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Participatory Video-Assisted Evaluation of Truck Drivers' Work Outside Cab: Deliveries in Two Types of Transport

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Participatory Video-Assisted Evaluation of Truck Drivers' Work Outside Cab: Deliveries in Two Types of Transport

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The aim of this study was to identify risks and ergonomics discomfort during work of local and short haul delivery truck drivers outside a cab. The study used a video- and computer-based method (VIDAR). VIDAR is a participatory method identifying demanding work situations and their potential risks. The drivers' work was videoed and analysed by subjects and ergonomists. Delivery truck drivers should not be perceived as one group with equal risks because there were significant differences between the 2 types of transportation and specific types of risks. VIDAR produces visual material for risk management processes. VIDAR as a participatory approach stimulates active discussion about work-related risks and discomfort, and about possibilities for improvement. VIDAR may be also applied to work which comprises different working environments.

accident delivery transportation musculoskeletal disorder participative ergonomics
risk management safety management work system truck driver VIDAR method

1. INTRODUCTION

Undisturbed and safe delivery is a basic prerequisite for modern society [1]. Truck drivers' work includes static postures and vibration while driving, and strenuous physical work while working outside a cab. Several studies have shown that drivers are exposed to musculoskeletal disorders

resulting from both driving [2, 3, 4, 5] and physical work [6]. Musculoskeletal problems are strongly associated with morbidity and low retirement age in industry [4, 7].

Accident statistics are high like musculoskeletal problems statistics. According to the accident statistics prepared by Finnish Federation of Accident Insurance Institutions, only a small proportion of

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9602 accidents (8.9%) during work in the industry in 2006 occurred when the subject was driving [8]. Most accidents were related to specific physical activities such as movement outside a cab, maintenance, operations at different heights and manual materials handling (MMH). Similar perceptions have also been made by different researchers [9, 10, 11, 12, 13] and by different authorities [14, 15].

Combination of driving and strenuous work outside a cab is characteristic for local and short haul (L/SH) deliveries [11]. L/SH delivery companies employ a small number of employees [7, 15]. During their shifts, L/SH truck drivers have many deliveries, which are often scheduled for nights, early mornings and mornings [11, 15]. This is due to customers' wishes and demands, and to optimize different factors affecting transportation such as a just-in-time approach. L/SH truck drivers usually work alone in different working environments [15].

Salmoni, Cann, Grillin, et al. noticed that there were difficulties in specifying drivers' work and tasks [5]. Driving is only part of the daily routine. According to Hanowski, Wierwille, Gellatly, et al., the actual driving phase for L/SH drivers was ~33% of the working day [11]. Pekkala interviewed Finnish L/SH drivers and obtained similar results although the number of interviewees was low [16]. L/SH drivers' work is a combination of various work phases such as driving, loading, unloading, maintaining, MMH and moving material [11, 13]. The work outside a cab is performed at terminals or at customer's premises such as enclosures and buildings, public places and places that belong to external owners (buyer-deliverer-customer relationship) [17, 18]. There are some differences within the transportation sector, e.g., between different kinds of cargos or between L/SH distributions [11].

Kjellen emphasized that risk management succeeded only when the work and the tasks were known and identified [19]. Although the risks at L/SH work are well identified [5, 11, 13], the companies still seem to have clear deficiencies in their risk management processes as highlighted, e.g., by Lind and Kivistö-Rahnasto [20], and Njå and Fjelltunn [21].

Afore-mentioned characteristics related to drivers' work cause risks of accidents and musculoskeletal disorders. Risks which do not result in accidents cause injuries or near accidents if they are not remedied [19]. Risks can occur during the driving phase or in numerous work phases outside a cab [13, 14, 15, 18]. Drivers' work involving movements should be improved. Securing safe work conditions in different working environments is significant [17, 18]. This requires complex co-operation between different interest groups [22, 23].

