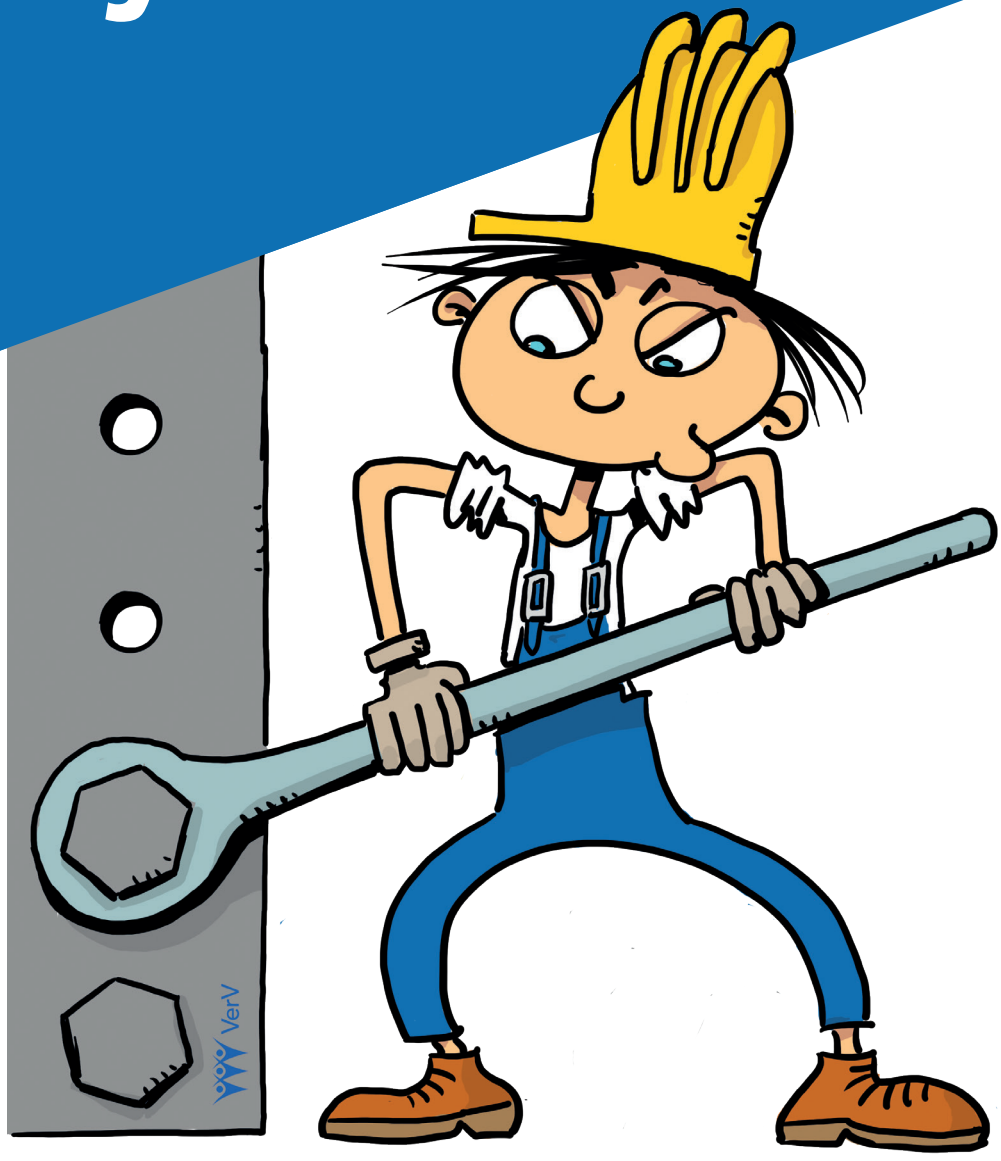
Practical guidelines: ergonomic risk analysis



A publication by VerV – Beroepsvereniging voor Ergonomie

VerV

“An ergonomic risk analysis is a road map towards a healthy and efficient workplace.”

Contents

1. Introduction

Ergonomics is about adjusting the environment to suit people. This can be in the context of a product, a building or a workplace. Physical complaints are still common in the construction, production, logistics, office and healthcare sectors. To reduce the risk of physical overload and consequent absenteeism, it is important to invest in ergonomics by using a human-centric approach when designing new workstations or by assessing existing workstations for ergonomic risks and adapting them where necessary, for example. Design, risk assessment and training are the building blocks of an ergonomics policy, an essential element of "workable work".

Risk analysis is a central concept in the Belgian code on Well-Being at Work. Book VIII on ergonomic stress explicitly demands a risk analysis in the case of manual load handling, working on screens and standing work. Because these risks exist in all companies, every company must carry out an ergonomic risk analysis. An ergonomics prevention advisor is called in for this task. In addition to Book VIII of the code, the subject of ergonomics is also touched upon in other parts of the Code, for example in the sections on work equipment, maternity protection, health surveillance, etc.

