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QUALITY IMPROVEMENT
Analysis of logistic processes / delivery of goods

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In the twenty first century, the quality is one of the major features which help companies to compete on the worldwide market. Quality it is not anymore a matter of the best possible raw materials and good design of an item, but it has become an integral part of culture of an organization. Quality is an integral component of everyday company existence.

The objective of this study was to illustrate the current situation in the working environment in Pouttu, and need of improvement. In this thesis the NOSHI checklists have been used, in order to collect specific data from employees. The results have been collected and analyzed to mark the ergonomic problems in Lähettämö. The second tool used in the study was REBA analysis. The physical movement performed by workers body was monitored and marked in the computer software.

The analysis of results and suggestions given in this study will towards the firm management for the need of changes and improvement in their work performance. The changes have to take place across all organizations in order to see long terms profits. The research aim was to demonstrate the importance of quality improvement in working environment.

Key words
Ergonomics, Occupational Health and safety, TQM , Total Quality management

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DEFINITIONS

Lähettämö - Dispatch center, place in the company where orders for customers are collected. The prepared orders are packed on pallets, waiting for transportation (shipping) to the ordering party.

Vaaka - Workstation where an employee reads the orders from the computer screen, pack the proper product to boxes and pushes it later on the conveyer (see appendix 6).

Lidl - Workstation where products are scanned and packed into carton boxes and later on pallets wrapped in foil, secured and prepared for transportation (see appendix 6).

ISO standards - a set of documents which gives information and guidelines for how to ensure product, process or service to fit for their intended purpose (iso.org 2014.)

Manual Material Handling (MMH) - the way of handling the task by human involving the usage of the force in order to lift, pull, push loads (involve usage of muscles)

Hazard - any source of potential damage, harm or adverse health effects on something or someone under certain conditions at work. (ccohs.ca 2009.)

Safety - Lack of unacceptable risk of loss appearing.

Six Sigma – one of quality management techniques, which aims to improve the output of processes by identifying and removing errors appearing during those processes and aims to simplify processes.

Occupational safety and health (OSH) - Conditions and organization of work and behavior of employees ensuring the required level of protection of health and life against the dangers in the workplace.

Checklists NIOSH (National Institute for Occupational Safety and Health) - Method of expertise set of questions to an employee about performing work activities

Ergonomics - An applied science, aiming to bring the tools, machines, technologies and physical work environment to the physical and psychological requirements of human.

"Cumulative Trauma Disorders "(CTDs) - in other sources can be presented also as RSI's (repetitive strain injuries) or WRMSD (work-related musculoskeletal disorders). Those disorders are caused by ergonomic risk factors such as external forces, impropriate body posture, repetition of motions, and many others. We can specify the main types of CTD disorder that affect muscles, tendons, nerves, blood vessels, bones, or all of mentioned. (oehc.edu 2014.)

RULA method (Rapid Upper Limb Assessment) - a method that aims to prepare assessment of rapped moves of the neck and upper-limb load during performing work tasks. The position of worker preforming work tasks is monitored and every deviation from the normal body posture is analyzed according to tables and proper score is assigned.

REBA (Rapid Entire Body Assessment) - A tool designed for easy assessment of performing task and evaluating them later and assigning a score of each body part (wrists, forearms, elbows, shoulders, neck, trunk, back, legs and knees). (ergo-plus 2014.)

1 INTRODUCTION

To understand what quality improvement is, at the first we need to know what does quality means. According to many sources there are several definitions of quality, because the concept of quality is complex and means different things to different people. It is problematic to define the exact meaning of quality. It is a wide aspect which can be implemented in every area of our life; in every item or every service. When talking about safety, quality is a set of standards and regulations. In case of physical items quality can be defined also as a class of the raw materials and workmanship when we think about items.

ISO standards defines quality as
"The totality of features and characteristics of a product or service that bears its ability to satisfy stated or implied needs."

Quality of an item can be explain as an item that has the ability to perform satisfactorily in service and it is suitable for its intended purpose. If there is quality existing there is always chance for improvement of current condition to achieve better performance.

"In manufacturing, quality is a measure of excellence or a state of being free from defects. It is brought about by strict and consistent commitment to certain standards that achieve uniformity of a product in order to satisfy specific customer or user requirements."(business dictionary)

Quality improvement is a process aiming to improve a product, service, processes and as in following study, the health of employees. It is important to recognize in the organization the risks connected to work done manually, mark them and try to prevent or eliminate them totally.

Total Quality Management (TQM) is a methodology whose purpose is to improve quality and performance to meet or even exceed customer expectations. It can be achieved by combining all related quality functions and processes through the entire organization. TQM focus at the quality measures used in a firm, including managing quality design and development, quality control and maintenance, quality improvement and quality assurance. TQM takes into account

all quality measures at every level of the organization and involves all of the company employees. (about.com 2014.)

Total Quality is a combination of the culture, attitude and system of organizing the company aim is to give for its clientele products and services that fulfill their needs. The culture needs quality across the entire company and all operations, which means things being done right at the first time, elimination of defects and waste from operations.
(Wickramasinghe & Lubitz 2007, 71.)

Total Quality Management (TQM) is an improvement of the traditional business model. It is a confirmed method to assure existence and competitiveness in the global competition. Only by changing the actions of management will the actions and culture of entire organization be transformed. (Dale 1999, Managing quality, Oxford, Blac Publishers)

TQM has been an important issue for organizations for many years. The early focus on quality evolved from inspection to quality control and later to quality assurance, according to Dale. However, Hellsten & Klefsjo view TQM as a management system in continuous change and consisting of values methodologies and tools, the aim of which is to increase external and internal customer satisfaction with a reduced amount of resources. (Besterfield 2003.)