Different work system components such as drivers, technologies, working environments and management are treated as independent entities with no or little relationship to each other, and ergonomics is merely considered to solve adaptations and corrections instead of contributing to larger entities [24]. According to macroergonomics, work system components are interdependent and must be analysed and developed systemically and jointly [25, 26, 27]. Managing these complexities is a challenge [28]. Behrends, Lindholm and Woxenius emphasized similar aspects related to macroergonomics under the term sustainable urban transport systems [29]. Some parts of these complexities can be improved in a more isolated manner, while other parts need co-operation between different authorities. However, ignoring the relations and focusing improvements on certain risks only can increase risk level somewhere else in the system [30]. Sweden, where the brewery sector has successfully developed standards for brewery deliveries, is a good example of macroergonomics decision making aimed at reducing microergonomics problems of carrying heavy objects [31]. The standards, e.g., define how many steps are allowed before using lifts.

2. OBJECTIVES

Although safety and ergonomics issues of L/SH drivers' work have been researched, there are still key areas, e.g., drivers' work outside a cab, that need to be studied. Different parties have their own interests in supply chain management and risk management. More precise data on risks are necessary to make improvements. There are not

many studies on methods assessing dynamic work that requires working in different working environments during the work shift. This study focused on the activities outside a cab in L/SH deliveries. This study was a part of a project whose aim was to improve truck drivers' work and to decrease risk of musculoskeletal disorders and accidents. The project included several participatory points of view in ergonomics assessment and product development issues [32, 33].

This study included two aims. The first aim was to identify risks and ergonomics discomfort in truck drivers' work outside a cab with subjective ergonomic video analyses. The second aim was to compare drivers' identification of discomfort in two types of truck driving work.

3. METHODOLOGY

Participatory ergonomics was the main framework for this study. In this approach, employees are involved in planning and controlling their work activities [34, 35, 36]. Participatory ergonomics improves a physical ergonomics framework [37, 38]. Several methods for participative ergonomics assessment have been developed and used to assess work systems or their parts. These methods are designed to assess monotonic work; all of them have limitations [39, 40]. Factors such as training, work technique, age and individual anthropometry may affect the measurements [41].

The validity and repeatability issues of participative ergonomics methods have been highlighted by, e.g., Takala, Pehkonen, Forsman, et al. [40]. MMH tasks, especially in dynamic work, are assessed as individual tasks and are rarely performed in a completely repeatable fashion [41]. Pehkonen emphasized that new approaches on evaluating dynamic and changing work were necessary [39]. Delivery truck drivers' mobile work is an example of dynamic work because working conditions vary during the work shift.

In this study, subjective ergonomics assessment were performed by L/SH drivers from two transportation companies with a video- and computer-based work analysis method (VIDAR). This study is qualitative and interpretative in nature.

3.1. VIDAR

VIDAR is a participatory method for ergonomics assessment [42]. Video analyses have been used in various studies for ergonomics assessment [13, 42, 43, 44, 45, 46]. They are very useful, but time consuming, basic tools in ergonomics studies [40, 47]. According to van der Beek and Frings-Dresen, videos are useful to assess fast changing tasks because a video material can be analysed later with reviews and slow motions [48]. VIDAR has been used in case studies to assess monotonic work, e.g., in hospitals and different areas of industry environments, but not to analyse dynamic work with different working environments during a work shift [42, 49].

VIDAR is based on video recorded material of an employee performing daily work [42]. The video material, which can be hours long, is condensed into a limited number of ergonomics problems at work in the analysis sessions [42]. The video material is analysed in the analysis sessions. Hence VIDAR is subjective by nature. Ergonomists operate a computer, identify situations and add information to the employee's saved situation [50]. The basic assumption of VIDAR is that the workers should be recognised as the experts in their work (routine work tasks) and they should provide valid assessment. Many of the unreliability issues are related to lack of expertise of the user [42, 50, 51].

VIDAR can be used with a computer connected to a digital camcorder. The subjects have to be informed about the methods and procedures before the study. Firstly, the employee (or a group) watches the video material through the VIDAR computer program (Figure 1). There are two kinds of identifications, i.e., demanding situations that the employee may identify: physical discomfort and psychosocial discomfort including risky situations. When a physically demanding situation is identified, a picture frame of the situation is captured for further analysis and a body map from the Nordic questionnaire is shown [52]. The particular body parts affected by physical discomfort are marked on the body map and rated by the employee on Borg's CR-10 scale [50, 53].

