and falls, this means that they cannot be viewed as industry or occupation specific accidents. Traditionally, management for OH&S may be more advanced in industries considered as particularly hazardous, while the prevention of occupational accidents related to these OH&S issues requires safety promotion across industries and occupations. Hence, this may be one reason why measures to prevent occupational accidents related to these OH&S issues are not as well established. Further research is still needed in order to identify the underlying mechanisms and their significance in order to guide accident prevention effectively, particularly in the case of the local government sector and TAW, which are less studied. The prevention of slips, trips and falls (see e.g. Bentley 2009) and violence at work (see e.g. Chappell & Di Martino 2006, Wassell 2009) would benefit from understanding the contributing factors from a wider system and organisation perspective.

Furthermore, there seem to be some interconnections and similarities in the factors contributing to occupational accidents between these different OH&S issues. For example, in many of the cases, major contributing factors were found to be gender and age, factors that have also been recognised elsewhere in the literature (see e.g. Chau et al. 2010, Lin et al. 2008, Laflamme & Menckel 1995). These issues are topical due to, for example, the ageing workforce, pressure to lengthen working careers and to the increasing participation of women in the labour force, especially in jobs previously dominated by men. Further research is needed on the epidemiology of occupational injuries in female workers (Lin et al. 2008) and to better understand the mechanisms through which various types of injuries relate to age (Chau et al. 2010). Furthermore, the effect of gender and age in particular settings may be even less studied. For example, workplace violence involving younger employees is rarely discussed (Rauscher 2008). Precarious employees (Chappell & Di Martino 2006, Mayhew 2002) and public sector employees (e.g. Lehto & Sutela 2008, Mayhew 2002, Salminen 2010), again, often work in risk areas of occupational violence and may have an increased workplace violence risk. The different interconnections may pose special requirements for accident prevention. Furthermore, efforts to prevent occupational accidents related to one OH&S issue may also affect another OH&S issue. Hence, it would be interesting to study them further.

7.3 Utilisation and usefulness of the FAII database and its web application for safety promotion

Overall, the FAII database and its web application can and is fairly widely utilised for safety promotion. The users regarded the existence of this kind of information source as important and were mainly satisfied with the database and its web application. In addition, information retrieval concerning the selected OH&S issue cases was successful. Nevertheless, the utilisation and usefulness of the database and its web application could still be enhanced. There were rather many less active and non-users and unexpectedly few active users. Many of the users had not used the application because they had forgotten about its existence. Hence, users' awareness of the existence of the application could be improved. Furthermore, the users had also faced some problems while using the application and named some targets for further improvement.

Most importantly, the utilisation and usefulness of the database and its web application could be enhanced and supported by improving the ease of use of the application and supporting users' skills to use the application, for example, by providing more guidance, directions and training. Particularly, less active users would benefit from additional guidance and directions, and active users from more advanced tools for information retrieval and processing. The respondents often mentioned that they had needed information that could not be retrieved using the existing classification variables and codes. New tools for information retrieval and production such as more variables and more specific classification codes, a search function for accident descriptions and data on working hours or accident frequencies were hoped for. Similar findings were made based on the OH&S issue cases. The OH&S issue cases used in this research clearly demonstrated that, in some cases retrieving information on occupational accidents from the FAII database may not be straightforward or even possible with the existing classifications. Nevertheless, the cases also showed that there are different ways to retrieve information from the database. Additional methods, such as accident description analysis and methods of data mining are useful in supplementing information retrieval based on classification variables. At the same time, new insights and examples for information retrieval from accident databases may enhance the utilisation of the database and its web application. Furthermore, novel ways to analyse the data may potentially provide new insights into safety promotion. The different suggestions for further improvement presented here have different practical feasibility. In general, the challenge is, on the one hand, to enable the availability of information related to topical occupational accident issues and, on the other hand, to maintain the continuity of the information.

It should be noted that, generally speaking, it is rather advanced for Finnish OH&S organisations to have access to the FAII database with a web application. According to Jacinto and Aspinwall (2004), even in most EU countries there is no general access to the national occupational accident databases but the access remains restricted to the particular register's personnel. In many countries, the data is only available in standard publications compiled based on the data or in special reports compiled following a request by the institutions in charge of the database (Jacinto & Aspinwall 2004). In that sense, the Finnish database and its web application show an example of how national databases could also be more harnessed for use in other countries.

REFERENCES

89/391/EEC. Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work. http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31989L0391:EN:NOT. Accessed on 19 June 2012.

1948/608. Tapaturmavakuutuslaki (in Finnish). http://www.finlex.fi/fi/laki/ajantasa/1948/19480608. Accessed on 4 June 2012. Unofficial English translation (Employment Accidents Insurance Act) available at: http://www.finlex.fi/fi/laki/kaannokset/1948/en19480608.pdf.

1996/516. Kauppa- ja teollisuusministeriön päätös sähköalan töistä (in Finnish). http://www.finlex.fi/fi/laki/alkup/1996/19960516. Accessed on 2 May 2012.

2002/738. Työturvallisuuslaki (in Finnish). http://www.finlex.fi/fi/laki/ajantasa/2002/20020738. Accessed on 2 May 2012. Unofficial English translation (Occupational Safety and Health Act) available at: http://www.finlex.fi/en/laki/kaannokset/2002/en20020738.pdf.

2004/1358. Laki tapaturmavakuutuslain muuttamisesta (in Finnish). http://www.finlex.fi/fi/laki/alkup/2004/20041358. Accessed on 16 June 2012.

2006/44. Laki työsuojelun valvonnasta ja työpaikan työsuojeluyhteistoiminnasta (in Finnish). http://www.finlex.fi/fi/laki/ajantasa/2006/20060044. Accessed on 6 July 2012. Unofficial English translation (Act on Occupational Safety and Health Enforcement and Cooperation on Occupational Safety and Health at Workplaces) available at: www.finlex.fi/fi/laki/kaannokset/2006/en20060044.pdf.

2008/104/EC. Directive 2008/104/EC of the European Parliament and of the Council of 19 November 2008 on temporary agency work. http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008L0104:en:NOT. Accessed on 9 June 2012.

Aaltonen, M., Hintikka, N., Hämäläinen, P., Lappalainen, J., Perttula, P., Räsänen, T., Salminen, S. & Sysi-Aho, J. 2010. Työtapaturmakehityksen analyysi: Loppuraportti esiselvityksestä (in Finnish). Unpublished research report. Finnish Institute of Occupational Health, Helsinki, 21 p.

Amuedo-Dorantes, C. 2002. Work safety in the context of temporary employment: The Spanish experience. Industrial and Labor Relations Review 55, 262–285.

Andersson, R. 1999. Injury Causation, Injury Prevention and Safety Promotion: Definitions and Related Analytical Frameworks. In: Laflamme, L., Svanström, L. & Schelp, L. (Eds.). Safety Promotion Research: A Public Health Approach to Accident and Injury Prevention. Karolinska Institutet, Department of Public Health Sciences, Division of Social Medicine, Stockholm, pp. 15–42.

Arrowsmith, J. 2008. Temporary agency work and collective bargaining in the EU. Eurofound, Dublin, 54 p. http://www.eurofound.europa.eu/docs/eiro/tn0807019s/tn0807019s.pdf. Accessed on 4 June 2012.

Asikainen, J., Majava, J., Oittinen, R. & Paasikallio, M. 2003. Selvitys julkisten verkkopalvelujen laatukriteereistä (in Finnish with English abstract). Ministry of Finance, Helsinki, 83 p.

http://www.vm.fi/vm/fi/04_julkaisut_ja_asiakirjat/01_julkaisut/04_hallinnon_kehittaminen/35328/35327_fi.pdf. Accessed on 27 June 2012.

Baida, Z., Gordijn, J. & Omelayenko, B. 2004. A Shared Service Terminology for Online Service Provisioning. Proceedings of the Sixth International Conference on Electronic Commerce, October 25–27 2004, Delft, Netherlands. http://doi.acm.org/10.1145/1052220.1052222. Accessed on 27 June 2012.

Bauer, H.H. & Hammerschmidt, M. 2004. Developing and validating a quality assessment scale for Web portals. Working paper. Institute for Market-Oriented Management, University of Mannheim, Mannheim, 33 p. http://ideas.repec.org/p/wpa/wuwpmi/0402007.html. Accessed on 27 June 2012.

Bell, J.L., Collins, J.W., Wolf, L., Grönqvist, R., Chiou, S., Chang, W-R., Sorock, G.S., Courtney, T.K., Lombardi, D.A. & Evanoff, B. 2008. Evaluation of a comprehensive slip, trip and fall prevention programme for hospital employees. Ergonomics 12, 1906–1925.