I chose the following topic for my final thesis because since I remember I have been interested in improving the existing quality in order to satisfy my own needs. The possibilities of the quality improvement can be found in every area of our life. After purchasing a new item from a store sometimes we ask from ourselves "why did they make the item in such a way?" "Why didn't they do it differently?" "I feel need of having this specific feature in here; why didn't they this solution at this time, even though the company applied such a solution in the previous version. Why not change it, it would be better for everyone and cheaper to produce". It is all about continuous improvement until we reach the perfection, and seeking for the possibilities of the new innovation. As I mentioned before, Quality Improvement (QI) can be applied in every area of our life, it is every item, technology, solution which is making our life easier, saving time, money or resources.

In my career I have visited many manufacturing plants, and I have also been part of the team in some of them. Whatever I visit a new facility I try to observe what kinds of processes are running inside the organization, how they are running and what kinds of steps the management has taken in order to improve the current performance and also what could be still done in order to get, a better outcome.

In this study I would like to share my observations and suggestions with the management of Pouttu. The study mainly focused on analyzing current ergonomic situation in Lähettämö department, on the Keruu and Lidl workstations. I would like to present for the management hazards connected to manual handling of materials at the work place.

Tools and techniques provided by me in this study can be easily used to analyze the situation in other departments, and to take proper steps to implement changes in the places where problems appeared. Suggestions included in the document are given under review of Pouttu management.

2 GENERAL BACKGROUND

During the past century quality management has developed from inspection to total quality management and its modern form such as six sigma. It has lad to developing essential processes, theories, ideas and tools which are used to improve performance in an organization or change the way of managing processes. Much work has been done and many researches have been conducted before the recent concepts of TQM have been presented in current format. At the beginning of manufacturing, the work of operator was reviewed and the decision whether to accept or reject a product was taken. As businesses started to grow and became larger, full time inspection jobs were created.

At the same time, separated inspection departments were created with a chief inspector, whose task was to report "problems" to the person in charge of the process or to the manager. Along with creation of new departments, there came such issues as standards, trainings, recording of data and the accuracy of measuring equipment. Responsibilities of the chief inspector increased and became more complex than just accepting the product quality and reporting misfits.
In the 1920's statistical theory began to be applied effectively to quality control, and in 1924 Shewhart presented a diagram which now we know as control chart.

Those techniques started to be used more widely in the 1940's due to crash of Japan's industrial system which was virtually destroyed. At that point the Japanese products had a status of cheap and poorly made fake products. Thanks to American scientists Juran, Deming and Feigenbaum a decade later Japanese plants, noticed raped bloom of new quality management activities. In the early 1950's, quality management practices developed rapidly in Japanese industrial plants, and become a major theme in Japanese management philosophy, so that, by 1960, quality control and management had become a national preoccupation. Due to the fact that in the 1950's management practices developed rapidly, Japanese products improved significantly in terms of quality while keeping competitive prices in the 1970's export of items into European and American market increased.

The first international conference on quality control took a place in Tokyo in the year 1969. In this conference the term of total quality management was presented for the first time to a wide audience. (Poorinma & Charantimath 2011, 61.)

2.1 The concepts of TQM

The concepts of quality control are primarily related to the manufacturing enterprises because the problems related to quality are most likely appearing in the manufacturing companies during the activities. The concepts are based on understanding the benefit of the quality and direct relation to the need of practice.

The origins of the practical implementation some of the tasks of quality management can lead to time when social groups in organized way interact in order to produce "designed" earlier item. Industrial revolution in the late 19th and early 20th century formatted the organizational structures of industry, where some of the quality management tasks took part. At first those techniques mainly targeted the supervision over the work of the employees. In the 20th century there was intensive development of organizational forms, methods and quality management techniques. In the recent decade we can observe a growth of newer and developed concepts on this field, to finally be introduced as Total Quality Management.

2.1.1 The concept created by E. W. Deming

Deming in his book wrote

> *"Most gains in productivity must come from improving the system, improvements to help people work smarter not harder. Low quality means high cost because someone gets paid for both making and correcting defects. Trusting hopefully in hardware (new gadgets) will be disappointing, and is not a substitute for improved management, which leads to improved system".*
>
> *"hopes without a method to achieve them will remain hopes."*
>
> *(Demind & Groberg, 2-3)*

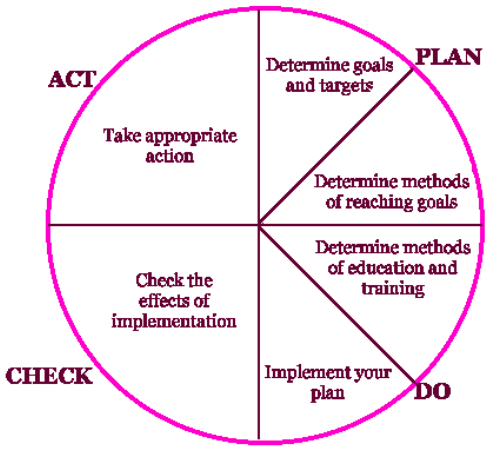
The most important figures needed for management of any organization are unknown and unknowable. Short term profits can come by deferring maintenance, cutting research, etc. Long terms profits come by improving quality and productivity (they go hand in hand). Top management must be committed to work faster and harder. It comes by following those points:

1. Create constancy of purpose toward improvement of the product and service.
2. Adopt the new philosophy (take on leadership for change)
3. Cease dependence on inspection to achieve quality.(build quality into the product in the first place)
4. Do not award business based on prices; minimize total costs by having single suppliers on long-term relationship of loyalty and trust.
5. Constantly improve the system of production and service (forever).
6. Institute training on the job
7. Institute leadership. (The aim of supervision should be to help people, machines and gadgets to do a better job. Supervision or management is in need to overhaul, as well as production worker.
8. Drive out fear (so that everyone may work effectively for the company).
9. Break down barriers between departments.
10. Eliminate slogans, exhortations, even targets goals etc. aimed at the work force (because the bulk of the causes of problem belong to the system and are beyond the power of the workforce per se).
11. Eliminate work standards (quotas) and Management my Objectives. SUBSTITUTTE LEADERSHIP. (If you have a stable system, there is no need to specify a goal: you will get what the system produces.)
12. Remove barriers that rob the employees/managers of pride of workmanship.
13. Institute a vigorous program of education and self-improvement
14. Put everyone in the organization to work accomplish the transfer.