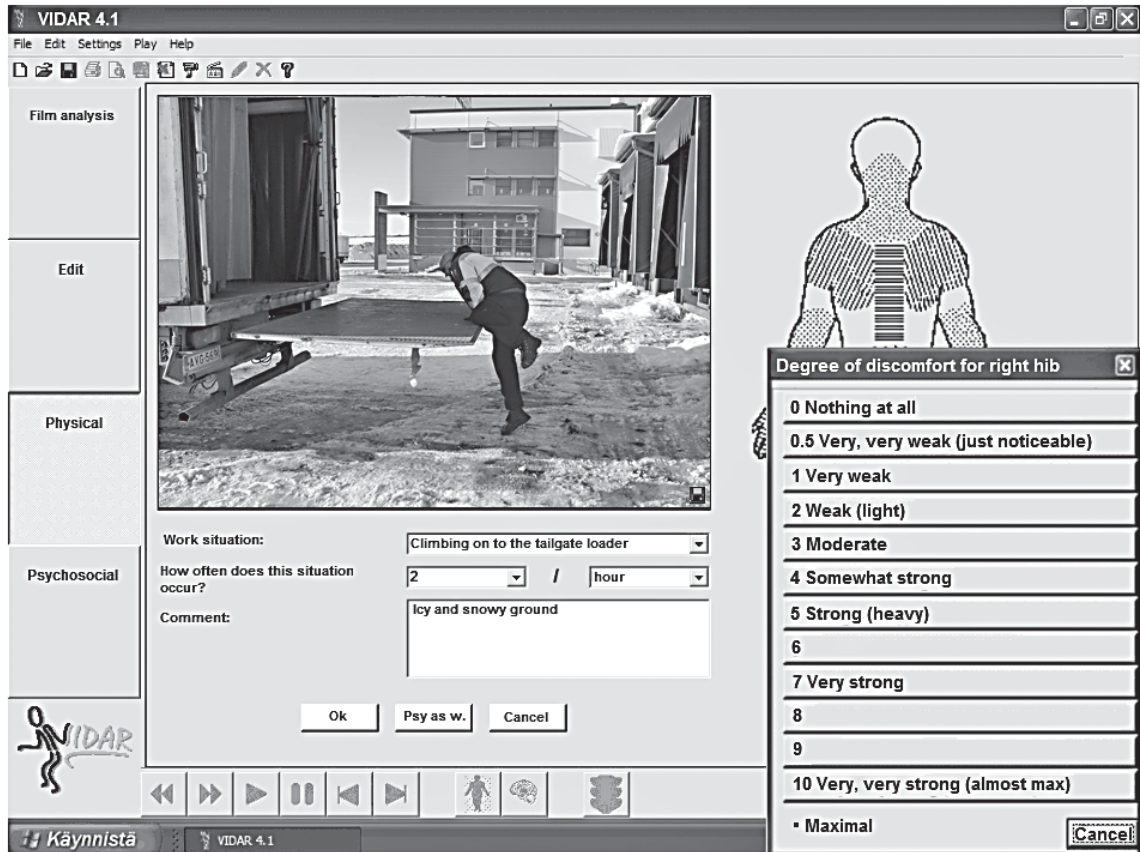


Figure 1. Identified physical discomfort in video- and computer-based method (VIDAR).

A new window opens when a psychosocially demanding work situation is identified. In this window, the subject may select psychosocial discomfort, which matches the saved situation, from a list or write a description. The list includes 9 psychosocial discomfort factors: time pressure; obstruction, interruption and disturbance; uncertainty; poor control; lack of response or feedback; fear of causing risks; emotional toughness; boring or meaningless task; and others. The discomfort factors facilitate a classification of the nature of the identified psychosocial discomfort. They are based on action theory and on circumstances that disturb the goal directed actions [49].

A report of saved situations with pictures, special notices, verbal descriptions and information on frequency can be printed after the analysis. The data are saved in a file together with its work moment (several situations may be identified within the same work moment). Similar identifications may be merged and discussed together. Ergonomists may prioritize the identifications on the basis of how many employees have identified them and

how often the situation has occurred. Ergonomists may then lead improvement discussions towards action plans in a participatory way [50].

