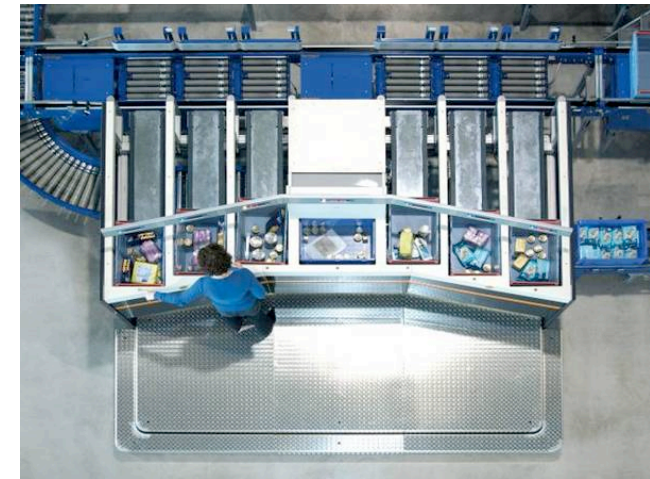


Improving productivity and working conditions in three cases

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TNO | Knowledge for business



Challenges for European companies in industry

Customers demands in industry:

- Large variety of customized products
- Shorter delivery time, lower costs and higher quality
- Flexibility in volumes and product mix

Work force:

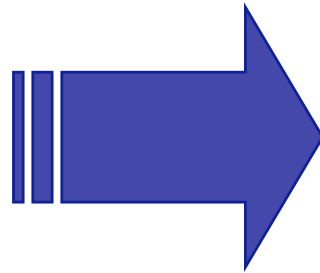
- Ageing work force
 - Work-Related Upper Extremity Disorders (WRUED) causes productivity losses and costs
 - increasing awareness to keep human workers healthy
- Need to improve the flow of production orders together with a more efficient and healthy employment of workers.



Case 1: Changing from batch to flow assembly in the production of emergency lighting

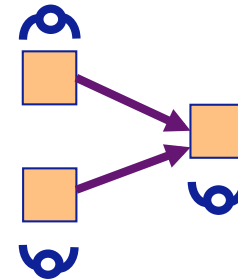
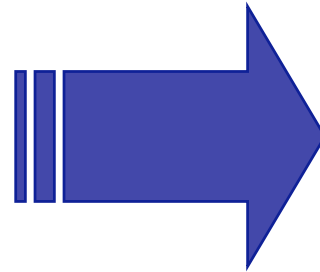
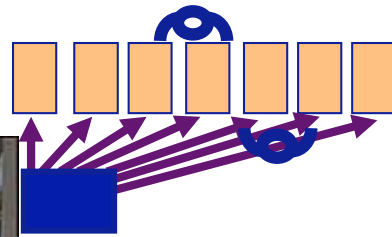


Pre-assembly



- One piece (carrier) flow instead of batchwise (five carriers)
- Smaller carriers to bring all boards within optimal reach
- Job rotation across the 'positioning' and 'soldering/inspection' stations
- Components within reach in tilted boxes for better access
- Improved lighting
- Height adjustable tables

Final assembly



- one piece flow instead of batchwise
- job rotation across the two types of work station
- all components within reach; in small tilted boxes for better access
- fixture to tilt the product into the right position
- main (screwing) tools within reach and weightlessly balanced
- improved lighting
- height adjustable tables

Results

	%
Through put time of a batch (60 products)	-46%
Time/person/product	-31%
Products/person/day	+44%
Required space	-44%
Reduction of hazards of <i>lifting</i> in new situation	
No increased risk regarding the <i>frequency</i> and <i>postures</i>	
Reduced experienced <i>fatigue</i> in new situation	
improved <i>job satisfaction</i> in new situation	
Experienced <i>mental work load</i> did not change	



Tool for estimating costs and benefits

<http://www.crfproject-eu.org> (click CyberManS)