(Demind & Groberg, 2-3)

W. Edwards Deming significantly contributed to developing the theory of quality circle (nominally; Plan Do Check Act circle). The quality circle is used as one of problem solving

techniques. Using that technique helps users organize their thoughts and structure the quality improvement process.



GRAPH 1. PDCA Circle (ualberta.ca 2014.)

2.1.2 The concept created by Joseph M. Juran

Joseph M. Juran is an expert on the field of statistics, and an author of many key publications in the area of quality control. He confirmed and extended Deming taught. In his publications he proved that the achieved results largely depend on management and not from production workers. He showed the need for timely planed implementation of quality in the manufacturing process, monitoring the quality of products throughout the duration of this process and instant improving quality. He said "there is a need of developing the process on which the companies can carry on, if the process is unreliable, you cannot consequently carry out its objectives".

Juran defines quality as a product of high quality, "fit for use" and "free from defects". Such an approach leads to locate the customer in the center of shaping the quality of the product. Similar to Deming, Juran in his theories marked the needs of paying attention to customer perception and participation in the process of planning and developing of quality. He shows this process as "quality spiral" which is a graphical expression for quality as a continuous, never-ending process, a cycle which stages are: Customers → Product → Development → Actions → Marketing → Customers. The process of quality improvement begins with the

customers and ends to them too. Juran identifies need of eliminating production errors before they occur.

Joseph M. Juran also suggested the Pareto principle and named it after an Italian economist Vilfredo Pareto. It is a common rule in business which says that for example "80% sales of the company come from 20% of customers". Mathematically, the 80-20 rule is roughly followed by a power law distribution (also known as a Pareto distribution) for a particular set of parameters, and many natural phenomena have been shown empirically to exhibit such a distribution. (Wikipedia & 80-20presentationrule 2014.)

The Pareto Principle or the 80/20 rule proves its mettle in practically every area of management some of which are given below:

a) 20 percent of the customers account for 80 percent of the sales.
b) 20 percent of the products or services account for 80 percent of the profits.
c) 20 percent of your stock takes up 80 percent of your warehouse space.
d) 80 percent of your stock comes from 20 percent of your suppliers.
e) 80 percent of your sales will come from 20 percent of your customers.
f) 20 percent of your staff will cause 80 percent of your problems.
g) 20 percent of a company's staff will output 80 percent of its production. (Wikipedia & 80-20presentationrule 2014.)

2.1.3 The concept created by Philip B.Crosby

Philip B.Crosby joined the senior experts in the field of quality of preaching the doctrine of "Quality First" - "quality above all". He supported the concept that quality does not increase the cost of production, but it decreases them. In his book *Quality is Free* he proves that investing at the beginning of any process in the best possible raw materials and resources is always profitable. Mistakes in business are costly because of lost time, lost profits, lost customers and missed opportunities for self-improvement. Compared with the costs, making something for the first time, is clearly cheaper. His concept of quality management, based on the recognition of the work as a process whose outcome depends on the materials and

provided information, on the idea of trouble-free system operations and a new culture of the company where the quality is understood as compatibility with the requirements.

His main contribution to quality management was a set of rights, so-called Absolutes of quality management:

1. Quality has to be defined as conformance to requirements, not as goodness or elegance.

   Management must establish requirements, supply the wherewithal, encourage and help employees to get the job done. The basis of this policy is "Do it right the first time".

2. The system for assuring quality is prevention, not appraisal.

   The first step to detect and prevent errors and defects is to understand the process of manufacturing the product. When a defect occurs, discovery and elimination are the top priorities.

3. The performance standard must be zero defects, not “that's good enough".

   The only performance standard that makes sense for the rule “do it right at the first time" is zero defects. Zero defects needs to be a performance standard for everyone in the company, from top management to workers on the production line.

4. The measurement of quality is the price of nonconformance, not indices.

   A dollar figure can be established for the cost of quality (COQ) by determining the difference between the price of nonconformance and the price of conformance. The price of nonconformance is the expense of doing things the wrong way, and can account for 20 to 35% of revenues. Price of conformance is the cost of doing things right-typically 3 to 4%. Managers should spend time identifying where cost of quality is occurring and address what makes it occur. (scribd 2014.)

2.1.4 The concept of Armand V. Feigenbaum

Armand V. Feigenbaum is an American quality control expert and businessman, the creator of the concept of Total Quality Control (TQC), which later in the eighties developed in to quality management (TQM). According to him, the concept of TQM involves the whole company, whose all organizational units are involved in the process of shaping the quality of the product.

The areas of activities in which TQM is implemented:

- Creation of a corporate strategy, in which the quality of the products is the main goal which is linked with the expectations of buyers.
- Transforming (converting) the quality strategy for the detailed specifications (technical specification) and marketing, corresponding to the needs and requirements of buyers.
- Sharing the duties and responsibilities for the quality of the products across the enterprise.
- Reduction and the perception to the work rules for the executives of the enterprise, quality control service emphasizing the responsibility for the quality system, technology and economic performance.
- Continuing to motivate employees to achieve and assess the qualitative performance of the company.

Actions in these areas must take into account the following rules:

- Quality is not only a technical function and the purpose of quality control services, but a complex process involving the entire company.
- At the work on the quality, must be seen and appreciate the performance of individual employees and organizational units
- The quality of the products should be considered as a value for the buyer
- Improving the quality requires the use of modern research techniques, design, manufacturing, measuring and regulating the quality of products, and commitment, cooperation between specific units and employees.
- The quality of products is the base for the selection of manufacturing techniques.