3.2. Material

The data were collected on 17 occasions in the midwinter of 2008 in Oulu, Finland. A total of 936 min of video material was recorded and analysed. The subjects were 8 drivers who participated in two cases: general and dairy. The general case is a large national company offering general transportations of different kinds of packages. One female and 3 male drivers (average age 35.3 years, working experience 7.4 years) participated in the general case. The dairy case includes dairy transportations and involves various subcontractors. Four male drivers (average age 30.5 years, working experience 5.2 years) participated in the dairy case. Dairy transportations deliver products such as milk cans, butter and ice cream packages, and meat packets. Most of them are packed into customers' dollies in a dairy terminal.

The companies which took part in the study were selected because they volunteered and because they were considered as representative for national transportation companies of a certain size. The drivers, transportation companies and the customers of the distribution companies signed written permission for the video recording before the study. The video recording was done in the customers' yards or on their premises.

3.3. Study Procedure

The general and daily cases started with introductory discussions of working groups in the companies. The working groups involved representatives from employee, supervisor and management level. The working groups and the researchers informed drivers and customers about the research. The researcher filmed work outside a cab of the drivers on their short haul routes. Data were collected between the early morning and late afternoon.

VIDAR version 4.1 and a laptop connected to a digital camcorder were used to analyse the video material. The analysis sessions were performed similarly for the general and daily cases. Two researchers and a driver, whose work was filmed, participated in the analysis sessions (8 analysis sessions in total). In every session, one researcher operated the computer and the other took notes. The driver concentrated on identifying discomfort from the video material. Each identification of discomfort included subjective estimation of the frequency of occurring in a certain period. The identifications were unique and possible duplicates or similar identifications were not considered after the first identification. Situations like object leaves the cargo space can occur 10–25 times during a work shift and pulling a heavy load with a fork truck 5–10 times during the work shift according to drivers' estimations (Figure 1). The frequencies of occurrence were averages of drivers' subjective estimations and were suggestive. Because the number of estimations was significantly low they could not be reliable.

The data were analysed with mean values and ranges as measures of average ratings and the χ^2 test measured associations between the general

and daily cases. The total number of alleged origins related to discomfort per category was a classifying variable in the χ^2 test. The level of statistical significance was $p < .05$.

The researchers analysed the alleged origins with the identifications. Each identified discomfort can include one or more different alleged origins. Figure 1 shows that the origins of the discomfort are related to tailgate loader (not used as it should be) and customer's courtyard (icy and snowy ground).

4. RESULTS

4.1. Drivers' Identifications of Physical Discomfort

The drivers identified 54 different physical discomfort and 37 different psychosocial discomfort. The physical discomfort in drivers' work was related to overexertion and/or repetitive motions during MMH activities (e.g., lifting, pulling and pushing) and movements in different environments (e.g., when ascending/descending the cargo space or when operating in heights).

Table 1 shows the average values for physical discomfort on Borg's CR-10 scale. The highest values were for the right shoulder (3.4), right elbow (3.3), left shoulder (3.2), left elbow (3.1) and right hip (3.0). All values were assessed between *moderate* and *somewhat strong* discomfort on Borg's CR-10 scale. Maximum ratings for the discomfort were for the upper body (*very strong*) and for the lower body (*strong*), except for the right hip, where one identified discomfort was rated as *very, very strong*. The identified discomfort was placed evenly and bilaterally (Table 1).

4.2. Drivers' Identifications of Psychosocial Discomfort

Over 50 psychosocial discomfort factors were identified from 37 psychosocial identifications. Most factors (29) belonged to a risk group (Table 2). The most common was fear of causing risk of own accident/injury (16 identifications), e.g., fear of falling from heights (3–4 times/work shift), fear of causing collisions (3–4 times/work shift) and fear of being caught between/under

TABLE 1. Average Values for Drivers' Identifications of Physical Discomfort (54)