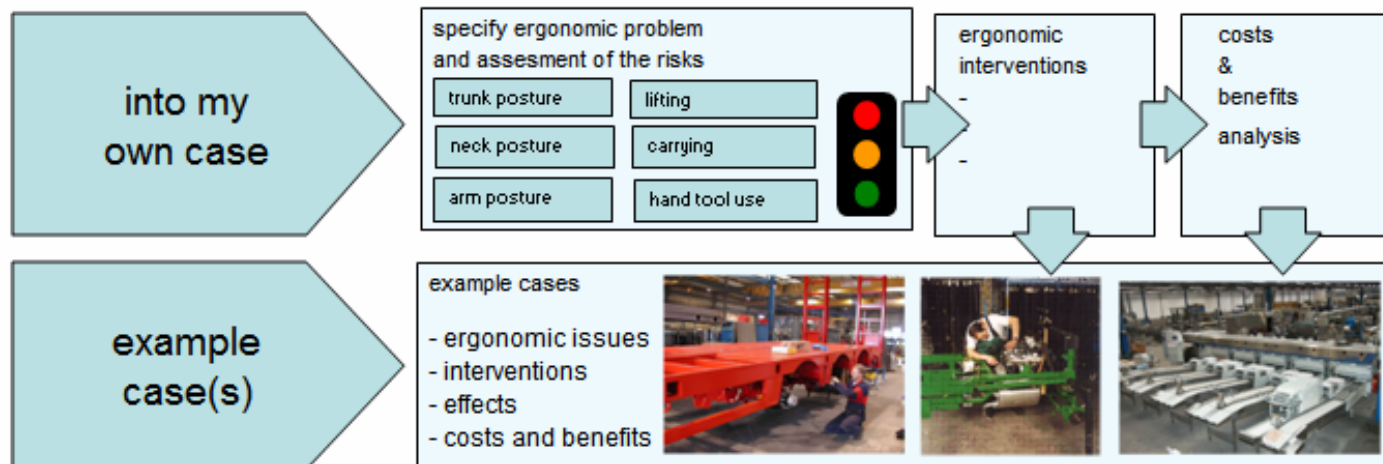
You may experience ergonomic problems in production.

There may be various ergonomic solutions. But what are their costs and benefits?

This tool helps you to specify the ergonomic problem and potential solutions

This tool helps you to make an estimation of the costs and benefits

please select one of both options



*This tool was developed within the EU project CyberManS - Call: FP6-2004 – IST-NMP-2, STREP Project n°016712
It cannot be copied or given to third parties without permission from the CyberMans consortium*



	One-time investments	Annual operational costs and benefits (over a 5 years period)
COSTS		
Personnel		
Internal personnel (participation in the project)	13.500	
External personnel (consultancy)	32.710	
Material		
Purchase of equipment for final assembly	45.000	
Related interest charge*		1.755
Purchase of equipment for print assembly / interest charge	50.000	
Related interest charge*		1.950
Total investments / depreciation costs (5 years)	141.210	28.242
Total operational costs		31.974

Costs

BENEFITS		
Productivity		
Less people required for same production output in final assembly		74.400
Less people required for same production output in print assembly		130.200
Quality		
Less re-work due to fewer failures in print and final assembly		27.250
Sick leave		
Less overtime by own workers to replace the sick workers		15.913
Total operational benefits		247.763

Benefits

Increased productivity by 44%

Current sick leave: 7%
 Assumptions:
 • 40% physical complaints
 • 45% caused by work
 • 30% reduction of complaints means:
 New sick leave: 6,6%



Case 2: workstation design in highly automated ware houses.



Design of different concepts in the Ergomix

two-level
versus
one-level



- Less high and far and less frequent reaching (upper arm elevations)
- Improved accessibility, especially for small operators (5th-percentile)

Prototype of PICK@EASE 4:



one level order picking

slightly curved front

*height adjustable
platform*



Test Sustainable Performance

- During a 4-hours working period (including a 15 min break)
- Performance during the 4 hours?
- Physical and Mental Load during the 4 hours?