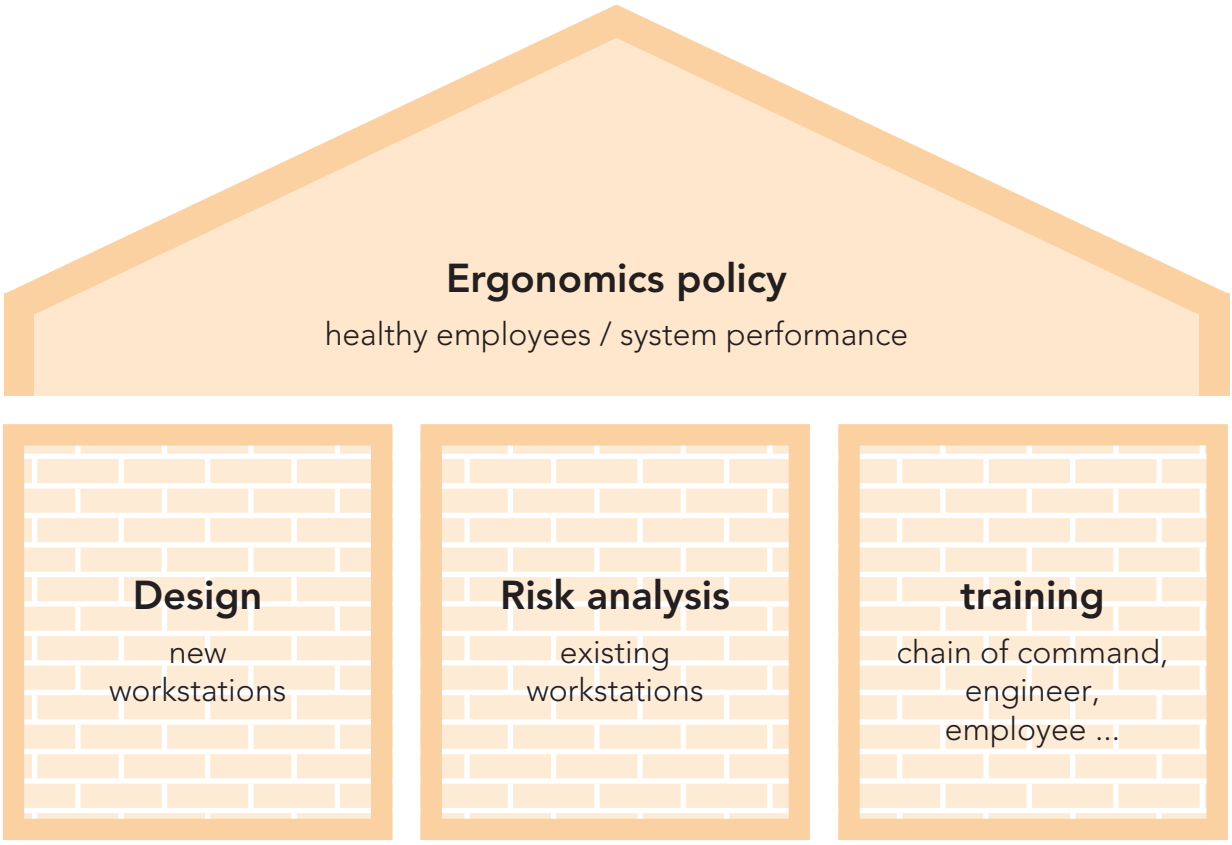
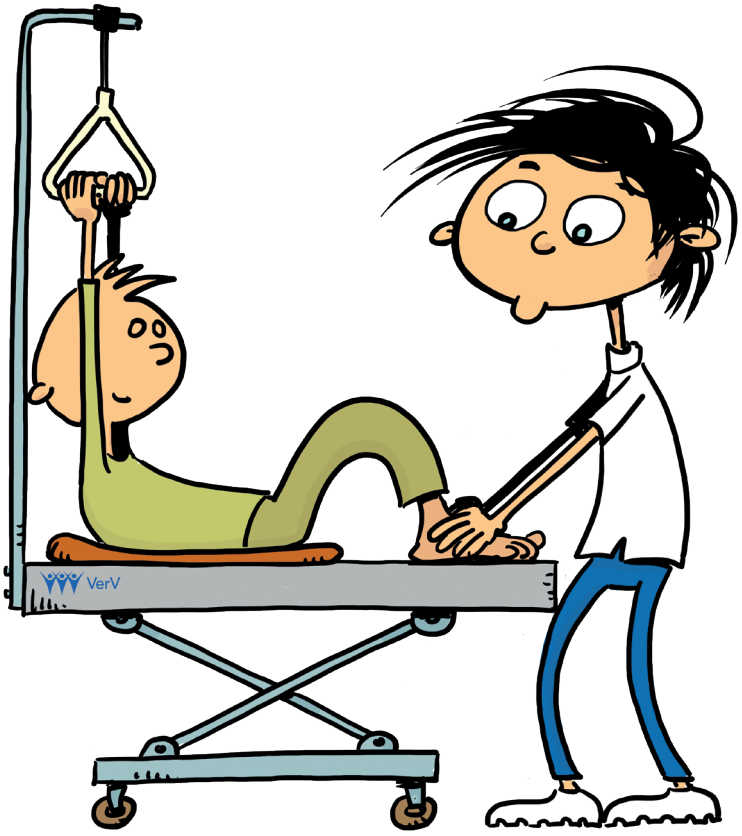


Figure 1: An ergonomic risk analysis is one of three columns that form and support an ergonomics policy, represented as the roof of a house in the figure above. If the columns are insufficiently developed, the roof of the house becomes unstable and the ergonomics policy leaves a lot to be desired.