Benavides, F.G., Benach, J., Muntaner, C., Delclos, G.L., Catot, N. & Amable, M. 2006. Associations between temporary employment and occupational injury: What are the mechanisms? Occupational and Environmental Medicine 63, 416–421.

Bentley, T. 2009. The role of latent and active failures in workplace slips, trips and falls: An information processing approach. Applied Ergonomics 40, 175–180.

Bentley, T.A. & Haslam, R.A. 2001. Identification of risk factors and countermeasures for slip, trip and fall accidents during the delivery of mail. Applied Ergonomics 32, 127–134.

Bentley, T., Tappin, D., Moore, D., Legg, S., Ashby, L. & Parker, R. 2005. Investigating slips, trips and falls in the New Zealand dairy farming sector. Ergonomics 48, 1008–1019.

Bohman, P. & Andersson, S. 2004. Toward User-Centered, Scenario-Based Planning and Evaluation Tools. Proceedings of the International Conference on Computers Helping People with Special Needs ICCHP, July 2004, Paris, France. http://webaim.org/articles/scenarios/. Accessed on 30 April 2012.

Bowie, V. 2002. Defining violence at work: A new typology. In: Gill, M., Fisher, B. & Bowie, V. (Eds.).Violence at work: Causes, patterns and prevention. Willan, Cullompton, pp. 1–20.

Boyle, A.J. 2003. The collection and use of accident and incident data. In: Ridley, J. & Channing, J. (Eds.). Safety at work. Elsevier Butterworth-Heinemann, Oxford, pp. 263–303.

Burgess, J., Rasmussen, E. & Connell, J. 2005. Temporary agency work in Australia and New Zealand: Out of sight and outside the regulatory net. New Zealand Journal of Employment Relations 30, 25–36.

Burton, J., Butcher, F., Whatman, R., McLeod, A., Graham, S., Rajan, R., Adams, M., Bridge, M., Hill, R. & Jahri, R. 2002. Evaluating the Social and Economic Consequences of Workplace Injury and Illness. Proceedings of the Australasian Evaluation Society (AES) International Conference, October/November 2002, Wollongong, Australia. http://www.aes.asn.au/conferences/2002/PAPERS/Rajan.pdf. Accessed on 20 June 2012.

Büttcher, S., Clarke, C.L.A. & Cormack, G.V. 2010. Information Retrieval: Implementing and Evaluating Search Engines. MIT Press, Cambridge (Mass.), 606 p.

BS 18004. 2008. Guide to achieving effective occupational health and safety performance. British Standards Institution, 143 p.

Camerino, D., Estryn-Behar, M., Conway, P.M., van Der Heijden, B.I.J.M. & Hasselhorn, H-M. 2008. Work-related factors and violence among nursing staff in the European NEXT study: A longitudinal cohort study. International Journal of Nursing Studies 45, 35–50.

Cham, R. & Redfern, M.S. 2002. Changes in gait when anticipating slippery floors. Gait and Posture 15, 159–171.

Chappell, D. & Di Martino, V. 2006. Violence at work. International Labour Office, Geneva, 360 p.

Chau, N., Wild, P., Dehaene, D., Benamghar, L., Mur, J.M. & Touron, C. 2010. Roles of age, length of service and job in work-related injury: A prospective study of 446 120 person-years in railway workers. Occupational and Environmental Medicine 67, 147–153.

Chi, C-F., Chang, T-C. & Ting, H-I. 2005. Accident patterns and prevention measures for fatal occupational falls in the construction industry. Applied Ergonomics 36, 391–400.

CIETT (International Confederation of Private Employment Agencies). 2009. The agency work industry around the world: Main statistics, 2009 Edition. CIETT, Brussels, 64 p. http://www.ciett.org/fileadmin/templates/ciett/docs/Agency_work_industry_around_the_world_-_2009_Edition.pdf. Accessed on 4 June 2012.

CIETT. 2012. The agency work industry around the world: Main statistics, 2012 Edition. CIETT, Brussels. 48 p. http://www.ciett.org/fileadmin/templates/ciett/docs/Stats/Ciett_econ_report_2012_final.pdf. Accessed on 4 June 2012.

Corti, L. 2003. Archival research. In: Lewis-Beck, M.S., Bryman, A. & Liao, T.F. (Eds.). The SAGE encyclopedia of social science research methods. Sage Publications, Thousand Oaks (Calif.), pp. 20-21. http://www.sage-ereference.com/view/socialscience/n20.xml?result=20&q=. Accessed on 30 April 2012.

Courtney, T.K., Sorock, G.S., Manning, D.P., Collins, J.W. & Holbein-Jenny. M. 2001. Occupational slip, trip, and fall-related injuries – can the contribution of slipperiness be isolated? Ergonomics 44, 1118–1137.

Creswell, J.W. 2009. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. Sage, Los Angeles, 260 p.

Decker, L., Houser, J.J., Noble, J.M., Karst, G.M. & Stergiou, N. 2009. The effects of shoe traction and obstacle height on lower extremity coordination dynamics during walking. Applied Ergonomics 40, 895–903.

Dembe, A.E. 2001. The social consequences of occupational injuries and illnesses. American Journal of Industrial Medicine 40, 403–417.

Eisenhardt, K.M. 1989. Building theories from case study research. The Academy of Management Review 14, 532–550.

Eisenhardt, K.M. & Graebner, M.E. 2007. Theory building from cases: Opportunities and challenges. Academy of Management Journal 50, 25–32.

Eriksson, P. & Koistinen, K. 2005. Monenlainen tapaustutkimus (in Finnish with English abstract). National Consumer Research Centre, Helsinki, 49 p.

EU-OSHA. 2002a. New trends in accident prevention due to the changing world of work. Office for Official Publications of the European Communities, Luxembourg, 35 p. http://osha.europa.eu/en/publications/reports/208. Accessed on 6 July 2012.

EU-OSHA. 2002b. Research on changing world of work. Office for Official Publications of the European Communities, Luxembourg, 95 p. http://osha.europa.eu/en/publications/reports/205. Accessed on 17 June 2012.

EU-OSHA. 2005. Expert forecast on emerging physical risks related to occupational safety and health. Office for Official Publications of the European Communities, Luxembourg, 82 p. http://osha.europa.eu/en/publications/reports/6805478. Accessed on 18 June 2012.

EU-OSHA. 2007. Expert forecast on emerging psychosocial risks related to occupational safety and health. Office for Official Publications of the European Communities, Luxembourg, 126 p. http://osha.europa.eu/en/publications/reports/7807118/. Accessed on 18 June 2012.

EU-OSHA. 2008. Hyvän työsuojelun liiketoiminnalliset edut (in Finnish). Factsheet 77. http://osha.europa.eu/fi/publications/factsheets/77. Accessed on 14 June 2012.

EU-OSHA. 2010. Workplace violence and harassment: A European picture. Publications Office of the European Union, Luxembourg, 160 p. http://osha.europa.eu/en/publications/reports/violence-harassment-TERO09010ENC. Accessed on 7 June 2012.

EU-OSHA. 2012. European risk observatory. http://osha.europa.eu/en/riskobservatory/index_html. Accessed on 17 June 2012.

Eurofound. 2012. Fifth European Working Conditions Survey. Publications Office of the European Union, Luxembourg, 160p. http://www.eurofound.europa.eu/pubdocs/2011/82/en/1/EF1182EN.pdf. Accessed on 21 August 2012.

European Commission. 2001. European statistics on accidents at work (ESAW): Methodology: 2001 Edition. European Commission, Directorate-General for Employment and Social Affairs, 117 p. http://circa.europa.eu/Public/irc/dsis/hasaw/library?l=/statisstics_methodology/esaw_methodology/ke4202569_en_pdf/_EN_1.0_&a=d. Accessed on 23 June 2012.

European Commission. 2002. Adapting to change in work and society: A new Community strategy on health and safety at work 2002–2006. Communication from the Commission COM(2002) 118 final, Brussels, 18 p. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2002:0118:FIN:EN:PDF. Accessed on 14 June 2012.

European Commission. 2007. Improving quality and productivity at work: Community strategy 2007–2012 on health and safety at work. Communication from the Commission COM (2007) 62 final, Brussels, 15 p. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0062:FIN:en:PDF. Accessed on 14 June 2012.

