

viveLab  
ERGO

PEOPLE CENTRIC TECHNOLOGY

## CASE STUDY

### WORKPLACE MONITOR

ERGONOMIC WORKPLACE ASSESSMENT  
AND SUGGESTIONS FOR REDESIGN

# WORK PROCESS DESCRIPTION

On the examined packaging workplace 45 kg industrial vacuum cleaners are being packaged into cartons by female employees. Three packages are put a pallet than it is strapped. For moving the boxes a lever could be used. Employees don't dare to use the lever because its inadequate design makes actuation unsafe, they rather use their physical power.

The packaging of a vacuum cleaner takes 5-6 minutes, strapping takes 2,5 minutes approximately.



THE WORK PROCESS CONSISTS OF THE FOLLOWING PHASES:



# ASSESSMENT DATA

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**Date of assessment:** 13.12.2016.

**Observed/ Recorded cycles:** During the assessment the three vacuum cleaner packaging work cycle was recorded with motion capture technology. In one case the lever was used, while in the other two cases the employee used physical power to complete the task. A separate recording was made of the strapping of the three packaged vacuum cleaners on the pallet.

**Data of the assessed person:**

**Name:** Andrea  
**Gender:** Female  
**Age:** 44 years  
**Height:** 168 cm (54 percentile)

# OBJECTIVE ANALYSIS RESULTS

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Various ergonomic analysis methods (RULA, ISO11226, EN 1005-4) support that the employee is under serious physical stress during the whole 8 hour shift. It is a serious problem is that the current layout demands static and forced postures as well.

**Based on RULA detailed statistics:**

- asymmetric body and neck postures occur approximately in half of the work cycle
- shoulders are lifted in 60% of the work cycle
- neck leans back in 33% of the work cycle
- intensive wrist movements even in the extreme zones:
  - during the work cycle the left wrist leans upwards in 29% of the time in >15°, in 44% of the time towards the thumb and in 33% towards the little finger
  - during the work cycle the right wrist leans upwards in 36% of the time in >15°, in 26% of the time towards the thumb and in 53% towards the little finger

The implemented version of ISO 11226 standard defined 40 static postures (postures that are held longer than 4 s) during the work cycle, the most critical ones are listed below:

- neck twist is being held for more than 9 s in an average angle of 25° that repeatedly occurs during the work cycle
- neck bending for more than 9 s in an average angle of 44°
- trunk bending for more than 4 s in an average angle of 92°
- right arm elevation for more than 8 s in an average angle of 71° that repeatedly occurs during the work cycle
- left arm elevation for more than 9 s in an average angle of 75° that repeatedly occurs during the work cycle

The implemented version of EN1005-4 standard defined 33 postures that occur with high frequency (these occur more times than it is allowed by the standard), the most critical ones are listed below:

- trunk twist occurred 27 times in a minute
- trunk bend occurred 23 times in a minute
- left arm elevation in >60° angle occurred 15 times in a minute
- right shoulder elevation occurred 24 times in a minute
- trunk bend in >60° angle occurred 9 times in a minute

## SUGGESTIONS FOR REDESIGN

The aim of the redesign is to minimize force exertion and optimize postures that occur during the work cycle.

### SUGGESTED PHASES OF THE WORK PROCESS:

0

**Testing** vacuum cleaner

1

**Fixing** of carton bottom and placing folded carton parts in it

2

**Preparing** vacuum cleaner for packaging

3

**Wheeling** the vacuum cleaner into the box on a relay platform, folding carton parts and putting them into the box, then close the carton by stapler

4

**Lifting** the carton to a vertical position

5

**Slithering carton onto the pallet with the help of the roller lifting table**

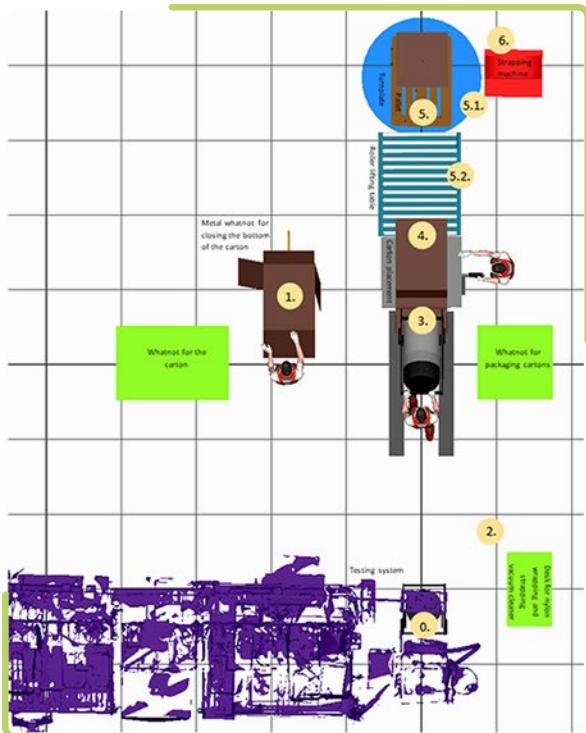
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**Turning** the pallet by 90° on the turnplate for strapping