For these reasons, the professional association for ergonomics *VerV* has drawn up these practical guidelines. They outline the specific elements of an ergonomic risk analysis on the one hand and the different actors involved on the other. Once the ergonomic risks of a task or function have been identified, it is important to assess them in terms of both quality and quantity. The risk analysis is not complete unless it also includes preventive measures and possible solutions. The aim of an ergonomic risk analysis is to reduce physical stress and to allow employees to perform at their best. Ergonomics, after all, is about working in a healthy and efficient manner.

These guidelines are the result of a consensus with ergonomics prevention advisors and are aimed at anyone who is involved with ergonomics or well-being at work in the broadest sense. This is the third "practical guidelines" publication by *VerV*, the two previous practical guidelines focused on office environments and healthcare work.



2. Summary

1

Ergonomic risk analysis distinguishes 12 risks.

Ergonomics recognises risks related to manual load handling, working on screens and unfavourable working postures. In addition, it links environmental factors to occupational health and the cognitive / mental strain to psychosocial aspects.

2

A participatory approach to ergonomic risk analysis ensures that it has a firm foothold in the workplace.

Ergonomic risk analysis is a participatory process by definition, in which the employees are the principal actors. When it comes to their job, they are the experts and good solution providers. Different actors can be involved in ergonomic risk analysis: designers, the chain of command, engineers, prevention consultants, HR staff, etc.

3

Ergonomic risk analysis is quantitative.

To determine the risk of occupational overload, different risk factors are combined and converted into a point score. The result of these quantitative methods is a risk score which expresses the priority of each measure.

4

Ergonomic risk analysis is solution-oriented.

A risk analysis is not an end in itself, but a means to come up with solutions. From the very first participatory steps of the risk analysis, the focus should be on possible measures and improvements. By quantifying the risk, these solutions can be justified and the effectiveness of a preventive measure can be determined.

5

The ergonomics prevention advisor is the expert on ergonomic risk analysis.

Ergonomic risk analysis includes both a qualitative and a quantitative part, which requires an ergonomics expert. The ergonomics prevention advisor works with the different actors in the company, from designers to decision-makers.

3. Five statements

1. Ergonomic risk analysis distinguishes 12 risks

Ergonomics in the workplace means working in a healthy and efficient manner. In order to improve ergonomics, 12 specific risks need to be assessed.

1. Lifting, carrying and holding loads
2. Pulling and pushing
3. Repetitive work
4. Moving of people
5. Working with display screens
6. Working in unfavourable postures
7. Working standing up
8. Working sitting down
9. Particularly strenuous work
10. Kneeling and crouching
11. Cognitive and mental load
12. Environmental factors (noise, lighting, climate, vibrations)

Ergonomics is more than just physical stress. For the employee to function optimally in their work environment, a holistic approach to the person at work must be taken and all these factors must be considered.

The first step in the risk analysis is to make a list of the ergonomic risks associated with each task or function. One task may present several risks. This list will serve as a starting point for discussing the qualitative aspects of the ergonomic risks with the employees. In addition, identifying the risks allows to chose the appropriate analytical method to quantify them. Specific tools exist to quantify each risk. Quantifying the risks gives an idea of their severity, which can help to define priorities for dealing with them.

It is equally important to properly recognise the risk of physical overload in order to take effective preventive measures. For example, repetitive work means repeated handling (> 2 per minute) of light objects (< 3 kg). This requires different measures than when lifting heavy weights (> 3 kg). In the case of standing work, both the static standing as well as the dynamic work while standing should be assessed.

A correct identification of the risks makes it easier to find the main cause and enables us to begin looking for optimisations in the work process or method. At this stage, the risk analysis allows for the possibility to improve not only the well-being of the employee, but also the performance of the system. By looking at ergonomic risks from this point of view, a common language is established between the different actors involved in this step, such as the chain of command, designers, engineers, the internal prevention consultant, etc.

2. A participatory approach to ergonomic risk analysis ensures that it has a firm foothold in the workplace

In order to get a correct picture of the existing risks, they are qualitatively discussed with the employees. After all, an ergonomic risk analysis is never done alone. The employees are the experts when it comes to their job and they know best how to perform their tasks. Because of this, they already know the main problems and are able to suggest probable solutions. Moreover, employees experience their well-being as a whole, making them a source of cross-domain information. This holistic perspective of the human being at work is what makes the participatory approach so powerful.

A good observation of the task or function provides an insight into the work situation and the actions that are being performed. By engaging in a dialogue with the employees and asking the right questions about the existing risk factors, bottlenecks can be identified. This can be done by different actors (superior, designer, decision-maker, prevention advisor, etc.), with or without the support of the ergonomics prevention advisor.

A participatory ergonomic risk analysis can be carried out in three ways:

- To assess a workstation, someone needs to be working at it at all times. This person can be consulted while performing their tasks. Better still, a colleague could explain what is going on, what the most important issues are and where there are opportunities for improvement. To obtain a representative assessment, several employees need to be consulted per task/workstation.

- A second way is in the form of a focus group discussion per function or task. In this scenario, a small group of employees discusses the existing ergonomic risks and possible solutions. The aim is to gain a better understanding of the risk factors that make the work so strenuous. This process takes place outside the workplace, to ensure that sufficient time and insight are given to this participatory analysis. Taking more time also helps to better understand the main cause of the strenuous activity and to find more elaborate solutions. These solutions can be tested against each other, which also creates a support base for the change.