- A major factor in improving the quality of products is the attitude, knowledge and skills of linear executives (superiors, production managers).

Dr. Feigenbaum sees the possibility of using the cost of quality for evaluating the effectiveness of quality control and statistical methods for regulation of the quality. The same as Deming or Juran, Feigenbaum spoke of the need to recognize the quality as the first top priority. Their study was based on the belief that it is not possible to achieve production goals without keeping attention on the processes leading to these goals. There is need of continuous improvement of processes in order to continually improve products.

2.2 The importance of a worker in the organization

Human resource should be the most valuable asset for any organization. Unlike other assets, people are the only greatest potential asset. The only greatest potential liability that an organization will acquire as it moves about its business. In the organization those are three types of major assets that are needful to an organization's ability to produce goods and services, namely, financial assets, physical assets and intangible assets. Intangible assets include intellectual capital (product patents, product designs, and process technology), good will, and human capital. In every organization the essential factor is human, and human has to be the most important for the every company. Human capital is not just the people working in an organization. It is a combination of their experience, attitudes, abilities, culture etc. The Nobel Prize-winning economist Gary S. Becker, says that "the basic resource in any company is the people. The most successful companies and the most successful countries will be those that manage human capital in the most effective and efficient manner".

It is widely known that the involvement of a motivated employee will be higher to perform tasks better. That is why it is so important to provide for the employees the best possible work conditions by improving performance. It will affect higher productivity, efficiency, effectiveness and then profit. Such factors as reduction of sickness and absence at work as also smaller rotation of employees cannot remain unnoticed. (academia.edu 2014.)

3 ERGONOMIC FACTORS

3.1 Description

This research aims to present professional ergonomic risk factors in the dispatching center (lähettämö) in Pouttu.

In literature as ergonomic risk factors we are determining hazards due to misfit in technical parameters of workplace. As well as performed work to the physical possibilities of a particular person. These factors arise primarily due to overload of the muscle-skeletal system, as well as due to the pressure on the nerves and blood vessels.

- Identifying ergonomic risk factors and their sources in the dispatch center. It is well known that even in the most ergonomic work conditions there are many various hazards. In the dispatch center work is done manually, what favors the formation of risk factors. In practice, to identify the threats we can use several methods. One of them which I am using in following research is checklists NIOSH (National Institute for Occupational Safety and Health).

3.2 The aim of the research

In this research I formatted three principal objectives. The overall objective was to identify ergonomic risk factors which affect the health and quality performed work of the employee in the dispatch center. By using checklists attached in this research, the management is able to notice which factors are most often appearing in the organization. The research is based on the work of employees in the dispatch center, but it can easily be implemented in other departments. The second objective was to propose and present the concept of new machinery pallet wrappers and advantages of implementing such a solution.

The last step was to prepare a set of stretching exercises for employees. The exercises can be expanded inside the whole organization in order to reduce symptoms of chronic pains and to improve performance. Chronic pains may be an effect of ergonomic misfits in the

organization. If then cannot be eliminated them, the organization can try to avoid them or at least minimize the negative effect.

3.3 The scope of the research

The scope of the thesis includes:

- Identification of factors affecting the health and quality of labor in the dispatch center,
- Ranking the role of these factors based on literature, data and computer software,
- Developing proposals to improve working conditions in the dispatch center,
- Implementing the basic rules of carrying items.

4 THEORETICAL FRAME WORK

4.1 Occupational safety and health (OSH), ergonomic of work.

Speaking about working conditions and security, one should know what is meant by security. According to the dictionary PWN, security is a state without insecurity where we feel calm and confident. Meaningful work where the individual's physical and mental health is ensured is essential for the quality of life and wellbeing of people.

Occupational safety and health is a set of conditions to ensure the elimination or maximal limitation of the negative impacts in the work environment on the employee. According to S. Klonowicz, protection of work is a set of techniques and methods, which aim to:

- maintain appropriate working conditions,
- prevent the accidents, disease and poisoning,
- reduce or elimination of harmful factors,
- eliminate of excessive tiredness,
- increase productivity of the employee.

(Olszewska1997, 18.)

An employee has the influence on increasing labor productivity but it is widely known that the greatest impact on the increasing of the quality at work has creation proper condition of health and safety in the working environment. According to many sources a company that has decided to increase safety in working environment as outcome received; increased productivity, reduction of sickness therewith absence at work and also smaller rotation of employees, increased employee morale and better quality of performance.

> *"For those who says, that safety costs, I can say one thing: lack of safety cost much more" Paula Lamaita*
>
> *(Wróblewska,2004)*

Doctor Deming knows also that the most important factors cannot actually be measured. During one of many interviews he says:

> *"There were figures, better known how to use them they guided by theory for example you do some training, you spend 20 000 pounds for training, what I mean training for skills. The costs are shown on the ledger, no doubt at all there is the amount. The benefit you will never know you, cannot measure."* (Deming Youtube, Part 2.)

It is crucial to take a good care of employees. When taking good care of the health and safety of the employees at the same time we take care of the condition and security of the business.

4.2 Ergonomic

The roots for word “ergonomics” are in Greek language; “ergon” means work and “nomos” means laws. Ergonomics can be defined as "designing the job to fit the worker, not forcing the worker to fit to the job." Ergonomics is a wide aspect which is responsible for physical stresses of the body of worker (joints, muscles, tendons, nerves) as well as environmental factors which can affect hearing, vision and general comfort and health.

One of the typical physical stressors is repetitive motions, which mean repeating the same actions over and over again during performing tasks. The tasks involving vibration also expose worker to hazards (jackhammer), or those which involve using excessive force such as lifting heavy boxes. Repetitive motions, vibration, excessive force and awkward positions are almost always connected to ergonomic disorders. However, the biggest amount of Cumulative Trauma Disorders (CTDs) is caused by repetitive motions, which would not cause any harm if performed once or twice a day. Carpal tunnel syndrome, Tendonitis, Tenosynovitis, DeQuarvain's Syndrome, Thoracic Outlet Syndrome, those and many other injuries may result from repetitive motions. (ehs.okstate 2014.)