European Commission. 2009. Causes and circumstances of accidents at work in the EU. Office for Official Publications of the European Communities, Luxembourg, 231 p. http://circa.europa.eu/Public/irc/dsis/hasaw/library?l=/statisstics_methodology/circumstances_accidents/_EN_1.0_&a=d. Accessed on 9 July 2012.

Eurostat. 2010. Health and safety at work in Europe (1999–2007): A statistical portrait. Office for Official Publications of the European Communities, Luxembourg, 97 p. http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-31-09-290/EN/KS-31-09-290-EN.PDF. Accessed on 7 June 2012.

Fabiano, B., Currò, F., Reverberi, A.P. & Pastorino, R. 2008. A statistical study on temporary work and occupational accidents: Specific risk factors and risk management strategies. Safety Science 46, 535–544.

FAII (Federation of Accident Insurance Institutions). 2002. Työtapaturmien Luokittelu : Opas Työpaikkojen Käyttöön (in Finnish) 2002. FAII and Ministry of Social Affairs and Health, 16 p.

FAII. 2004. Lakisääteisen tapaturmavakuutuksen ammattiluokitus 2004 (in Finnish). FAII, 79 p.

FAII. 2007a. Työtapaturmat ja ammattitaudit: Tilastovuodet 1996–2005 (in Finnish). FAII, Helsinki, 51 p.

FAII. 2007b. Vuosi 2006: Työtapaturmien määrä ja taajuus selvässä kasvussa (in Finnish). Press release 11.06.2007. FAII, Helsinki. http://www.tvl.fi/www/page/tvl_www_2523. Accessed on 4 June 2012.

FAII. 2009a. Työtapaturmat ja ammattitaudit: Tilastovuodet 1996–2007 (in Finnish). FAII, 56 p.

FAII. 2009b. Vuosi 2008: Työtapaturmien lukumäärä ja taajuus edelleen kasvussa (in Finnish). Press release 23.04.2009. FAII, Helsinki. http://www.tvl.fi/www/page/tvl_www_2523. Accessed on 4 June 2012.

FAII. 2010. Työtapaturmat: Tilastovuodet 2000–2009 (in Finnish). FAII, Helsinki, 48 p. http://tvl.fi/www/page/tvl_www_9539. Accessed on 10 June 2012.

FAII. 2011. Työtapaturmat: Tilastovuodet 2001–2010 (in Finnish). FAII, Helsinki, 44 p. http://tvl.fi/www/page/tvl_www_9536. Accessed on 10 June 2012.

FAII. 2012a. Ennakkoarvio: Työtapaturmien lukumäärä kasvoi edelleen vuonna 2011 (in Finnish). Press release 22.03.2012. FAII, Helsinki. http://www.tvl.fi/www/page/tvl_www_2523. Accessed on 4 June 2012.

FAII. 2012b Tapaturmapakin käyttö helpottunut (in Finnish). Tapaturmavakuutus 2/2012. FAII, Helsinki, pp. 4.

FAII. 2012c. Tapaturmavakuutuslaitosten liitto (in Finnish). http://www.tvl.fi/. Accessed on 25 June 2012.

Fernández-Muñiz, B., Montes-Peón, J. & Vázquez-Ordás, C. 2009. Relation between occupational safety management and firm performance. Safety Science 47, 980–991.

Fisher, B.S. & Gunnison, E. 2001. Violence in the workplace: Gender similarities and differences. Journal of Criminal Justice 29, 145–155.

Gao, C. & Abeysekera, J. 2004. A systems perspective of slip and fall accidents on icy and snowy surfaces. Ergonomics 47, 573–598.

Gao, C., Holmér, I. & Abeysekera, J. 2008. Slips and falls in a cold climate: Underfoot surface, footwear design and worker preferences for preventive measures. Applied Ergonomics 39, 385–391.

Giudici, P. 2003. Applied Data Mining: Statistical Methods for Business and Industry. Wiley, New York, 364 p.

Grönqvist, R. 1995. A dynamic method for assessing pedestrian slip resistance. Dissertation. Finnish Institute of Occupational Health, Helsinki, 83 p.

Grönqvist, R. & Hirvonen. M. 2009. Liukastumistapaturmat ja liukastumisten ehkäisy (in Finnish). Finnish Institute of Occupational Health, Helsinki, 2 p. http://www.ttl.fi/fi/tietokortit/Documents/Tietokortti%201.pdf. Accessed on 5 May 2012.

Grönqvist, R., Mattila, S. & Salminen, S. 2010. Työtapaturmat (in Finnish with English summary). In: Kauppinen, T., Hanhela, R., Kandolin, I., Karjalainen, A., Kasvio, A., Perkiö-Mäkelä, M., Priha, E., Toikkanen, J. & Vilkuksela, M. (Eds.). Työ ja terveys Suomessa 2009. Finnish Institute of Occupational Health, Helsinki. pp. 109–117.

Guadalupe, M. 2003. The hidden costs of fixed term contracts: The impact on work accidents. Labour Economics 10, 339–357.

Guidebook for temporary agency work. 2011. Ministry of Employment and the Economy, 24 p. http://www.tem.fi/index.phtml?C=97989&s=3441&xmid=4571. Accessed on 4 June 2012.

Haikonen, K. & Salminen, S. 2010. Työtapaturmat (in Finnish with English abstract). In Haikonen, K. & Lounamaa, A. (Eds.). Suomalaiset tapaturmien uhreina 2009: Kansallisen uhritutkimuksen tuloksia. National Institute of Health and Welfare, Helsinki. pp. 46–50. http://www.thl.fi/thl-client/pdfs/509a0a2b-aa80-452f-9642-8d2581848f55. Accessed on 21 August 2012.

Han, J., Kamber, M. & Pei, J. 2012. Data Mining: Concepts and Techniques. Morgan Kaufmann, Waltham (Mass.), 703 p.

Hand, D., Mannila, H. & Smyth, P., 2001. Principles of Data Mining. MIT Press, Cambridge (Mass.), 546 p.

Haslam, R.A., Hide, S.A., Gibb, A.G.F., Gyi, D.E., Pavitt, T., Atkinson, S. & Duff, A.R. 2005. Contributing factors in construction accidents. Applied Ergonomics 36, 401–415.

Hassenzahl, M. & Tractinsky, N. 2006, User experience – a research agenda. Behaviour & Information Technology 25, 91–97.

Heikkilä, T. 2005. Tilastollinen tutkimus (in Finnish). Edita, Helsinki, 328 p.

Heiskanen, M. 2005. Työpaikkaväkivalta suomessa (in Finnish with English summary). In: Sirén, R. & Honkatukia P. (Eds.). Suomalaiset Väkivallan uhreina: Tuloksia 1980–2003 Kansallisista Uhrihaastattelututkimuksista. National Research Institute of Legal Policy, Helsinki, pp. 39–56.

Hendricks, S.A., Jenkins, E.L. & Anderson, K.R. 2007. Trends in workplace homicides in the U.S., 1993–2002: A decade of decline. American Journal of Industrial Medicine 50, 316–325.

Hernanz, V. & Toharia, L. 2006. Do temporary contracts increase work accidents? A microeconometric comparison between Italy and Spain. Labour 20, 475–504.

Hintikka, N. 2007. Kunta-alan työtapaturmat ja ammattitaudit vuonna 2004 – Tilasto- ja vahinkokuvausaineiston hyödyntäminen (in Finnish). Tampere University of Technology, Tampere, 61 p.

Hintikka, N. 2008. TVL:n Tapaturmapakin käyttäjäkysely (in Finnish). Unpublished research report. Tampere University of Technology, Tampere 40 p.

Hintikka, N. & Saarela, K.L. 2006. Nuorten työtapaturmat (in Finnish). Tampere University of Technology, Tampere, 28 p.

Hintikka, N. & Saarela, K.L. 2007. Väkivaltatyötapaturmat Suomessa vuonna 2003 (in Finnish with English abstract). Työ ja ihminen 21, 345–363.

Hyytinen, T. 2010. Orientation and Guidance of Temporary Agency Workers. Proceedings of the International Conference on Industrial Engineering and Engineering Management IEEM, December 2010, Macao, China.

Hyytinen, T. & Nenonen, N. 2011. Malli vuokratyön työturvallisuuden ja –hyvinvoinnin varmistamiseen (in Finnish). Tampere University of Technology, Tampere, 35 p. http://www.ttk.fi/files/2174/Toimintamalli210611.pdf. Accessed on 30 April 2012.

Hämäläinen, P. 2010. Global estimates of occupational accidents and fatal work-related diseases. Dissertation. Tampere University of Technology, Tampere, 95 p.