- In the case of a fully participatory approach, employees and other stakeholders are involved throughout the risk analysis. Managers can provide additional input on how to organise the work. Engineers can help to find solutions. Decision-makers will eventually want to gather all this data and make a decision based on cost and effectiveness. Depending on the corporate culture, the risk analysis is carried out with all parties together or stakeholders can be involved in different phases of the process. The ergonomics prevention advisor is the central moderator of the whole process, which aims to optimise performance and well-being.

To ensure proper ergonomics in the workplace, as many employees as possible should be involved in the participatory part of the risk analysis. It is essential that all employees participate in the discussion of the risks and that they all search for improvements. This way, preventive measures will find wider support and possible new ways of working will become more anchored in the day-to-day operation of the company.

The following overview will greatly assist in making a qualitative assessment of the existing risks.

Non-exhaustive list of questions that can be asked in the qualitative phase of the risk analysis to get an insight into the existing risk factors:

1 Lifting, carrying and holding loads

What is the weight of the load?
How often is the load lifted?
What posture is used when lifting?
How is the weight distributed and what is the size of the load?
Does the worker have a good grip?
Is the lifting done with one or both hands?

2 Pulling and pushing

What posture is used?
How often is this task executed?
What is the condition of the floor?
Are there any turns to be taken?
Does the trolley have handles?
Is the pushing/pulling done with one or both hands?
What distance needs to be travelled?
What is the condition of the wheels?

3 Repetitive work

What is the cycle time of the task?
What is the duration (number of hours per day) of the repetitive work?
What postures are used?
How much effort is required by the worker?
Can the worker organise their work (pace, breaks)?
What are the environmental conditions (temperature, draughts, vibrations, lighting)?

4 Moving of people

What is the patient's residual mobility?
What assistive devices are available?
Is there enough room to carry out the transfers?
What are the worker's abilities and limitations?
What is the profile of the client/patient (pathologies, aggressiveness, weight, mobility class)?
What postures are frequently used?

5 Working with display screens

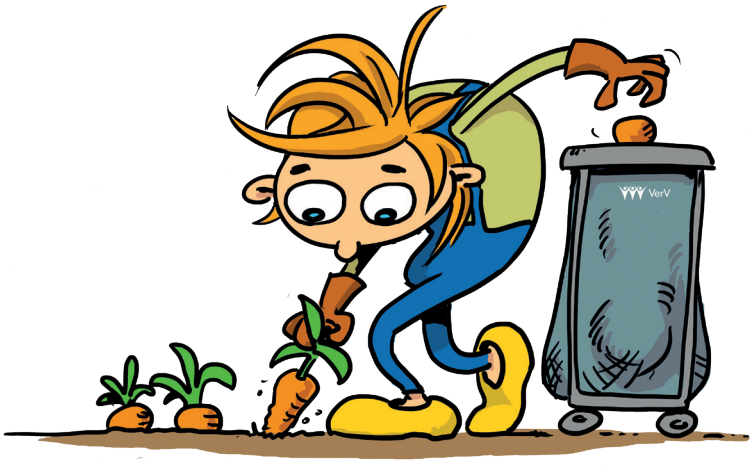
In what ways can the office chair be adjusted?
Can the table be height-adjusted?
Is the screen large enough and readable?
Are the environmental conditions favourable (sound, temperature, lighting)?

6 Working in unfavourable postures

What part of the body (back, shoulder, wrist, neck) is used?
Is it a static or a dynamic posture?
How often is this posture used?
Does this posture involve a great physical effort?
How long is this posture maintained?

7 Working standing up

How many hours a day does the employee work standing up?
Is the employee mainly standing still or walking around?
Does the employee have the possibility to sit down from time to time?
Does the standing work alternate with sitting work?
What posture is used during the standing work?
What are the environmental conditions (temperature, body vibrations)?
What is the condition of the floor?



8 Working sitting down

How many hours a day does the employee work standing up?
How many hours in a row does the employee work sitting down?
Can the employee alternate between sitting and some other posture?
Is the chair sufficiently adjustable?
Are there sit-stand tables available?
Are there high tables available?
Are there dynamic chairs available?

9 Particularly strenuous work

Is there an increase in heart rate or sweat production?
Is the employee physically tired at the end of the working day?
Does the work take place in a hot environment?
How often are loads carried up stairs?
What posture is used for this task?
How long does this task last?
Does the employee have to walk a lot, climb, carry, take the stairs etc?

10 Kneeling and crouching

How often are tasks executed while crouching/kneeling?
How long does this task last?