4.3 Manual material handling

Manual material handling in a working environment can mean for example lifting, carrying and pushing loads. That is why manual material handling appears in many different working fields. Manual material handling (MMH) is the most common cause of low back pain. Manual handling of loads may cause cumulative disorders due to gradual and cumulative deterioration of the musculoskeletal system through continuous lifting / handling activities, e.g. low back pain. It can also cause an cuts or fractures due to accidents. Statistically almost every fourth

worker in Europe whose job includes Manual Material Handling suffers from back pain, which is listed on the top of work related disorders.

Low back pain and injuries are the most common musculoskeletal disorders caused by manual handling. Such back injuries account for about one third of all lost work and even more than one third of all compensation costs. More important than financial cost is human suffering. Each year several thousand Finnish workers are permanently disabled by back injuries. Many others are unable to return to their jobs.

All these facts make prevention of back injuries a crucial and challenging problem for occupational health and safety. This research focuses on identifying and preventing back injuries caused by MMH in the organization.

4.3.1 Negative health effects of MMH

Negative health effects of manual material handling are injuries of the back, neck, shoulders and arms. The injuries are usually cuts, bruises and fractures. The more serious injuries from manual material handling are damages to the musculoskeletal system. These injuries are rated as musculoskeletal disorders' (MSDs) which includes neck and upper limb disorders, lower limb disorders and back injuries. Preventing injuries is really important because musculoskeletal disorders are very often difficult to cure and they are restricting the ability of work and doing activities for rest of the life.

4.3.2 Common reasons of manual handling hazards

In every organization there are several factors which make manual material handling dangerous. The same factors may also cause an increased number of accidents and injuries. The risk factors are related to a few aspects of manual handling: the load, the task, the environment and the individual.

The risk of back injury increases during such activities as lifting, carrying, pushing and pulling of loads, if the load is too heavy, too large, unbalanced or difficult to grab or reach. One of the

most important rules for lifting and carrying loads is to keep the load as close to the body as possible. Usually a weight around 20 kg is too heavy to lift and carry for most of the people especially if the same motion needs to be repeated several times during one hour. Pushing and pulling the load imposes less loading on the body.

The loads which are difficult to grab should be handled with gloves to ease grabbing and to prevent slipping. Gloves protect also hands from coldness when working in unfavorable environment, and from injuries when handling for example sharp or dangerous materials. Unbalanced loads can cause sudden movements while lifting or carrying and make workers lose their balance and fall. Loads which are difficult to reach may require the worker to bend and twist the trunk. The spine can easily get hurt if the trunk is bent or twisted while lifting the load.

The features of tasks can also increase the probability of back injury. If the task is too strenuous or if it involves awkward body posture or movements the risk of back injury is bigger. Too strenuous tasks may be for example tasks which include continuous lifting and carrying for long distances or tasks where the working speed is expeditious. Awkward postures and movements such as bending and twisting the trunk, neck or other body parts should be avoided like as well as sudden moves and overreaching.

The environmental reasons for a back injury are usually the lack of space causing inappropriate body postures and dangerous imbalance with loads. In addition the condition of floors and proper lighting are important components in a safe environment. The physical climate such as temperature, humidity and ventilation affect workers vitality level and thereby prevent injuries while working.

Among others there are also individual factors that can cause back injuries. Such factors include: age, life style, physical dimension and capacity, experience, trainings, knowing of the job. The personal life style and knowing the performing job have a significant influence on the hazards related to MMH.

Other factors which might cause hazards are mainly related to performing tasks, for example awkward body postures, repetition of movements, forces (during such activities as lifting, pushing, pulling etc.), pressure on soft tissues of the body or vibrations. Such disorders as rheumatoid arthritis, diabetes, obesity, pregnancy or menopause might be a reason of hazards.

4.3.3 Preventive measures

At the moment negative health effects of manual handling at present moment are not possible to be eliminated fully without investing a large amount of money. What can always be done is to try to reduce the risk factors involved. In every organization where MMH is taking a place and as a part of everyday duties and cannot be avoided, the company management should take every possible step in order to eliminate hazards.

Elimination- the current design of the workstation/workplace, should be checked and redesigned if it is necessarily, to create proper ergonomic condition. The workstation should be designed in such a way that the manual handling of work can be reduced to zero.

Technical measures new machinery, robots, mechanization and the use of lifting and transport equipment should be considered (e.g. conveyors, hoists, cranes, vacuum lifting devices, lift tables, pallet trucks, lift trucks, barrows, trolleys). Always when we are implementing such changes one should make sure that by eliminating one factor we are not creating another one (noise, light, radiation vibrations etc.).

Organizational/Administrative measures – In case when the technical measures did not bring intendant effect organizational measures should be considered. If the load is to heavy it should be handled with help of other worker, the load can be reduced to the acceptable amount. Adjusting brakes properly to handled loads in order to give muscle adequate time to rest. Provide information and training of proper handling techniques to workers. The workers should be informed of the risks of accidents and ill health, particularly concerning their specific tasks. The workers should receive training on the use of equipment and on correct handling techniques.

5 DESCRIPTION OF THE METHODS FOR THE ERGONOMIC ASSESSMENT OF WORKSTATIONS

There are several methods for assessing the ergonomic of work a place. They can be divided into two groups:

1. Methods used for estimating and evaluating the risk of ailments and diseases caused by the method of work,
2. MSD identification methods and ergonomic risk factors

The first group includes:

OWAS Method (Ovako Posture Analysing System). The original version of this method was developed by Karhu (1977) (Finnish scientist) and the team in the 1970s. OWAS method has been modified many times, introducing new concepts such as the type of item and the burden or risk category. Examples of the extended method are OWAS Owasco, OWASAN and WinOWAS. WinOWAS is a computer program which allows describing each observed position by using an ordered combination of four digits, which in turn determine the position of the back, arms, legs and external load.