Hämäläinen, P., Saarela, K.L. & Takala, J. 2009. Global trend according to estimated number of occupational accidents and fatal work-related diseases at region and country level. Journal of Safety Research 40, 125–139.

ILO (International Labour Organization). 2011. ILO Introductory Report: Global Trends and Challenges on Occupational Safety and Health. XIX World Congress on Safety and Health at Work, September 2011, Istanbul, Turkey / International Labour Office, Geneva, 64 p. www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/---safework/documents/publication/wcms_162662.pdf. Accessed on 10 July 2012.

ILO. 2012. Safety and health at work. http://www.ilo.org/global/topics/safety-and-health-at-work/lang--en/index.htm. Accessed on 13 June 2012.

Ingwersen, P. 1992. Information Retrieval Interaction. Taylor Graham, London, 246 p.

International standards for HCI and usability. 2012. Usability net. Tools and methods. http://www.usabilitynet.org/tools/r_international.htm. Accessed on 27 June 2012.

Isotalus, N. 2002. Työväkivalta ja sen torjunta kaupan alalla (in Finnish with English abstract). Dissertation. Finnish Institute of Occupational Health, Helsinki, 114 p.

Isotalus, N. & Saarela, K.L. 1999. Väkivaltatyötapaturmat Suomessa (in Finnish with English abstract). Työ ja ihminen 13, 137–149.

Jacinto, C. & Aspinwall, E. 2004. A survey on occupational accidents' reporting and registration systems in the European Union. Safety Science 42, 933–960.

Jacinto, C., Canoa, M. & Guedes Soares, C. 2009. Workplace and organisational factors in accident analysis within the food industry. Safety Science 47, 626–635.

Jacinto, C. & Guedes Soares, C. 2008. The added value of the new ESAW/Eurostat variables in accident analysis in the mining and quarrying industry. Journal of Safety Research 39, 631–644.

Jensen, O.C. & Laursen, L.H. 2011. Reduction of slips, trips and falls and better comfort by using new anti-slipping boots in fishing. International Journal of Injury Control and Safety Promotion 18, 85–87.

Johansson, A., Denk, T. & Svedung, I. 2009. The typology for allocations of societal risk and safety management tasks at the local government level – Framing the current directions in Sweden. Safety Science 47, 680–685.

Jordan, P.W. 1998. An Introduction to Usability. Taylor & Francis, London, 120 p.

Juntunen, P. & Leinonen, J. (Eds.). 2007. Exploring Finnish local and regional administration: Some current perspectives. University of Lapland, Rovaniemi, 212 p.

Järvinen R. & Lehtinen U. 2005. Services, e-Services and e-Service innovations - Combination of theoretical and practical knowledge. In: Hannula, M., Järvelin, A-M. & Seppä, M.

(Eds.). Frontiers of e-business research 2004. Tampere University of Technology and University of Tampere, Tampere. pp. 78–89. http://einsurance.ebrc.info/news/eBRF_article_2004_final_RJ.pdf. Accessed on 27 June 2012.

Kalliolinna, H. 2009. Kohti 0-työtapaturmaa: Opas kuntien ja seurakuntien turvallisuusjohtamisen tueksi (in Finnish). The Centre for Occupational Safety, 40 p.

Karjalainen, A., Saarela, K.L., Vänskä, J. & Notkola, V. 2000. Työtapaturmat (in Finnish). In: Paananen, S. (Ed.). Työn vaarat 1999. Statistics Finland, Helsinki, pp.22–32.

Kauppinen, T., Hanhela, R., Heikkilä, P., Kasvio, A., Lehtinen, S., Lindström, K., Toikkanen, J. & Tossavainen, A. (Eds.). 2007. Työ ja terveys Suomessa 2006 (in Finnish with English summary). Finnish Institute of Occupational Health, Helsinki, 462 p. http://www.ttl.fi/fi/verkkokirjat/tyo_ja_terveys_suomessa/Sivut/default.aspx. Accessed on 21 August 2012.

Keller, B. & Seifert, H. 2005. Atypical employment and flexicurity. Management Revue 16, 304–323.

Kemmlert, K.. & Lundholm. L. 2001. Slips, trips and falls in different work groups – with reference to age and from a preventive perspective. Applied Ergonomics 32, 149–153.

Kirschenbaum, A., Oigenblick, L. & Goldberg, A.I. 2000. Wellbeing, work environment and work accidents. Social Science and Medicine 50, 631–639.

Kjellén, U. 2000. Prevention of Accidents through Experience Feedback. Taylor & Francis, London, 424 p.

Kostamo, L. 2009. Työvoiman vuokraus ja yksityinen työnvälitys Suomessa vuonna 2008 (in Finnish with English abstract). Ministry of Employment and the Economy, Helsinki. http://www.tem.fi/files/24240/Tyovoiman_vuokraus_ja_yksityinen_tyonvalitys_Suomessa_vuonna_2008.pdf. Accessed on 4 June 2012.

Krug, E.G., Dahlberg, L.L., Mercy, J.A., Zwi, A.B. & Lozano, R. (Eds.). 2002. World report on violence and health. World Health Organization, Geneva, 372 p. http://whqlibdoc.who.int/hq/2002/9241545615.pdf. Accessed on 21 August 2012.

Kukkonen, S. & Karmavalo, T. 2004. Työtapaturmakirja: Työtapaturmien ja ammattitautien korvaus- ja vakuutusasiat (in Finnish). Finnish Financial and Insurance Publishing Ltd, Helsinki, 221 p.

Laaksonen, M., Martikainen, P., Rahkonen, O. & Lahelma, E. 2008. Explanations for gender differences in sickness absence: Evidence from middle-aged municipal employees from Finland. Occupational and Environmental Medicine 65, 325–330.

Laflamme, L. & Menckel, E. 1995. Aging and occupational accidents: A review of the literature of the last three decades. Safety Science 21, 145–161.

Laine, M., Bamberg, J. & Jokinen, P. 2007. Tapaustutkimuksen käytäntö ja teoria (in Finnish). In: Laine, M., Bamberg, J. & Jokinen, P. (Eds.). Tapaustutkimuksen taito. Gaudeamus, Helsinki, pp. 9–38.

Law, E.L-C., Roto, V., Hassenzahl, M., Vermeeren, A.P.O.S. & Kort, J. 2009. Understanding, Scoping and Defining User eXperience: A Survey Approach. Proceedings of Human Factors in Computing Systems conference CHI, April 2009, Boston, MA, USA.

Leclercq, S. 2005. Prevention of so-called “accidents on the level” in occupational situations: A research project. Safety Science 43, 359–371.

Leclercq, S. & Thouy, S. 2004. Systemic analysis of so-called 'accidents on the level' in a multi trade company. Ergonomics 47, 1282–1300.

Leclercq, S., Thouy, S. & Rossignol, E. 2007. Progress in understanding processes underlying occupational accidents on the level based on case studies. Ergonomics 50, 59–79.

Lehto, A.-M. & Sutela, H. 2008. Työolojen kolme vuosikymmentä. Työolotutkimusten tuloksia 1977–2008 (in Finnish). Statistics Finland, Helsinki, 228 p.

Lipscomb, H.J., Glazner, J.E., Bondy, J., Guarini, K. & Lezotte, D. 2006. Injuries from slips and trips in construction. Applied Ergonomics 37, 267–274.

Lim, Y. & Sato, K. 2003. Scenarios for Usability Evaluation: Using Design Information Framework and a Task Analysis Approach. Proceedings of the Congress of the International Ergonomics Association IEA, August 2003, Seoul, Korea. http://www.id.iit.edu/media/cms_page_media/54/lim_sato_iea.pdf. Accessed on 30 April 2012.

Lin, Y-H., Chen, C-Y. & Luo, J-L. 2008. Gender and age distribution of occupational fatalities in Taiwan. Accident Analysis and Prevention 40, 1604–1610.

Lind, S. & Kivistö-Rahnasto, J. 2008. Utilization of external accident information in companies’ safety promotion. Case: Finnish metal and transportation industries. Safety Science 46, 802–814.

Lockhart, T.E., Grönqvist, R. & Chang, W-R. 2005. Prevention of fall-related accidents. Safety Science 43, 355–357.

Luukkonen, O. 2010. Työturvallisuuden edistäminen vuokratyössä ja yhteistyökäytännöt (in Finnish with English abstract). Master’s thesis. Tampere University of Technology, Tampere, 84 p.