11 Cognitive and mental load

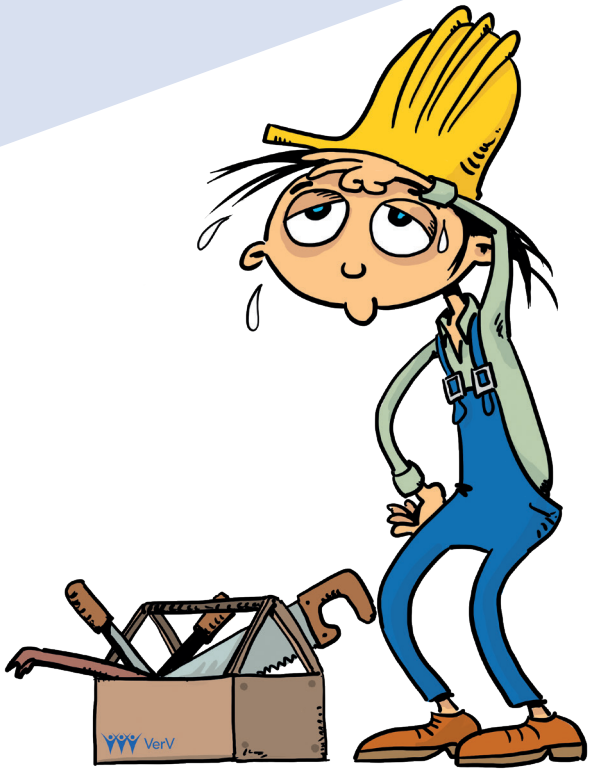
Can the employee choose their own pace of work?
Are there peak moments during the work?
Is the display screen in the employee's field of vision?
Is all information easy to find, read and understand?
Are the controls clear and logical?

12 Environmental factors

Is the work environment noisy?
Does the lighting cast shadows or reflections?
Are there noticeable vibrations on the body?
Does the work take place near a heat source (e.g. an oven) or a draught (e.g. an open door)?

3. Ergonomic risk analysis is quantitative

A thorough and evidence based analysis allows for a quantitative risk assessment. This phase of the risk analysis combines and quantifies various risk factors to obtain a final result in the form of a score indicating the likelihood of suffering a strain injury, often accompanied by absenteeism. Moreover, it makes it easier to identify priorities and take effective preventive measures to reduce the risk of overload. The ergonomics prevention advisor is responsible for the quantification of the ergonomic risks.



3.1. Analysis methods

Risks can be quantified in two ways: detailed or integrated.

- In a detailed risk analysis, each risk will receive its own risk score. The KIM methods are often used for this task, as they express all ergonomic risks on the same scale. This means that a single workstation receives several scores and the highest score is the one that is taken into account. This has the advantage that targeted solutions can be found for each risk and the impact of these solutions evaluated.
- Another approach is to assess all workplaces using an integrated method. All ergonomic risks are then combined into one risk score. For example, larger companies often have their own method to assess all workplaces relatively quickly. The risk scores provide the input for the global prevention plan and the annual action plan. The coarser the method, the more difficult it is to demonstrate the effect of a preventive measure

Depending on the ergonomic culture, risk quantification is carried out in a structural manner and/or in response to musculoskeletal complaints from employees. Dynamic risk management requires a structural risk analysis every five years. This frequency can be increased on the basis of absenteeism figures, complaints or data from other research (e.g. medical examinations). Dynamic work environments with frequent changes in workstations or task allocations also require a higher frequency.

Companies that have integrated the discussion and rating of ergonomic risks into their daily operations do more than merely prevent physical strain injuries.

These companies practice proactive ergonomics, starting with the design of new workstations. They place the human being at the centre of the work process, from different perspectives. In this way, ergonomics will also contribute to quality and productivity and therefore to an improved system performance. In addition, employees will be able to work longer and remain healthier (workable work). A structured and objective approach will facilitate the creation of a support base for both the employer and the employee.