Body Part	M	Range	%
Neck	2.6	0.5–7	61
Left shoulder	3.2	0.5–7	88
Right shoulder	3.4	0.5–7	87
Back	2.6	1–7	85
Left elbow	3.1	1–7	81
Right elbow	3.3	1–7	79
Lower back	2.9	1–7	81
Left hand	2.7	1–9	87
Right hand	2.8	1–7	85
Left hip	2.9	0.5–6	72
Right hip	3.0	0.5–10	72
Left knee	2.9	0.5–5	64
Right knee	2.9	0.5–5	64
Left foot	2.6	0.5–5	57
Right foot	2.6	0.5–5	57

objects (0–1 times/work shift). Fear of causing risk of economic damage or harm to others, e.g., collisions (3–4 times/work shift), risk of making damage to customers' premises (3–4 times/work shift) were also identified as risk factors. Time pressure (3–4 times/work shift) and bad planning solutions (e.g., door opens in wrong direction, narrowness inside buildings and no help available) in customers' courtyards and premises were emphasized.

4.3. Comparison Between General and Daily Cases

The drivers identified 91 physical and psychosocial discomfort. The drivers from the general case identified 34 identifications (17 physical and 17 psychosocial) and the drivers from the dairy case identified 57 identifications (37 physical and 20 psychosocial). The researchers identified 26 additional physical identifications from the same video material. The identifications (117 in total) were divided into 3 work phases on the basis of the place where they occurred (Table 3).

The identifications (117) contained 242 alleged origins (Table 4). Most origins were related to a working environment (54.1%) and included customer's premises (21.9%), tailgate loader (11.6%) and customer's courtyard (9.1%). Technology-

related alleged origins included working with roll cages (8.7%) and with dollies (7.4%). Moreover, 16.9% of all alleged origins were directly related to MMH where no technological devices were used.

TABLE 2. Psychosocial Discomfort Factors (50) From Drivers' Identifications of Psychosocial Discomfort (37)

Psychosocial Discomfort in VIDAR	Psychosocial Discomfort Factor
Risks	29
risk of own accident/injury	16
risk of causing economic damage	7
risk of others being harmed	5
risk of criticism from fellow workers or boss	1
Obstruction, interruption or disruption	2
difficulties to come near	1
other have not done their job	1
Time pressure	2
Emotionally tough	2
Others	15
customer's limited space	4
the door opens at wrong side	2
frustrating to wait	2
others (single cases)	7

Notes. VIDAR = video- and computer-based method.

TABLE 3. Identifications of Discomfort (117) Divided Into Work Phases

Work Phase	General Case			Dairy Case			Total	
	Driver		Researcher	Driver		Researcher	Total	
	Physical	Psychosocial	Physical	Physical	Psychosocial	Physical	Psychosocial	
At customer's place before unloading a truck	7	5	2	12	8	3	24	13
Related to unloading a truck at customer's place	9	11	11	20	10	7	47	21
At customer's place after unloading a truck	1	1	0	5	2	3	9	3

TABLE 4. Identified Physical and Psychosocial Discomfort (117) Divided Into Alleged Origins

Group	Alleged Origin	General Case	Dairy Case	Total (%)
Work environment	customer's premises	18	35	53 (21.9)
	customer's courtyard	9	13	22 (9.1)
	customer's loading platform	4	1	5 (2.1)
	tailgate loader	15	13	28 (11.6)
	cargo space	10	8	18 (7.4)
	common area	1	4	5 (2.1)
Technology	roll cage	0	21	21 (8.7)
	dolly	0	18	18 (7.4)
	remote control	0	1	1 (0.4)
	hand truck	0	6	6 (2.5)
	high roll cage	1	1	2 (0.8)
	lifting hook	0	7	7 (2.9)
	pallet truck	9	0	9 (3.7)
	rack with wheels	2	0	2 (0.8)
	pallet converter with wheels	3	0	3 (1.2)
	fork truck	1	0	1 (0.4)
Manual tasks		21	20	41 (16.9)

TABLE 5. Original Values of Alleged Origins and Expected Values for χ^2

Group	Original Value			Expected Value	
	General Case	Dairy Case	Total	General Case	Dairy Case
Work environment	57	74	131	50.9	80.1
Technology	16	54	70	27.2	42.8
Manual tasks	21	20	41	15.9	25.1

Table 5 shows the original values and expected values for the χ^2 test; $\chi^2 = 11.376$. With two degrees of freedom the differences were significant ($p = .03$) and there was a difference between the nature of the transported items and the alleged origins.