Manka, M-L., Heikkilä-Tammi, K. & Vauhkonen, A. 2012. Työhyvinvointi ja tuloksellisuus: Henkilöstön arvoa kuvaavat tunnusluvut johtamisen tukena kunnassa (in Finnish). University of Tampere, Research and Education Centre Synergos, Tampere, 39 p. http://www.uta.fi/jkk/synergos/tyohyvinvointi/hakuopas_netti.pdf. Accessed on 9 June 2012.

Marttinen, J. & Raatikainen, J. 2009. Vuokratyövoimaselvitys: Yhteenveto (in Finnish). http://www.tyosuojelu.fi/upload/TiedoteVuokratyovoima18122009.pdf. Accessed on 4 June 2012.

Mayhew, C. 2002. Occupational violence in industrialized countries: Types, incidence patterns and ‘at risk’ groups of workers. In: Gill, M., Fisher, B., Vaughan, B. (Eds.). Violence at work: Causes, patterns and prevention. Willan, Cullompton, pp. 21–40.

McCall, B.P. & Horwitz, I.B. 2004. Workplace violence in Oregon: An analysis using workers’ compensation claims from 1990–1997. Journal of Occupational and Environmental Medicine 46, 357–366.

McGorry, R., DiDomenico, A. & Chang, C-C. 2010. The anatomy of a slip: Kinetic and kinematic characteristics of slip and non-slip matched trials. Applied Ergonomics 41, 41–46.

Meadow, C.T., Boyce, B.R. & Kraft, D.H. 2007. Text Information Retrieval Systems. Academic Press, Amsterdam, 371 p.

Mehta, C. & Theodore, N. 2006. Workplace safety in Atlanta's construction industry: Institutional failure in temporary staffing arrangements. Working USA: The Journal of Labor and Society 9, 59–77.

Merchant, J.A. & Lundell, J.A. 2001. Workplace violence intervention research workshop, April 5–7, 2000, Washington, DC. Background, rationale, and summary. American Journal of Preventive Medicine 20, 135–140.

Metsämuuronen, J. 2006. Metodologian perusteet ihmistieteissä (in Finnish). In: Metsämuuronen, J. (Ed.). Laadullisen tutkimuksen käsikirja. International Methelp, Helsinki, pp. 16–78.

Ministry of Employment and the Economy. 2012. Työvoiman käyttötapojen ja työn tekemisen muotojen muutostrendejä selvittävän ja kehittävän työryhmän väliraportti (in Finnish). Ministry of Employment and the Economy, Helsinki, 63 p. http://www.tem.fi/files/33054/TEMrap_16_2012.pdf. Accessed on 9 June 2012.

Ministry of Justice. 2008. Parisuhde- ja työpaikkaväkivalta ja pahoinpitelysäännökset (in Finnish). Ministry of Justice, Helsinki, 4p. http://www.om.fi/Satellite?blobtable=MungoBlobs&blobcol=urldata&SSURIapptype=BlobServer&SSURIcontainer=Default&SSURIsession=false&blobkey=id&blobheadervalue1=inline;%20filename=parisuhde-tyopaikkavakivalta-tr.pdf&SSURIsscontext=Satellite%20Server&blobwhere=1243790103517&blobheadername1=Content-Disposition&ssbinary=true&blobheader=application/pdf. Accessed on 23 May 2012.

Ministry of Social Affairs and Health. 2004. Occupational safety and health in Finland. Ministry of Social Affairs and Health, Tampere, 21 p. http://pre20090115.stm.fi/hm1101115401134/passthru.pdf. Accessed on 30 April 2012.

Ministry of Social Affairs and Health. 2008. Työsuojelustrategian seurantaraportti 1998–2007 (in Finnish with English summary). Ministry of Social Affairs and Health, Helsinki, 64 p. http://www.stm.fi/c/document_library/get_file?folderId=39503&name=DLFE-6316.pdf. Accessed on 14 June 2012.

Ministry of Social Affairs and Health. 2010a. Occupational safety and health in Finland. Ministry of Social Affairs and Health, Helsinki 33 p. http://www.stm.fi/c/document_library/get_file?folderId=1087418&name=DLFE-13602.pdf. Accessed on 30 April 2012.

Ministry of Social Affairs and Health. 2010b. Työsuojelustrategian neljäs seurantaraportti (in Finnish with English summary). Ministry of Social Affairs and Health, Helsinki, 38 p. http://www.stm.fi/c/document_library/get_file?folderId=2765155&name=DLFE-15357.pdf. Accessed on 14 June 2012.

Ministry of Social Affairs and Health. 2011a. Policies for the work environment and well-being at work until 2020. Ministry of Social Affairs and Health, Helsinki, 11 p. http://www.stm.fi/julkaisut/nayta/-/_julkaisu/1566807#en. Accessed on 14 June 2012.

Ministry of Social Affairs and Health. 2011b. Socially sustainable Finland 2020. Strategy for social and health policy. Ministry of Social Affairs and Health, Helsinki, 24 p. http://www.stm.fi/julkaisut/nayta/-/_julkaisu/1550874. Accessed on 14 June 2012.

Morgan, D.L. 2007. Paradigms lost and pragmatism regained: Methodological implications of combining qualitative and quantitative methods. Journal of Mixed Methods Research 1, 48–76.

Morris, J.A. 1999. Injury experience of temporary workers in manufacturing setting. Factors that increase vulnerability. Official Journal of the American Association of Occupational Health Nurses 47, 470–478.

Nenonen, N. 2012. Kunta-alan työtapaturmat sekä ammattitaudit ja ammattitautiepäilyt vuonna 2009 (in Finnish). The Centre for Occupational Safety, 65 p. http://www.ttk.fi/files/2441/Kunta_alan_tyotapaturmat_2009.pdf. Accessed on 4 May 2012.

Nielsen, J. 1993. Usability Engineering. Academic Press, San Diego (CA), 362 p.

Nilsen, P., Bourne, M. & Coggan, C. 2007a. Using local injury surveillance for community-based injury prevention: An analysis of Scandinavian WHO Safe Community prevention and Canadian Safe Community Foundation programmes. International Journal of Injury Control and Safety Promotion 14, 35–43.

Nilsen, P., Ekman, R., Stark Ekman, D., Ryen, L. & Lindqvist, K. 2007b. Effectiveness of community-based injury prevention: Long-term injury rate levels, changes, and trends for 14 Swedish WHO-designated safe communities. Accident Analysis and Prevention 39, 267–273.

Nola, A., Cattaneo, G., Maiocchi, A., Gariboldi, C., Rocchi, R., Cavallaro, S., Loreto, B., Lanfredini, L. & Bassino, P. 2001. Occupational accidents in temporary work. La Medicina Del Lavoro 92, 281–285.

Ollanketo, A. 2006. Työtapaturmailmoitusjärjestelmän laatutekijöitä – ESAW-luokittelun kenttäkokemuksia ja muuttujapolkujen tarkastelua (in Finnish with English abstract). Master's thesis. University of Oulu, Oulu, 97 p.

OSF (Official Statistics of Finland). 2006. Accident at work. Statistics Finland, Helsinki, 123 p.

OSF. 2012a. Labour force survey. Statistics Finland, Helsinki. http://stat.fi/til/tyti/index_en.html. Accessed on 26 April 2012.

OSF. 2012b. Labour force survey, Employment and unemployment in 2011, Appendix table 35, Employees doing temporary agency work by sex and age in 2009–2011. Statistics Finland, Helsinki. http://www.stat.fi/til/tyti/2011/13/tyti_2011_13_2012-03-09_tau_035_en.html. Accessed on 9 June 2012.

OSF. 2012c. Local government sector wages and salaries. Statistics Finland, Helsinki. http://stat.fi/til/ksp/index_en.html. Accessed on 26 April 2012.

OSF. 2012d. Occupational accident statistics: Two out of three commuting accidents occur to women. Statistics Finland, Helsinki. http://stat.fi/til/ttap/2010/ttap_2010_2012-05-24_tie_001_fi.html. Accessed on 15 June 2012.

OSF. 2012e. Työtapaturmat: Palkansaajille työpaikalla vuonna 2010 sattuneet tapaturmat (in Finnish). Statistics Finland, Helsinki. http://stat.fi/til/ttap/2010/ttap_2010_2012-05-24_kat_001_fi.html. Accessed on 15 June 2012.

Oulasvirta, A. 2011. Mitä on ihmisen ja tietokoneen vuorovaikutus (in Finnish)? In: Oulasvirta, A. (Ed.). Ihmisen ja tietokoneen vuorovaikutus. Gaudeamus, Helsinki, 320 p.