Ergonomics maturity curve

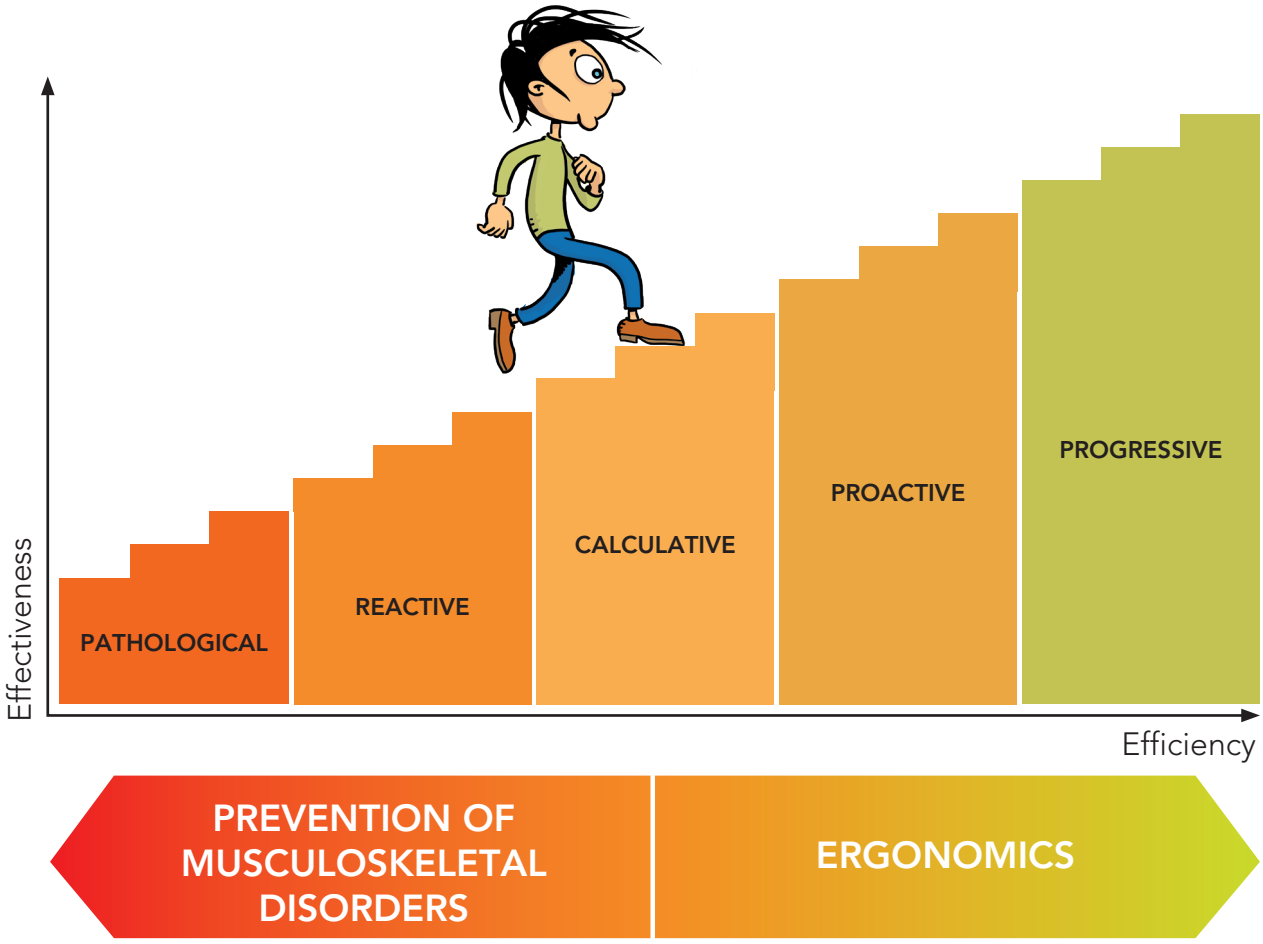


Figure 2: The ergonomics maturity curve reflects the different corporate cultures. A more reactive company culture has to deal with physical strain injuries or musculoskeletal disorders, while proactive and progressives companies are strongly committed to the pursuit of ergonomics. The latter group will see their system efficiency and effectiveness increase. (figure inspired by Humantech)

3.2. Objective measurements

In addition to the use of analytical methods, risk can also be quantified by objective measurements.

- Postures can now be measured quickly with the help of 3D recording methods. Using sensors or artificial intelligence, it is possible to create an avatar from the operator's posture, on which all calculations are then made. This data can also be used to feed biomechanical models that provide information on the total burden on the body.
- Force can be measured using electromyography. Muscle activity can be recorded using surface electrodes. Muscle activity during work is usually expressed as a percentage of the maximum voluntary contraction.
- Fatigue can be measured using heart rate measurements. Just as a top athlete trains within a certain intensity zone, an operator will also work in a certain heart rate zone. On this basis, a task or subtask can be categorised as light, medium or heavy.
- Tensile and compressive forces are measured using a dynamometer. This device uses a tension spring which records the force required to move a trolley or keep it in motion. The measured values can then be compared with reference values from studies, e.g. Snook's tables

These measurement methods require sufficient training and experience. For this reason, they must be carried out by the ergonomics prevention advisor, possibly in collaboration with a research institute.

3.3. Design guidelines

Ergonomics are most effective during the design phase of the workstations. By designing workstations according to these guidelines, the design will result in an acceptable physical burden. Therefore, these guidelines can also be used as criteria for the "three green lights" procedure. After all, when designing a workstation it's possible to fully commit to prevention. This also avoids any surprises during the ergonomic risk analysis.

The following is a non-exhaustive list of design guidelines:

1 Lifting, carrying and holding loads

Max. weight to be lifted under optimal conditions: 25 kg (EN1005-2, ISO11228-1)
Max. weight to be lifted frequently during a working day: 15 kg (EN1005-2, ISO11228-1)
Max. tonnage during a working day: 10 000 kg (ISO11228-1)
Max. weight to be carried: 15 kg (ISO11228-1)
Max. weight to be lifted above shoulder height: 10 kg (HSE)

2 Pulling and pushing

Max. slope angle: 2 ° (4 %) (KIM)
Max. weight of pallet: 500 kg (INRS)
Max. weight of trolley: 350 kg (INRS)
Max. weight of bed + person: 150 kg (INRS)
Max. distance covered: 60 m (INRS)

3 Repetitive work

Up to 2 continuous hours without a 10 minute break (moderate frequency and force) (OCRA)
Up to 30 hand movements per minute (EN1005-5, ISO11228-3)

4 Moving of people

Clearance: min. 90 cm
Bed width: min. 105 cm
Turning radius for wheelchair: min. 150 cm
Turning radius for wheelchair and assistant: min. 175 cm
Wheelchair width: min. 90 cm
Wheelchair depth: min. 120 cm
Wheelchair free legroom: min. 75 cm high
Operation: min. 90 – 120 cm

5 Working with display screens

Clearance for individual workstations: min. 90 cm (NEN1824)
Clearance for side-by-side workstations: min. 120 cm (NEN1824)
Clearance for back-to-back workstations: min. 180 cm (NEN1824)
At least 6 m² per person (NEN1824)
At least 1 m² per cabinet, door, extra working area, etc. (NEN1824)
Dynamic office chair (NPR1813 and EN1335)
Adjustable table and sit-stand table (EN527)
Large screen (> 19'')
Block light sources from the back
At least 2 m depth of visibility
Maximum 4 persons per room