5. DISCUSSION

Professional drivers have a mobile work system, which includes interactions between personnel, technological and environmental variables. The aim of this study was to identify risks

and discomfort related to the work of L/SH drivers outside a cab and whether there were differences between identifications of two types of truck driving work (according to the nature of the transported items).

There is a significant difference between the general and dairy cases. The origins of technology-related discomfort are related to the dairy case. In the general case, the drivers used pallet truck and fork truck only. The drivers in the general case deliver irregularly-shaped items, which are not usually delivered in big units with roll cages or dollies. In the dairy case, materials are often packed and delivered in big units in roll cages or dollies. However, the subject group in this study was small, which makes it difficult to draw definite conclusions.

Earlier studies with VIDAR do not define the number of subjects. Kadefors and Forsman's [42] study on a car assembly line involved seven subjects, whereas Forsman, Pousette, Persson, et al.'s [49] study involved 12–20 subjects. Practical reasons such as resources, which companies were willing to allocate for this new experiment, affected the number of the subjects. Virzi's guideline for usability studies was acknowledged in the study design phase [54]. According to the guideline, 80% of the usability problems are detected with 4–5 objects. Even though the research frames are remarkably different the results of this study support the guideline. Drivers identified 78% of all discomfort and the researcher identified the rest.

Most identifications of risks and discomfort are related to a working environment and technology like earlier risk and accident studies on the state of industry. The physical and psychosocial discomfort are often inter-related and several factors influence the progress. A good example of a single microergonomic discomfort is descending the cargo space. L/SH drivers may perform this activity many times during their work shift and the risks are associated merely with driver's performance. From a macroergonomics point of view, the risks of the physical work performance are more complex and related to, e.g., drivers' own decisions (e.g., the decision of jumping instead of using ladders to save time), managerial deficiencies

(insufficient risk analyses, tight schedules) and deficiencies on other interest groups' actions (e.g., icy ground, insufficient lighting, bad planning solutions on the platform).

According to Kaila-Kangas, Miranda, Takala et al., discomfort do not always result in accidents but may increase the risk for future musculoskeletal disorders [6]. In their 3-year prospective cohort study, Hamberg-van Reenen, van der Beek, Blatter et al. considered whether musculoskeletal discomfort at work may predict future musculoskeletal pain [55]. About 1800 subjects rated discomfort in different body regions on a 10-point scale that was based on, and was very similar to, Borg's CR-10 scale (the localized musculoskeletal discomfort method) 6 times during a work day [56]. Peak discomfort was defined as a discomfort level of 2 occurring at least once during a day and cumulative discomfort was defined as the sum of discomfort during the day. Peak discomfort was a significant predictor of pain in all four regions. Cumulative discomfort predicted pain in the neck and shoulders. These findings support the approach of VIDAR where subjective ratings are included in the assessment. This also indicates that it may be an effective approach in finding alternative solutions to the identified demanding situations.

5.1. Risk Management Requires Broad Participation

It might be difficult to define who should be responsible for ensuring that the devices and tools are appropriate and available and that the premises and courtyards are safe. Not using devices or using them incorrectly causes over-exertion on the human body. This is a very common discomfort, which can cause long-lasting absences from work. Often the effects of these kinds of discomfort are not so immediate and can only be seen in the long term. The devices and tools are space consuming for the driver especially at L/SH deliveries, where large number of customers are served during a work shift. Often the customers, especially small customers such as kiosks and restaurants, are not willing or able to arrange devices or tools. Other parties might own the equipment and have their own usage

requirements. In this study, roll cages and dollies used during food transport were owned by a third party that pools and disseminates equipment for food transport in the whole country. These devices were developed to fit normal environments but not special conditions, e.g., northern climate, as tyres do not function well on snowy ground.

The work outside the drivers' cab is performed in various places such as terminals or customers' territories, e.g., enclosures and buildings, public places and places that belong to external owners due to the orderer–deliverer–customer relationship. Harmonizing and standardizing these circumstances is a complex challenge. Improvements might require more permanent solutions such as ramps and lifts. Hence, it might be hard to find a sponsor for the improvements. That requires sharing of information and co-operation between different parties. The Swedish delivery standard is a good example of participation and successful co-operation. These kinds of national standards are necessary.