Parent-Thirion, A., Macías, E F., Hurley, J. & Vermeylen, G. 2007. Fourth European Working Conditions Survey. Office for Official Publications of the European Communities, Luxembourg, 139 p. http://www.eurofound.europa.eu/pubdocs/2006/98/en/2/ef0698en.pdf. Accessed on 2 May 2012.

Patton, M.Q. 1990. Qualitative Research and Evaluation Methods. Sage, Newbury Park, 532 p.

Peek-Asa, C., Howard, J., Vargas, L. & Kraus, J.F. 1997. Incidence of non-fatal workplace assault injuries determined from employer's reports in California. Journal of Occupational and Environmental Medicine 39, 44–50.

Peek-Asa, C., Runyan, C.W. & Zwerling, C. 2001. The role of surveillance and evaluation research in the reduction of violence against workers. American Journal of Preventive Medicine 20, 141–148.

Pekka, T., Kaartinen, R. & Forma, P. 2011. Kuntajohtajien työhyvinvointi 2011 (in Finnish). The Local Government Pensions Institution, Helsinki, 40 p. http://www.google.fi/url?sa=t&rct=j&q=kuntajohtajien%20ty%C3%B6hyvinvointi%202011%20&source=web&cd=1&cad=rja&ved=0CEMQFjAA&url=https%3A%2F%2Fwww.keva.fi%2Ffi%2Fjulkaisut%2FSivut%2Ftutkimusjulkaisut.aspx%3FfileName%3Dkuntajohtajien_tyohyvinvointi_2011.pdf&ei=KLgzUKHIH_GP4gT-6ICIAQ&usg=AFQjCNGCnm5hT4gFB0CTKZa2oVgn6GyLhQ. Accessed on 21 August 2012.

Persona, A., Battini, D., Faccio, M., Bevilacqua, M. & Ciarapica, F.E. 2006. Classification of occupational injury cases using the regression tree approach. International Journal of Reliability, Quality and Safety Engineering 13, 171–191.

Pietiläinen, R. 2008. Työturvallisuuslaki: Soveltamisopas (in Finnish). Finnish Institute of Occupational Health, Helsinki, 149 p.

Piha, K., Martikainen, P., Rahkonen, O., Roos, E. & Lahelma, E. 2007. Trends in socioeconomic differences in sickness absence among Finnish municipal employees 1990–99. Scandinavian Journal of Public Health 35, 348–255.

Piispa, M. & Hulkko, L. 2010. Työväkivallan riskiammatit (in Finnish). The Centre for Occupational Safety, 20 p. http://www.ttk.fi/files/1527/Tyovakivallan_riskiammatit_raportti_1_2010_TTK.pdf. Accessed on 23 May 2012.

Platt, J. 1992. "Case study" in American methodological thought. Current Sociology 40, 17–48.

Preece, J., Rogers, Y. & Sharp, H. 2002. Interaction Design: Beyond Human–Computer Interaction. John Wiley, New York, 519 p.

Quinlan, M., Mayhew, C. & Bohle, P. 2001. The global expansion of precarious employment, work disorganization, and consequences for occupational health: A review of recent research. International Journal of Health Services 31, 335–414.

Quinlan, M., Muntaner, C., Solar, O., Vergara, M., Eijkemans, G., Santana, V., Chung, H., Castedo, A. & Benach, J. 2010. Policies and interventions on employment relations and health inequalities. International Journal of Health Services 40, 297–307.

Rajala, H-K. & Väyrynen, S. 2010. Constructing "core stories" for contributing practical safety actions in industrial units. Safety Science 48, 1393–1401.

Rauscher, K.J. 2008. Workplace violence against adolescent workers in the US. American Journal of Industrial Medicine 51, 539–544.

Rautio, S. (Ed.). 2006. The world of Finnish local and regional authorities. The Association of Finnish Local and Regional Authorities, Helsinki, 48 p.

Redfern, M.S., Cham, R., Gielo-Perczak, K., Grönqvist, R., Hirvonen, M., Lanshammar, H., Marpet, M., Pai, C.Y. & Powers, C. 2001. Biomechanics of slips. Ergonomics 44, 1138–1166.

Robson, C. 2002. Real World Research: A Resource for Social Scientists and Practitioner-Researchers. Blackwell, Oxford, 599 p.

Rohrer, C. 2008. When to use which user experience research methods? Useit.com. http://www.useit.com/alertbox/user-research-methods.html. Accessed on 5 December 2012.

Ronkainen, S., Pehkonen, L., Lindblom-Ylänne, S. & Paavilainen, E. 2011. Tutkimuksen voimasanat (in Finnish). WSOYpro, Helsinki, 198 p.

Rosson, M.B. & Carroll, J.M. 2008. Scenario-based design. In: Sears, A. & Jacko, J.A. (Eds.). The human–computer interaction handbook: Fundamentals, evolving technologies and emerging applications. Lawrence Erlbaum Associates, New York, pp. 1032–1050.

Runyan, C.W. 2001. Moving forward with research on the prevention of violence against workers. American Journal of Preventative Medicine 20, 169–172.

Räsänen, T. 2007. Management of occupational safety and health information in Finnish production companies. Dissertation. Finnish Institute of Occupational Health, Helsinki, 169 p.

Saarela, K.L., Nenonen, N. & Hyytinen, T. 2012. Development of a Model for Ensuring Health, Safety and Well-Being in Temporary Agency Work. Proceedings of the International Conference on Occupational Risk Prevention ORP, May 2012, Bilbao, Spain.

Saha, A., Kulkarni, PK., Chaudhuri, R. & Saiyed, H. 2005. Occupational injuries: Is job security a factor? Indian Journal of Medical Sciences 59, 375–381.

Saha, A., Ramnath, T., Chaudhuri, R.N. & Saiyed, H.N. 2004. An accident-risk assessment study of temporary piece rated workers. Industrial Health 42, 240–245.

Salminen, S. 1997. Violence in the workplaces in Finland. Journal of Safety Research 28, 123–131.

Salminen, S. 2004a. Have young workers more injuries than older ones? An international literature review. Journal of Safety Research 35, 513–521.

Salminen, S. 2004b. Tapaturmavaarat (In Finnish with English summary). In: Kauppinen, T., Hanhela, R., Heikkilä, P., Lehtinen, S., Lindström, K., Toikkanen, J. & Tossavainen, A. (Eds.). Työ ja Terveys Suomessa 2003. Finnish Institute of Occupational Health, Helsinki, pp. 47–51.

Salminen, S. 2010. Tapaturmat ja fyysinen väkivalta (in Finnish). In: Perkiö-Mäkelä, M., Hirvonen, M., Elo, A-L., Kandolin, I., Kauppinen, K., Kauppinen, T., Ketola, R. & Viluksela, M. Työ ja terveys –haastattelututkimus 2009. Finnish Institute of Occupational Health, Helsinki, p. 14. http://www.ttl.fi/fi/verkkokirjat/tyo_ja_terveys_suomessa/Documents/tyo_ja_terveys_haastattelututkimus_2009.pdf. Accessed on 8 June 2012.

Salminen, S., Ruotsala, R., Vorne, J. & Saari, J. 2007. Työturvallisuuslain toimeenpano työpaikoilla: Selvitys uudistetun työturvallisuuslain vaikutuksista työpaikkojen työturvallisuustoimintaan (in Finnish with English summary). Ministry of Social Affairs and Health, Helsinki, 119 p. http://pre20090115.stm.fi/el1174044963473/passthru.pdf. Accessed on 13 June 2012.

Saloniemi, A. & Salminen, S. 2010. Do fixed-term workers have a higher injury rate? Safety Science 48, 693–697.

SFS-EN ISO 9241-11. 2000. Ergonomic requirements for office work with visual display terminals (VDTs) – Part 11: Guidance on usability. Finnish Standards Association, Helsinki, 43 p.

SFS-EN ISO 9241-210. 2010. Ergonomics of human-system interaction – Part 210: Human-centred design for interactive systems. Finnish Standards Association, Helsinki, 65 p.

Sinkkonen, I., Kuoppala, H., Parkkinen, J., & Vastamäki, R. 2006. Käytettävyyden psykologia (in Finnish). Edita Oy, Helsinki, 254 p. http://www.adage.fi/uploads/pdf/Kaytettavyyden_psykologia.pdf. Accessed on 21 May 2012.

Siiki, p., Häkkinen, K., Hollmén, J., Liivala, R., Lanttola, P., Auvinen, E., Ilveskivi, P., Mäkinen, A-M. & Valtonen, S. 2009. 40 p. Työturvallisuussäännöksiä valmistelevalle neuvottelukunnalle (in Finnish). http://www.pardia.fi/@Bin/872200/Vakivallan+uhka+Final_240309.pdf. Accessed on 23 May 2012.