6 Working in unfavourable positions

Maximum reaching distance: 180 cm (DINBelg)
Max. 2 times per minute (tpm) further than 60 cm (reaching distance) (EN 1005-4)
Max. 2 tpm lower than 45 cm (knee height) (EN 1005-4)
Max. 2 tpm trunk flexion of more than 60 ° (EN 1005-4)
Max. 2 tpm shoulder flexion of more than 60 ° (EN 1005-4)
Max. 25 % of the work time: static back or shoulder flexion (ISO11226)

7 Working standing up

Max. 4 h per day standing in a confined space (< 2 m) (WHI)
Max. 1 h of continuous standing in a confined space (WHI)
Min. 3 x 15 minutes of break in case of static standing work (VerV-tool standing work)
Min. 2 × 15 minutes of break in case of walking/standing work (VerV-tool standing work)

8 Working sitting down

Max. 2 h of continuous sedentary work without a 15 minute break (WHI)
Max. 6 h per day of sedentary work (WHI)

9 Particularly strenuous work

Max. time spent climbing a ladder: 10 minutes per working day (KIM)
Max. time spent climbing stairs:

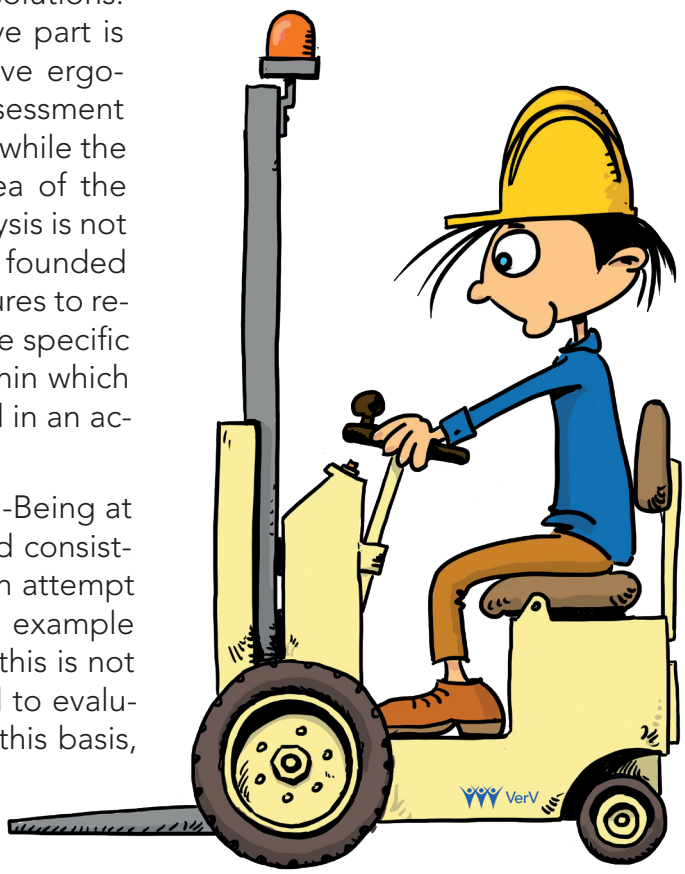
- without a load: 10 minutes per day for steep stairs, 30 minutes per day for regular stairs (KIM)
- with a load of 10 kg: 10 minutes per day (KIM)

10 Kneeling and crouching

Max. 15 consecutive minutes* (WHI)
Max. 30 minutes per day* (WHI)
Max. 30 times per hour* (Arbo)
Max. 1 minute per hour* (Arbo)
(*without PPE)

4. Ergonomic risk analysis is solution-oriented

The ergonomic risk analysis is not an end in itself, but a means to come up with solutions. The starting point for the participative part is the correct identification of the twelve ergonomic risks. The qualitative risk assessment provides insight into the bottlenecks, while the quantitative assessment gives an idea of the extent of the risk. However, a risk analysis is not complete if it does not include well founded advice and effective preventive measures to reduce the risk of physical overload. The specific actions, as well as the time frame within which they will be carried out, are described in an action plan.



Book VIII of the Belgian code on Well-Being at Work deals with ergonomic stress and consistently uses the same rationale. First, an attempt is made to eliminate the hazard, for example by avoiding manual load handling. If this is not possible, a risk assessment is needed to evaluate the risk of physical overload. On this basis, the necessary preventive measures are developed, with respect for the prevention hierarchy.

The prevention hierarchy

- Risk elimination: automation, lift trolleys or electric pallet truck
- Substitution: pushing instead of lifting, pushing/pulling instead of carrying
- Collective protection: scissor tables, standing mats, roller conveyors, placing objects at an appropriate height
- Personal protection: knee pads, passive exoskeleton
- Organisational: training, job rotation, process optimisation
- Signage: indicate heavy weights, instructions