Macroergonomics is a framework confronting multiple problems and challenges drivers are facing. It considers workers' professional and psychosocial characteristics in designing the whole work system. Gathering the right people and interest groups participating in the development process is a challenge. Concrete goals, which have been approved by all parties, are crucial factors of success of multiple co-operation. It is important to keep in mind that small, simple and continuous improvements may cause large advances in the long term.

VIDAR is a good example of a simple tool that enables participation in risk management processes. It provides more precise data useful for planning and developing drivers' work by concretizing and highlighting problems, risks and discomfort for further analyses and risk management processes. VIDAR provides a new system for making concrete initiatives.

In this study, connecting authorities, researchers, managers and employees created a win–win situation between parties. The drivers' identifications resulted in new proposals for improvements including information and communication technology solutions for evaluating working environ-

ments, enhancements in cargo structures and devices, and in new types of co-operation practises between interest groups [33, 34]. A key element was the fact that the researchers followed the drivers on their distribution routes several times and showed commitment to the common matter. The research and data collection was performed on the employee's level.

Besides individual analyses, VIDAR analyses were done by a group of employees with a laptop connected to a large screen projector. Different interest groups such as co-workers, supervisors, managers and ergonomics experts can do their own analyses of the same video material. The ultimate analysis will be a combination of these analyses. Other subjective and objective measures should be considered. Each type of measure contains errors and disadvantages so combining measures gives the most reliable overview.

Moreover, it would be interesting to compare the variation within the general and diary cases between the drivers with the differences between the general and diary cases in this study. The number of subjects per case was too small for this kind of analysis. It would also be interesting to deepen the research and to perform more studies on other transportation types.

5.2. Limitations

The validity of VIDAR method is not yet clearly confirmed. VIDAR was selected as an assessment method because researchers wanted to introduce and test new procedures on dynamic work assessment. VIDAR provides useful data but the size of the subject groups, their homogeneity and subjectivity are questionable. Another important question is whether the results would be different if the analysis had been done parallel with the video recording immediately afterwards or later as in this study. Borg's CR-10 scale is used in VIDAR to assess subjective discomfort. Discomfort indicates physical stress, thus it is questionable whether it is sufficient to assess mechanical exposure; e.g., Hernandez, Alhemo, Genaidy, et al. discussed different scales [57]. Nonetheless the approach of the case in this study does not make it possible to clarify the validity of the method.

This study has some limitations. Firstly, the number of subjects is rather small. The results only indicate what kind of discomfort and risks are related to L/SH work. The results of comparing two types of transportation should be interpreted with reserve. Nonetheless, the results are similar to those in previous studies. Secondly, VIDAR analyses were done as case studies. These case studies were performed in northern Finland during the first half of the year. Thereby, the analyses concerned winter and spring conditions only. Thirdly, in this kind of subjective analyses, it is possible that each interest group tends to emphasize its own importance aspects. When using self-confrontation methods, the extent to which the video recordings reflect the natural behaviour of the participants or whether they are influenced by the recording must be considered. Kadefors et al.'s study confirmed that behaviour may change [42]. This study also argued that the subjects may change their standards and angle of analysis during the analysis phase, which is a more significant risk related to the reliability of the study. Many video recordings of workers performing their routine work confirmed that subjects hardly change their behaviour because of recording [42].

6. CONCLUSIONS

This study on L/SH drivers' work outside a cab identified a large variety of ergonomic discomfort and risks. The results also show that there are significant differences in discomfort and risks between different types of truck driving. The analysis identified both physical and psychosocial discomfort. Most discomforts were related to movement in different working environments and MMH activities. Specific discomfort and risks related to transportation type, especially those related to equipment used in MMH, were also found.

Although many of these discomfort, risks and problems were already known, VIDAR analyses produce visual material that facilitates direct action plans, which transportation companies and other parties need. This kind of precise analyses should improve risk management processes. This

study proved that VIDAR should be used in assessing mobile work in different working environments.

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