**5.1.** In case of the second package turning the turnplate by 180°, then slithering the carton onto the pallet

**5.2.** In case of the third package placing it horizontally on the roller lifting table, then lifting the desk and placing it on the previous two packages

The suggested layout may not work out as presented in the picture, but to secure constant paths, it may be implemented in another direction, possibly parallel to the production line.



Suggested layout

The ideal solution for preserving the employee's health would be the following: after placing the carton on the metal whatnot, then the folded carton parts should be put in to fix the vacuum cleaner's position.

The carton parts for fixing should be secured with a two sided adhesive tape, those can not move in the box afterwards.

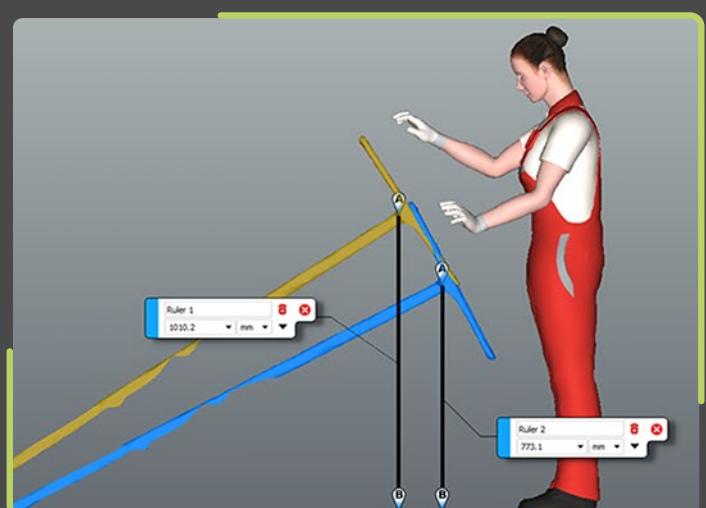
## 2. stage

The nylon packaging and strapping should be done near the testing system. The tools needed are to be placed on the side of the table.

## 1. stage

The currently used metal whatnot for fixing the bottom of the carton can be used onward but its placement and height should be changed. The height of the metal whatnot's bearing bar should be 1010 mms. The occurrence of the 62° angle trunk bend and the asymmetrical postures during the task execution make it necessary to change the height. In the 2nd picture the yellow panel shows our suggestion to replace the original blue one. The current solution's height data was gained from the scanned environment data.

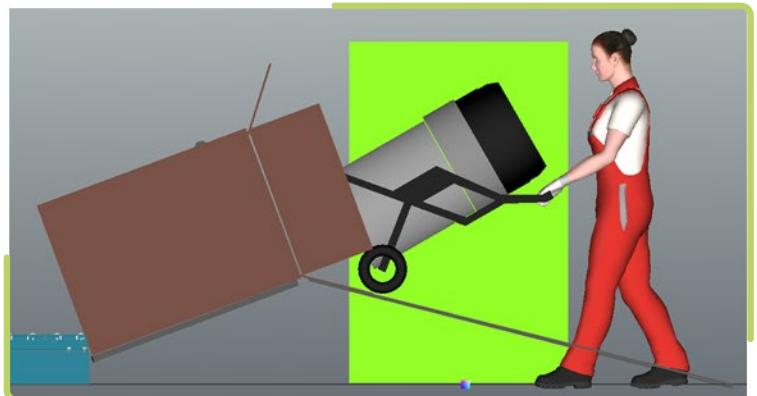
The metal part should be placed opposite to the testing system. Cartons should be stored on the shelves on the employee's left hand side.



Metal whatnot, original (blue)  
and optimal (yellow) height

## 3. stage

We suggest that instead of rolling the vacuum cleaner into the box on the ground or doing the placement with the lever, the employee should roll it into a box located on a 20° slope using a relay platform. The employee doesn't go up the slope she advances in the middle on the ground. On the relay platform a guide secures that the vacuum cleaner doesn't fall off during the process.