Sirén, R., Aaltonen, M. & Kääriäinen, J. 2010. Suomalaisten väkivaltakokemukset 1980–2009 (in Finnish). National Research Institute of Legal Policy, Helsinki, 42 p. http://www.optula.om.fi/Etusivu/Julkaisut/Kriminologisentutkimusyksikonjulkaisut/1266334264756. Accessed on 21 August 2012.

Sirén, R., Kivivuori, J., Kääriäinen, J. & Aaltonen, M. 2007. Suomalaisten kokema väkivalta 1980-2006 (in Finnish), National Research Institute of Legal Policy, Helsinki, 34 p. http://www.optula.om.fi/1210772814270. Accessed on 21 August 2012.

Statistics Finland. 2012. Classification of occupations 2001. Statistics Finland, Helsinki. http://stat.fi/meta/luokitukset/ammatti/001-2001/index_en.html. Accessed on 5 December 2012.

Statistics Finland. 2012. Standard Industrial Classification 2002. Statistics Finland, Helsinki. http://stat.fi/meta/luokitukset/toimiala/001-2002/index_en.html. Accessed on 5 December 2012.

Storrie, D. 2002. Temporary agency work in the European Union. Office for Official Publications of the European Communities, Luxembourg, 110 p. http://www.eurofound.europa.eu/pubdocs/2002/02/en/1/ef0202en.pdf. Accessed on 3 May 2012.

Strömgren, M. & Andersson, R. 2010. The usage of safety management tools in Swedish municipalities. Safety Science 48, 288–295.

Tervakari, A-M., Silius, K., Huhtamäki, J., Kaikuvuo, I. & Isännäinen, V. 2007. Vakuutuspalveluiden verkkosivustojen käyttökelpoisuuden arvioiminen (in Finnish). Tampere University of Technology, Hypermedia Laboratory, 81 p.

http://einsurance.ebrc.info/news/Tervakari_et_al-eInsurance2-tutkimusraportti_2007.pdf. Accessed on 30 April 2012.

The Association of Finnish Local and Regional Authorities. 2012a. Local authorities. http://www.localfinland.fi/en/authorities/Pages/default.aspx. Accessed on 3 June 2012.

The Association of Finnish Local and Regional Authorities. 2012b. Municipal personnel. http://www.localfinland.fi/en/authorities/municipal-personnel/Pages/default.aspx. Accessed on 3 June 2012.

The Finnish public sector as employer. 2006. Ministry of Finance, Commission for Local Authority Employers, Helsinki, 19 p. http://www.vm.fi/vm/en/04_publications_and_documents/01_publications/06_state_employers_office/ho_eupj_enkku_netti.pdf. Accessed on 3 June 2012.

Tucker, D. 2002. 'Precarious' non-standard employment – A review of the literature. Labour Market Policy Group, Department of Labour, Wellington, 78 p. http://www.dol.govt.nz/pdfs/PrecariousNSWorkLitReview.pdf. Accessed on 4 June 2012.

USDL. 2009. Workplace injuries and illnesses – 2008. Bureau of Labor Statistics, Washington, DC, 28 p. http://www.bls.gov/news.release/archives/osh_10292009.pdf. Accessed on 3 June 2012.

USDL. 2010a. Nonfatal occupational injuries and illnesses requiring days away from work, 2008. Bureau of Labor Statistics, Washington, DC, 29 p. http://www.bls.gov/news.release/archives/osh2_02242010.pdf. Accessed on 6 June 2012.

USDL. 2010b. Nonfatal occupational injuries and illnesses requiring days away from work, 2009. Bureau of Labor Statistics, Washington, DC, 37 p. http://www.bls.gov/news.release/archives/osh2_11092010.pdf. Accessed on 6 June 2012.

USDL. 2010c. Workplace injuries and illnesses – 2009. Bureau of Labor Statistics, Washington, DC, 28 p. http://www.bls.gov/news.release/archives/osh_10212010.pdf. Accessed on 3 June 2012.

USDL. 2011a. National census of fatal occupational injuries in 2010 (Preliminary results). Bureau of Labor Statistics, Washington, DC, 13 p. http://www.bls.gov/news.release/pdf/cfoi.pdf. Accessed on 7 June 2012.

USDL. 2011b. Nonfatal occupational injuries and illnesses requiring days away from work, 2010. Bureau of Labor Statistics, Washington, DC, 32 p. http://www.bls.gov/news.release/pdf/osh2.pdf. Accessed on 6 June 2012.

USDL. 2011c. Workplace injuries and illnesses – 2010. Bureau of Labor Statistics, Washington, DC, 29 p http://www.bls.gov/news.release/pdf/osh.pdf. Accessed on 3 June 2012.

Vartiainen, M., Leskinen, T., Grönqvist, R., Forsman, P., Plaketti, P., Nieminen, K., Toppila, E. & Takala, E.P. 2009. Liukuesteiden ja nastakenkien tehokkuus kaatumisten ehkäisyssä: laboratoriotutkimus jäällä (in Finnish with English abstract). Finnish Institute of Occupational Health, Helsinki, 29 p. http://www.ttl.fi/fi/tyoturvallisuus_ja_riskien_hallinta/tapaturmien_ehkaisy/tutkimuksia_tyoturvallisuudesta/Documents/liukueste_loppuraportti.pdf. Accessed on 2 June 2012.

Viitasara, E. 2004. Violence in caring: Risk factors, outcomes and support. Dissertation. National Institute for Working Life, Stockholm, 67 p.

Vingård, E., Lindberg, P., Josephson, M., Voss, M., Heijbel, B., Alfredsson, L., … & Nygren, Å. 2005. Long-term sicklisting among women in the public sector and its associations with age, social situation, lifestyle, and work factors: A three-year follow-up study. Scandinavian Journal of Public Health 33, 370–375.

Virtanen, M., Kivimäki, M., Joensuu, M., Virtanen, P., Elovainio, M. & Vahtera, J. 2005. Temporary employment and health: A review. International Journal of Epidemiology 34, 610–622.

Voss, M., Stark, S., Alfredsson, L., Vingård, E. & Josephson, M. 2008. Comparisons of self-reported and register data on sickness absence among public employees in Sweden. Occupational and Environmental Medicine 65, 61–67.

Väisänen, J. 2010. The potential and usage of search engine marketing (SEM) in Finnish SMEs. Dissertation. Tampere University of Technology, Tampere, 196 p.

Väyrynen, S., Nevala, N. & Päivinen, M. 2004. Ergonomia ja käytettävyys suunnittelussa (in Finnish). Teknologiainfo Teknova, Helsinki, 336 p.

Wang, H-S., Yeh, W-C., Huang, P-C. & Chang, W-W. 2009. Using association rules and particle swarm optimization approach for part change. Expert Systems with Applications 36, 8178–8184.

Wassel, J.T. 2009. Workplace violence intervention effectiveness: A systematic literature review. Safety Science 47, 1049–1055.

Welander, G., Svanström, L. & Ekman, R. 2000. Safety promotion: An introduction. Karolinska Institutet, Department of Public Health Sciences, Division of Social Medicine, Stockholm, 134 p.

WHO. 1998. Safety and Safety Promotion: Conceptual and Operational Aspects. WHO Collaborating Center on Community Safety Promotion, Stockholm, 24 p. http://www.phs.ki.se/csp/pdf/Publications/safety_promotion1998%20.pdf. Accessed on 5 July 2012.

Wynne, R., Clarkin, N., Cox T. & Griffiths, A. 1997. Guidance on the prevention of violence at work. European Commission, DG V, Luxembourg 51 p.

Yin, R.K. 2003. Case Study Research: Design and Methods. Sage Publications, Thousand Oaks London, 181 p.

Yoon, H. & Lockhart, T.E. 2006. Nonfatal occupational injuries associated with slips and falls in the United States. International Journal of Industrial Ergonomics 36, 83–92.

Zviran, M., Pliskin, N. & Levin, R. 2005. Measuring user satisfaction and perceived usefulness in the ERP context. Journal of Computer Information Systems 3, 43–52.

Appendix A: The FAII database user questionnaire
(Translation from Finnish)

THE FAII DATABASE USER QUESTIONNAIRE

GENERAL QUESTIONS RELATED TO THE FAII DATABASE WEB-APPLICATION USE

Have you participated in the FAII database web-application user training?

- □ Yes
- □ No

How often do you use the FAII database web application?