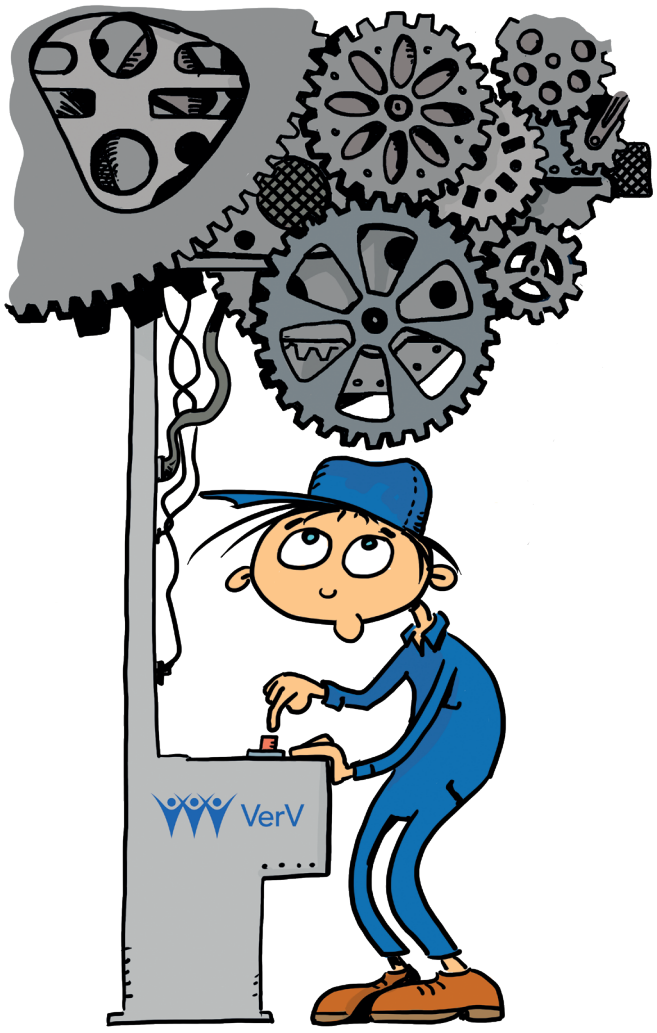
Because the prevention hierarchy was developed from the point of view of occupational safety, with a direct link between cause and effect, this classification is not always obvious in the context of ergonomics. That is why the Netherlands proposes the TOP approach: technical, organisational and personal. Technical solutions can tackle problems at the source, e.g. an electric pallet truck to replace manual pulling and pushing. These measures are the most effective. Organisational is about reducing exposure by rotating jobs or eliminating redundant actions. For example: creating a passageway can reduce the pushing distance. Finally, there are the personal measures, of which training is the best known. This comes last in the list of possible solutions.

However, standard solutions are not always possible. Tailor-made solutions are often needed for a given context. The existing working methods are often the result of historical decisions or other factors which affect the workflow. The implementation of preventive measures such as technical aids or changes in working methods require a thorough analysis of the impact on the working process. The risk analysis should also take into account the introduction of new risks. Finally, it may be of interest to study the impact of the changes on other KPI's, such as quality and productivity.

In order to create a sufficiently large support base for the chosen solution, it is advisable to test the proposed solutions thoroughly before making a final choice. Once again, it is important to involve as much employees as possible. After the implementation of a preventive measure, it can be subject to a reassessment of its ergonomic risks, as well as to a cost-benefit analysis in order to compare the effectiveness of each measure. The ergonomics prevention advisor's involvement is essential at this stage. The risk analysis is not completed until after the final implementation of the preventive measures.

5. The ergonomics prevention advisor is the expert on ergonomic risk analysis

At present, however, Book VIII of the Belgian code on Well-Being at Work refers to the competent prevention advisor who must give an opinion on the risk analysis. This is the person who is referred to in the identification document as the ergonomics expert.



There is an urgent need to revise this legislation: the ergonomics prevention advisor should be included in Book VIII "Ergonomic stress" as the competent prevention advisor. An ergonomics expert is a prevention advisor who has a specialised master's degree, at least three years of experience and who receives at least 16 hours of additional training per year.

Different actors work together to prevent physical overload: management, the chain of command, designers, the prevention advisor and all the other parties involved in the health policy. They all have a role to play in the ergonomic risk analysis process.

Quantifying and measuring risks is the responsibility of the ergonomics prevention advisor. Their expertise is required because of the complexity of physical overload and the interaction between the different risk factors.

Ergonomic risk analysis is one of the building blocks of a company's ergonomics policy. The ergonomics policy is in turn part of the overall health policy. A policy only really comes to life if it is sufficiently talked about. Only then does it become fully embedded in a company's daily operations and can ergonomics be practised proactively. The ergonomics prevention advisor is the right person to help develop this policy in all its aspects.

AN ERGONOMIST is ...

An expert on Book VIII "Ergonomic stress" of the code on Well-Being at Work.

He is the expert and competent prevention advisor for ergonomic risks. There is an urgent need to adapt the legislation and to include the ergonomist as primary prevention advisor.

An expert on physical strain at the workplace.

Physical overload is a complex subject that requires a lot of experience. An ergonomist takes a structural approach to analysing risks and solutions. They report directly to the CEO or the head of the internal department.

A designer.

Ergonomics is particularly effective during the design phase or when purchasing new materials. Identifying and preventing problems and difficulties is the key to success. A good design should always be ergonomic.

A participatory problem-solver.

The ergonomist places the human being at the centre of the design and analysis. By involving the employees, who are experts when it comes to their job, effective and sustainable solutions are created

A close colleague of the internal prevention consultant.

The internal prevention consultant coordinates and coaches at the workplace, follows up the preventive measures and ensures that the wellness policy is firmly anchored within the hierarchical structure. The ergonomist provides substantive ergonomics support.

A close colleague of the ergonomics coach.

A workstation is only ergonomic if people use it correctly. Using the design or analysis as input, the ergonomics coach can correctly teach the working methods.

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