RULA method (Rapid Upper Limb Assessment). The method was developed in 1993
To estimate the risk of MSDs use the four tables:

- Table A - to determine the load position the of the hand (wrist, arm and forearm),
- Table B - to determine the load and position of the neck, torso and lower limbs,
- Table C - to determine the total body load based on the Tables A and B,
- Table D - to estimate the risk of MSD and the identification of actions that must be taken in the workplace.

REBA (Rapid Entire Body Assessment) method was developed in 2000 and it allows estimating the risk of musculoskeletal disorders caused by way of performing the work. It allows determining the body posture, the range of motion, external load and force applied, the dynamics of muscle and the type of grip during the work.

Table A – to determine the total load and position of the neck, torso and lower limbs including taking under consideration the external load (or applied force), the type of the movement and the way of the movement (rapid or sudden)

Table B - to determine the total load of the arm position, forearm and wrist paying attention to the quality of the grip (grip load)

Table C - to determine the load of the whole body position, external load or force applied and the kind of the grip

Table D - to determine the total load of the body at work (scale 1 - 15) and recommended actions on the examined position (presented on a scale 0 - 4).

The JSI indicator (Job Strain Index). Is used for a quick evaluation of the total load of the hand, wrist, forearm and elbow. This indicator is based on the following variables:

- intensity of the physical strain,
- duration of the physical strain,
- intensity of the physical strain,
- position of the hand (wrist),
- the speed of performing actions,
- a total duration of actions during the day.

To determine the JSI indicator a checklist JSI checklist is used, which is available in both the manual and computerized form.

The second group of methods can be divided into subjective methods and expertise.

Subjective methods are used very often and those methods are mainly based on surveys. Through surveys employees provide information about their health by identifying the symptoms of musculoskeletal disorders, which have appeared as a result of performing work and the reasons which caused them. Information in surveys allows familiarizing the

employee, with the health effects of load and overload the musculoskeletal system and the methods of prevention.

IDMS questionnaire (identification disorders of musculoskeletal system).

It is used for the preliminary identification of:

- Ailments symptoms and musculoskeletal diseases and their causes on the basis of answers given by the employee,
- Ergonomic risk factors in the workplace.

The main objective of a questionnaire is to identify the positions and movements during the performed work. The questionnaire consists of four sections which include the individual predisposition of respondents, the symptoms of ailments and the diseases of the locomotor system due to the work performance, sources of the hazard which effect on the work performance and ergonomic risk factors related to the method of work. It can be used among different occupational groups. The questionnaire is anonymous.

The questionnaire SWP (pol. Sposób Wykonywanej Pracy - the way of performing the work). The purpose of the survey is to help identify loads and overloads locomotors stem, body position and movements performed during operation.

The questionnaire is used to:

- preliminary identification of risk factors for diseases caused by way of performing work at the examined workstation,
- preliminary recognition by employers and designers health risks connected to misfits in designs of working place,
- introduction of a specific ergonomic program, organization and training in the workplace,
- Informing and educating employees about ergonomics.

The questionnaire is divided into sections which include the following body segments: trunk, head and neck, upper limbs and lower limbs. The questions concern movements and body position, which is why the answers help to identify the acceptable and unacceptable risk for individual body parts.

Methods of expertise, to which belong to a checklists NIOSH. They are used to identify ergonomic risk factors at the workplace and the prevention of musculoskeletal disorders and diseases of the locomotor system caused by the inappropriate way of work.

The NIOSH checklists include:

- List of 5A. General Ergonomic Risk Analysis Checklist
- List 5B. Ergonomic Hazard Identification Checklist
- List of 5C. Workstation Checklist,
- List 5D. Task Analysis Checklist
- List 5E. Handtool Analysis Checklist,
- List 5F. Control list of manual handling of materials,

All of the lists mentioned above, consist of sets of problematically grouped questions for the occurrence of the risk of musculoskeletal disorders.

With the help of checklists it is possible to:

- determine of the areas of the workplace in which the worker is exposed to the musculo-skeletal system risks
- identify the causes of ailments that employees pointed in the questionnaire in order to identify the symptoms of musculoskeletal disorders

5.1 Identification of ergonomic risk factors with the help of NOSHI checklists

To identify ergonomic risk factors in this research I used the checklist NOISHI, contained in the book of Alexander L. Cohen “Elements of Ergonomics Programs: A Primer Based on Workplace Evaluations of Musculoskeletal Disorders”. The checklists has been taken from pages 91 – 99 and modified by me for the need of research (empty checklists for further analysis available as appendix 4). The biggest disadvantage of the project was a language barrier, which is why the feedback was collected only from english speaking people. Nominally the replies were collected from four workers out of ten working with me on the same shift. That is why the questionnaire should be repeated again with larger number of participants in order to collect more accurate results. In the dispatch center “lähettämö” a full elimination of ergonomic risks factors is not possible, it is related to the way of handling the

tasks. However, it is possible to locate the places where the risks are most common and also the activities during which the human body is exposed to unfavorable ergonomic factors. The checklists enclosed as an appendix in this thesis work should be used to analyze awkward body position and locate the source of problems in other departments. According to the data collected I received following replies.

GLOSSARY OF TERMS;

The mark "✓" indicates answer given by employees in the questionnaire.

The mark "□" indicates questions where the responses of employees were different, the main reason being the different work performed by the employee (workstations lidl, keruu, maintenance)

No data – employee was not inform about problem or doesn't know the answer for the following question

Response "yes" in the list 5A indicates an ergonomic risk factor may be present which requires further analysis.