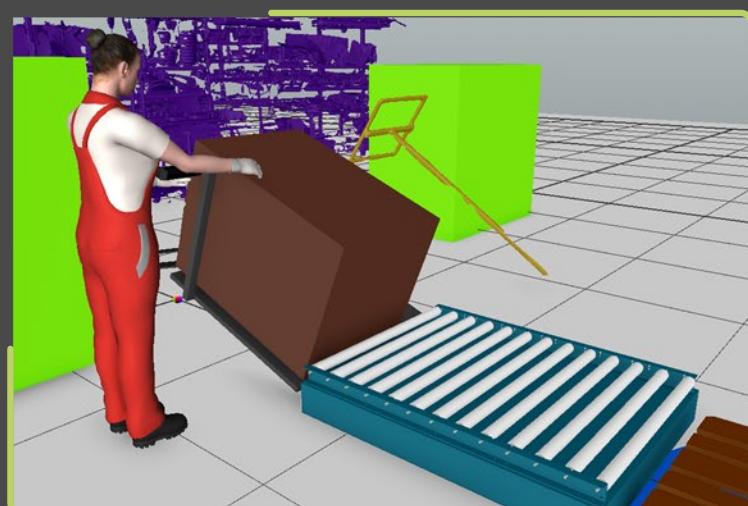


*Rolling of the vacuum cleaner into the carton on a relay platform*

The handrails placed on the sides stop the employee from stepping over the relay platform which may cause accident. The carton parts used for packaging can be taken off from the selves near the relay platform and can be placed in the box then the top can be closed by the stapler.

## 4. stage

After placing the vacuum cleaner in the carton the employee should stand by the side of the relay platform, she should push the handle upwards to lift the box in a vertical position onto the roller lifting table.



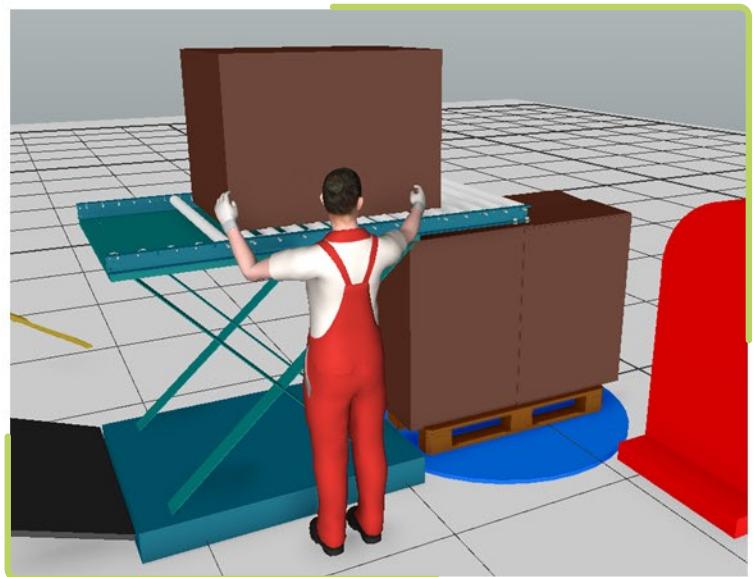
*Moving carton into a vertical position*

## 5. stage

With the help of the roller lifting table the package can be easily slithered to the pallet.

5.1. The pallet stands on a turnplate that makes it possible for the employee to turn it by 180° so the second packaged vacuum cleaner also can be placed on the pallet simply.

5.2. The packaged third carton is placed on the roller lifting table horizontally, then the desk is raised to the height of the already packaged cartons. Since the roller is in a guide it can be moved onto the top of the two other cartons then the placement of the third box is easy.

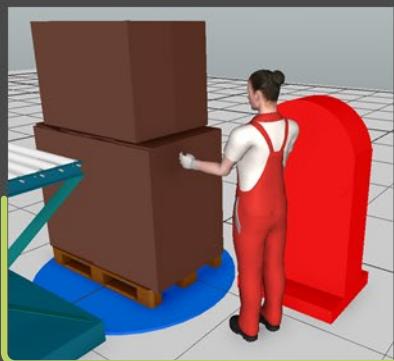


*Moving of the third carton onto the two packages on the pallet*

## 6. stage

For strapping the pallet we suggest the use of ErgoPack pallet strapping system that makes strapping possible without bending. The employee can stand near the machine through the process. The use of this machine makes strapping faster.

If the three packaged vacuum cleaners are turned by 90° with the help of the turnplate then Ergopack can process strapping.



*Strapping the pallet*



*ErgoPack strapping system*

The pictures are made with ViVeLab Ergonomic System to help understanding the de-scribed problems. This documentation contains only theoretical solutions, not technical ones.

The documentation can be used as requirement specification but for implementing technical solutions the manufacturer should be consulted to reach appropriate solution for preserving employee health.