- □ Daily
- □ Weekly
- □ Monthly
- □ A couple of times a year
- □ More sparsely
- □ Not at all

Choose three of the most important reasons in order of importance as to why you have not used the FAII database web application (at all or more often)

	The most important	Second most important	Third most important
I have not needed the application	□	□	□
Someone else is using the application for me	□	□	□
I have not remembered that I am able to use the application	□	□	□
The information I have needed has not been found from the application	□	□	□
I have not known how to use the application	□	□	□
It has been difficult to use the application	□	□	□
The application has not functioned when I wanted to use it	□	□	□
Other reason	□	□	□

If you chose other reason, what other reason have you had?

For what purpose do you usually retrieve information from the FAII database web application?

Appendix A: The FAII database user questionnaire
(Translation from Finnish)

USER EXPERIENCE

How satisfied are you with the following statements concerning the FAII database web application?
(1=Very dissatisfied, …, 5=Very satisfied)
Use the alternative "I don't know" only if you do not have experience with the statement in question

	1	2	3	4	5	Don't know
Adequacy of the training to be able to use the application	□	□	□	□	□	□
Pleasantness of the application use	□	□	□	□	□	□
Content of the application	□	□	□	□	□	□
Ease of use of the application	□	□	□	□	□	□
Operating speed of the application	□	□	□	□	□	□
Versatility of the information-retrieval possibilities in the application	□	□	□	□	□	□
Graphical presentation of the information-retrieval results in the application	□	□	□	□	□	□
Usefulness of the error messages for problems related to use	□	□	□	□	□	□
Clarity of the visual appearance of the application	□	□	□	□	□	□
Readability of the text in the application	□	□	□	□	□	□
Readability of the icons in the application	□	□	□	□	□	□
Placement of the icons and functions in the application	□	□	□	□	□	□

What is your opinion on the following statements concerning the FAII database web application?
(1=Strongly disagree, …, 5=Strongly agree)
Use the alternative "I don't know" only if you do not have experience with the statement in question

	1	2	3	4	5	Don't know
It is easy to learn how to retrieve information in the application	□	□	□	□	□	□
The operating time of the application is too short	□	□	□	□	□	□
There are too many disruptive interruptions in the functioning of the application	□	□	□	□	□	□
It is easy to find the desired functions in the application	□	□	□	□	□	□
It is difficult to navigate between different functions	□	□	□	□	□	□
There are sufficient predefined information-retrieval alternatives in the application	□	□	□	□	□	□
Predefined information-retrieval alternatives are well suitable for my purposes	□	□	□	□	□	□
It is difficult to understand the meaning of the classification variables used in the application	□	□	□	□	□	□
It is easy to form tables/reports in the application	□	□	□	□	□	□
It is easy to get help in application use from the administrators	□	□	□	□	□	□
It is difficult to use the application	□	□	□	□	□	□
The appearance of the application is disorganised	□	□	□	□	□	□
There is enough additional material available on the info page	□	□	□	□	□	□
The content of the information I have retrieved from the application has met my expectations	□	□	□	□	□	□
The abbreviations used for the classification variables are useful	□	□	□	□	□	□
There are enough instructions available on application use	□	□	□	□	□	□

Appendix A: The FAII database user questionnaire
(Translation from Finnish)

What kind of information that you desired were you not able to retrieve from the FAII database web application?

Have you had problems in using the FAII database web application?

- □ Not at all
- □ Rarely
- □ Often

What kind of problems have you had when using the FAII database web application?

DEVELOPMENT

How should the FAII database web application be developed?

BACKGROUND INFORMATION

Gender

- □ Male
- □ Female

Year of birth _____

Organisation where you are working at the moment?

- □ Occupational Safety and Health Department of the Ministry of Social Affairs and Health
- □ Occupational Safety and Health Inspectorates
- □ Labour market organisation
- □ The Centre For Occupational Safety
- □ Research or education institution
- □ Insurance company
- □ Other organisation, if so, what? _____

How often do you use search engines (for example Internet search machines, library databases)?

- □ Daily
- □ Weekly
- □ Less frequently
- □ Not at all

Appendix B: The Cronbach's alphas of usefulness characteristic variables created and statements included in each variable

Usefulness characteristics	**Statements**	**Cronbach's alpha**
Appearance	Clarity of the visual appearance of the application Readability of the text in the application Readability of the icons in the application Placement of the icons and functions in the application The appearance of the application is disorganised	0.80
Content	Content of the application Content of the information I have retrieved from the application has met my expectations	0.69
General user experience	Pleasantness of the application use Ease of use of the application It is easy to find desired functions in the application It is difficult to navigate between different functions It is difficult to use the application	0.82
Guidance and directions	Adequacy of the training to be able to use the application Usefulness of the error messages in problems related to use It is easy to get help for application use from the administrators There is enough additional material available on the info page There are enough instructions available on application use	0.62
Information retrieval	Versatility of the information-retrieval possibilities in the application It is easy to learn how to retrieve information in the application There are sufficient predefined information-retrieval alternatives in the application Predefined information-retrieval alternatives are well suitable for my purposes It is easy to form tables/reports in the application	0.76
Presentation of search results	Graphical presentation of the information-retrieval results in the application	-
Technical functionality	Operating speed of the application Operating time of the application is too short There are too many disruptive interruptions in the functioning of the application	0.63
Use of classification variables	It is difficult to understand the meaning of the classification variables used in the application The abbreviations used for the classification variables are useful	0.51

Appendix C: The ESAW variables and categories related to circumstances, causes and consequences of accidents at work used in the accident analysis

Variable	Categories
Working Process (Victim's main type of work at the time of the accident)	11–19 Production, manufacturing, processing, storing 21–29 Excavation, construction, repair, demolition 31–39 Agricultural type work, forestry, horticulture, fish farming and work with live animals 41–49 Providing services to enterprise and/or to the general public; intellectual activity 51–59 Other work related to tasks coded under 10–40 61–69 Movement, sport and artistic activity 99 Other working processes
Specific Physical Activity (Victim's activity immediately before the accident)	10 Operating machinery 20 Work with hand-held tools 30 Driving/being on board a means of transport or handling equipment 40 Handling of objects 50 Carrying by hand 60 Movement 70 Presence 99 Other specific physical activities
Deviation (The last event deviating from normality and leading to the accident)	10 Electrical problems, explosion, fire 20 Overflow, overturn, leak, flow, vaporisation, emission 30 Breakage, bursting, splitting, slipping, fall, collapse of material agent 40 Loss of control of machine, means of transport, or handling equipment, hand-held tool, object, animal 50 Slipping or stumbling – with fall, fall of persons 60 Body movement without physical stress 70 Body movement under or with physical stress 80 Shock, fright, violence, aggression, threat, presence 99 Other deviations
Contact – Mode of Injury (The contact that injured the victim, describes how the victim was hurt)	11–19 Electrical voltage, temperature, hazardous substances 20 Drowned, buried, enveloped 30 Impact with or against a stationary object (the victim is in motion) 40 Struck by object in motion, collision 50 Sharp, pointed, rough or coarse material agent 60 Trapped, crushed etc. 70 Physical or mental stress 80 Bite, kick etc. (by animal or human) 99 Other contact – modes of injury 11–19 Electrical voltage, temperature, hazardous substances
Material Agent of Contact – Mode of Injury (Object, tool or instrument with which the injured was contacted or the psychological mode of injury)	1100–1399 Buildings, structures, surfaces 2100–2899 Tools and machines 3100–3200 Transportation vehicles 4100–4400 Material, supplies and equipment 5100–5300 Others (living organisms and human beings, bulk waste, physical phenomena and natural elements) 9999 Other material agents

Appendix C: The ESAW variables and categories related to circumstances, causes and consequences of accidents at work used in the accident analysis

Type of Injury (Describes the physical consequences for the victim)	010 Wounds and superficial injuries 020 Bone fractures 030 Dislocations, sprains and strains 040 Traumatic amputations (loss of body parts) 050 Concussions and internal injuries 060 Burns, scalds and frostbite 070 Poisonings and infections 080 Drownings and asphyxiations 090 Effects of sound, vibration and pressure 100 Effects of temperature extremes, light, radiation 110 Shocks 120 Multiple injuries 999 Other types of injuries 010 Wounds and superficial injuries
Part of Body Injured	11–19 Head 21–29 Neck, inclusive of spine and vertebra in the neck 31–39 Back, including spine and vertebra in the back 41–49 Torso and organs 51–59 Upper extremities 61–69 Lower extremities 71–78 Whole body and multiple sites 99 Other parts of body injured

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