In the list 5B answers:

"Never" (the worker is never exposed to the condition)
"Sometimes" (the worker is exposed to the condition less than 3 times daily)
"Usually" (the worker is exposed to the condition 3 times a day or more)

In the lists 5C - 5F answer "no" indicates the area of potential problems that should be investigated.

Tray 5-A. General Ergonomic Risk Analysis Checklist

Manual Material Handing	**YES**	**NO**
Is there lifting of loads, tools, or parts?	✓	
Is there lowering of tools, loads, or parts?	✓	
Is there overhead reaching for tool, loads or parts?	✓	
Is there bending at the waist to handle tools, loads, or parts?	✓	
Is there twisting at the waist to handle tools, loads, or parts?	✓	

Physical Energy Demands	**YES**	**NO**
Do tools and parts weigh more than 4.54 kg?		✓
Is reaching greater than 50.8 centimeters?	✓	
Is bending, stooping or squatting a primary task activity?	✓	
Is lifting or lowering loads a primary task activity?	✓	
Is walking or carrying loads a primary task activity?	✓	
Is star or ladder climbing with loads a primary task activity?		✓
Is pushing or pulling loads a primary task activity?		✓
Is reaching overhead a primary task activity?		✓
Do any of the above tasks require five or more complete work cycles to be done within a minute?	✓	
Do any workers complain that rest breaks and fatigue allowances are insufficient?	✓	

For further analysis, refer to checklist 5-F.

Other Musculoskeletal Demands	**YES**	**NO**
Do manual jobs require frequent, repetitive motions?	✓	
Do work postures require frequent bending of the neck, shoulder, elbow, wrist, or finger joints?	✓	
For seated work, do reaches for tools and materials exceed 38.1 cm from the worker's position	✓	
Is the worker unable to change his or her position often?		✓
Does the work involve forceful, quick, or sudden motions?		✓
Does the work involve shock or rapid buildup of forces?		✓
Is finger-pinch gripping used?		✓
Do job postures involve sustained muscle contraction of any limb?		✓

Computer Workstation	**YES**	**NO**
Do operators use computer workstations for more than 4 hours a day?	✓	
Are there complaints of discomfort from those working at these stations?	✓	
Is the chair or desk nonadjustable?		✓
Is the display monitor keyboard, or document holder nonadjustable?		✓
Does lighting glare or make the monitor screen hard to read?		✓
Is the room temperature too hot or too cold?	✓	
Is there irritating vibration or noise?		✓

For further analysis, refer to checklist 5-G.

Environment	**YES**	**NO**
Is the temperature too hot or too cold?	✓	
Are the worker's hands exposed to temperatures less than 21.11 Celsius?	✓	

Is the workplace poorly lit?	✓	
Is there glare?		✓
Is there excessive noise that is annoying, distracting, or producing hearing loss?	✓	
Is there upper extremity or whole body vibration?		✓
Is air circulation too high or too low?		✓

General Workplace	**YES**	**NO**
Are walkways uneven, slippery, or obstructed?	✓	
Is housekeeping poor?		✓
Is there inadequate clearance or accessibility for performing tasks?	□	
Are stairs cluttered or lacking railings?		✓
Is proper footwear worn?	✓	

Tools	**YES**	**NO**
Is the handle too small or too large?		✓
Is the handle too small or too large?		✓
Is the tool hard to access?		✓
Does the tool weigh more than 4.08kg?		✓
Does the tool vibrate excessively?		✓
Does the tool cause excessive kickback to the operator?		✓
Does the tool become too hot or too cold?		✓

For future analysis, refer to checklist 5-E

Gloves	**YES**	**NO**
Do the gloves require the worker to use more force when performing job tasks?	✓	
Do the gloves provide inadequate protection?		✓
Do the gloves present a hazard of catch points on the tool or in the workplace?		✓

Administration	**YES**	**NO**
Is there little worker control over the work process?		✓
Is the task highly repetitive and monotonous?		✓
Does the job involve critical tasks with high accountability and little or no tolerance for error?	✓	
Are work hours and breaks poorly organized?		✓

Tray 5-B, Ergonomic Hazard Identification Checklist

Use the following responses to describe **how frequently** workers are exposed to the job conditions described below:

Never (the worker is never exposed to the condition)

Sometimes (the worker is exposed to the condition less than 3 times a day)

Usually (the worker is exposed to the condition 3 times a day or more)

	Never	*Sometimes*	*Usually*	*If usually, list jobs to which answer applies here*
l. Do workers perform tasks that are externally paced?		✓		
2. Are workers required to exert force with their hands (e.g. gripping, pulling, pinching)?			✓	

3. Do workers use hand tools or handle pars or objects?		✓		
4. Do workers stand continuously for periods of more than 30 min?			✓	
5. Do workers sit for periods of more than 30 min without the opportunity to stand or move around freely?	✓			
6. Do workers use electronic input devices (e.g. keyboard, mice, joysticks, track balls) for continuous periods of more than 30 min?			✓	
7. Do workers kneel (one or both knees)?		✓		
8. Do workers perform activities with hands raised above shoulder height?			✓	
9. Do works perform activities while bending or twisting at the waist?			✓	
10. Are workers exposed to vibration?	✓			
11. Do workers lift or lower objects between floor and waist height or above shoulder height?			✓	
12. Do workers lift or lower objects more than once per min for continuous periods of more than 15 min?		✓		
13. Do workers lift, lower, or carry large objects or objects that cannot be held close to the body?		✓		
14. Do worker lift, lower, or carry objects weighting more than 22.67 kg		✓		
Total Assessment	2	6	6	

Tray 5-C, Workstation Checklist	**YES**	**NO**
1. Does the work space allow for a full range of movement?		✓

2. Are mechanical aids and equipment available?	□	
3. Is the height of the work surface adjustable?		✓
4. Can the work surface be tilted or angled?	□	
5. Is the workstation designed to reduce or eliminate bending or twisting at the wrist?	✓	
reaching above the shoulder?	✓	
static muscle loading?	✓	
full extension of the arms?	✓	
raised elbows?	✓	
6. Are workers able to vary posture?	✓	
7. Are the hands and arms free from sharp edges on work surfaces?		✓
8. Is an armrest provided where needed?	✓	
9. Is a footrest provided where needed?		✓
10. Is the floor surface free of obstacles and flat?	✓	✓
11. Are cushioned floor mats provided for employees required to stand for long periods?	✓	
12. Are chairs or stools easily adjustable and suited to the task?	✓	
13. Are all task elements visible from comfortable positions?		✓
14. Is there a preventive maintenance program for mechanical aids, tools, and other equipment?	No data	

Tray 5-D, Task Analysis Checklist	**YES**	**NO**
1. Does the design of the primary task reduce or eliminate bending or twisting of the back or trunk?		✓
crouching?		✓
bending or twisting the wrist?		✓
extending the arms?		✓
raised elbows?		✓
static muscle loading?		✓
clothes wringing motions?		✓
finger pinch grip?		✓
2. Are mechanical devices used when necessary?	✓	
3. Can the task be done with either hand?	✓	
4. Can the task be done with two hands?	✓	
5. Are pushing or pulling forces kept minimal?	✓	
6. Are required forces judged acceptable by the workers?	✓	
7. Are the materials able to be held without slipping?	✓	
easy to grasp?	✓	
free from sharp edges and comers?	✓	
8. Do containers have good handholds?	✓	
9. Are jigs, fixtures, and vises used where needed?	✓	
10. As needed, do gloves fit properly and are they made of the proper fabric?	✓	
11. Does the worker avoid contact with sharp edges when performing the task?	✓	
12. When needed, are push buttons designed properly?	✓	

13. Do the job tasks allow for ready use of personal equipment that may be required?	✓	
14. Are high rates of repetitive motion avoid by job rotation?		✓
self- pacing?	✓	
sufficient pauses?	✓	
adjusting the job skill level of the worker?		✓
15. Is the employee trained in proper work practices?	No data	
when and how to make adjustments?		
recognizing signs and symptoms of problems?		

Tray 5-E, Handtool Analysis Checklist	**YES**	**NO**
1. Are tools selected to limit or minimize exposure to excessive vibration?	✓	
use of excessive force?	✓	
bending or twisting the writ?	✓	
finger pinch grip?	✓	
problems associated with trigger finger?	✓	
2. Are tools powered where necessary and feasible?	□	
3. Are tools evenly balanced?	✓	
4. Are heavy tools suspended or counterbalanced in ways to facilitate use?	✓	
5. Does the tool allow adequate visibility of the work?	□	
6. Does the tool grip/handle prevent slipping during use?	✓	
7. Are tools equipped with handles of textured non-conductive material?	No data	

8. Are different handle sizes available to fit a wide range of hand sizes?		✓
9. Is the tool handle designed not to dig into the palm of the hand?	✓	
10. Can the tool be used safely with gloves?	✓	
11. Can the tool be used by either hand?	✓	
12. Is there a preventive maintenance program to keep tools operating as designed?		□
13. Have employees been trained in the proper use of tools?	✓	
when and how to report problem with tools?	✓	
in proper tool maintenance?	✓	

Tray 5-F, Hand tool Analysis Checklist	**YES**	**NO**
1. Are the weights of loads to be lifted judged acceptable by the workforce?	□	
2. Are materials moved over minimum distances?	□	
3. Is the distance between the object load and the body minimized?	□	
4. Are walking surfaces level?	✓	
wide enough?	□	
clean and dry?	✓	
5. Are objects easy to grasp?	✓	
stable?	✓	
able to be held without slipping?	✓	
6. Are there handholds on these objects?	✓	
7. When required, do gloves fit properly?	✓	

8. Is the proper footwear worm?	□	
9. Is there enough room to maneuver?		✓
10. Are mechanical aids used whenever possible?	✓	
11. Are working surfaces adjustable to the best handling heights?	✓	
12. Does material handling avoid movements below knuckle height and above shoulder height?		✓
		✓
static muscle loading?		✓
sudden movements during handling?		✓
twisting at the waist?		✓
extended reaching?		
13. Is help available for heavy or awkward lifts?	✓	
14. Are high rates of repetition avoided by job rotation		□
self-pacing?		✓
sufficient pauses?	✓	
15. Are pushing or pulling forces reduced or eliminated?	✓	
16. Does the employee have an unobstructed view of handling the task?	□	
17. Is there a preventive maintenance program for equipment?	□	
18. Are workers trained in correct handling and lifting procedures?	□	

5.2 RULA method

In this research a computer software was used to carry out assessment of rapid upper limb (RULA). The individual predispositions of workers were not taken under consideration (weight, increase, gender etc.) while conducting the research. In order to receive more

accurate results, the work performed in the workstation should be recorded and all of movements need to be analyzed. Based on RULA methodology, five basic moves of Keruu worker which are repeated many times during a working day were analyzed. The software is available on the internet website rula.co.uk. In this research a score of 1 or 3 indicates that posture is acceptable if it is not maintained or repeated for long periods.

6 CONCLUSIONS

The aim of this study was to identify the ergonomic risk factors in Lähettämö department during performing the tasks. The main focus was putt on Keruu workstation where the employees repeating the same movements during the working day. After identifying the factors, I marked the places where the most likely ergonomic factors appear. It must be remembered that after implementing any changes, corrections or new technology in the workstation, a hazards identification and risk assessment need to be carried out. In order to see whether the implemented changes have reduced the risk or created new threats. For each ergonomic risk factor the risk assessment should be carried out separately. Every risk analysis which is done in the company aims to improve the working conditions. The creation of appropriate working conditions contributes to the reduction such factors as absentees, sickness and accidents at work. Proper working conditions increase job satisfaction and that in the final result definitely affects the economical results of the company.

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