Kinematics



Muscle fatigue



Mental fatigue



Local discomfort



Energetics



Results for test workstation for 4 working hours

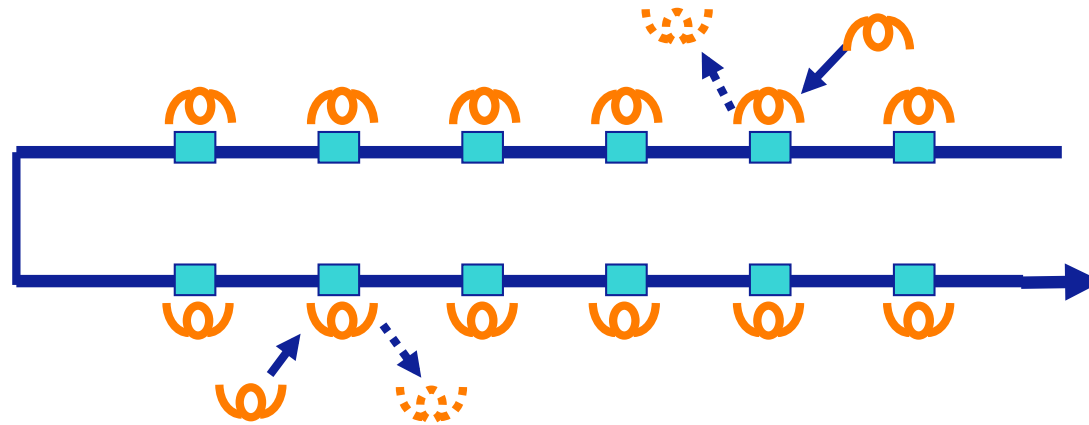
- No significant decrease in work pace chosen by the operators
 - the work pace was similar to the MTM-analysis
- No significant increase of physical or mental loads;
 - no increase in discomfort; local discomfort at acceptable levels
 - no increase in energetic loading
 - no signs of forearm muscle fatigue
 - no increased risk regarding the frequency and movements of the upper extremities in 4 hours

Duration	Risk assessment upper extremities
2 hrs	Green
4 hrs	Green
6 hrs	Yellow
8 hrs	Red

A one level order picking concept opens the way for a sustainable performance without increased health risks for a 4-hours period

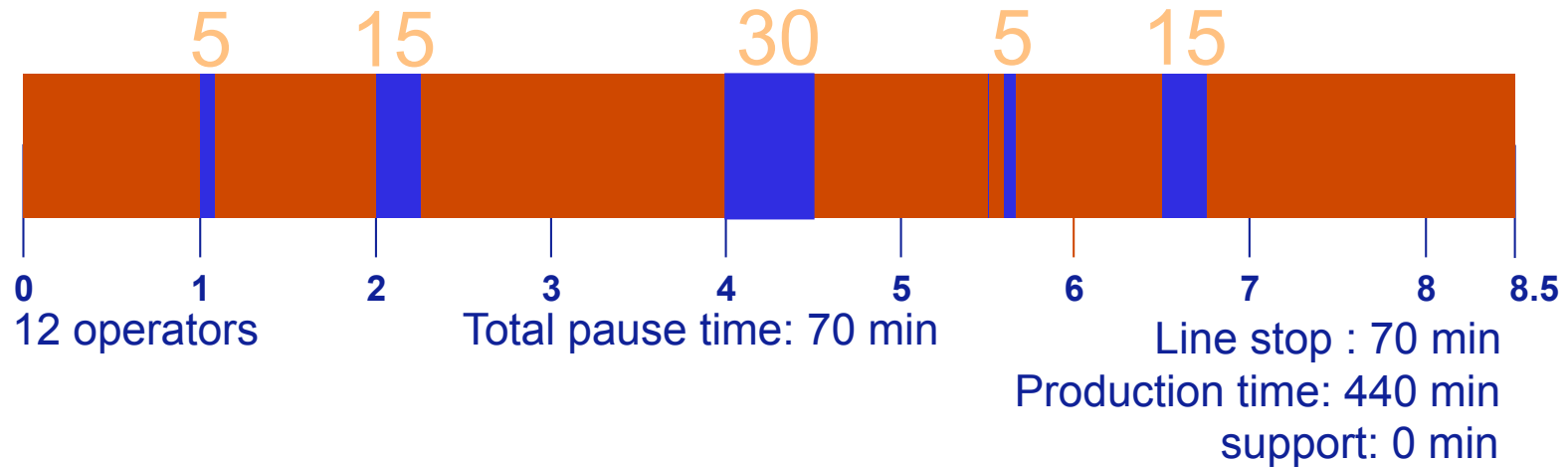


Case 3: Work rest schemes at Philips shavers

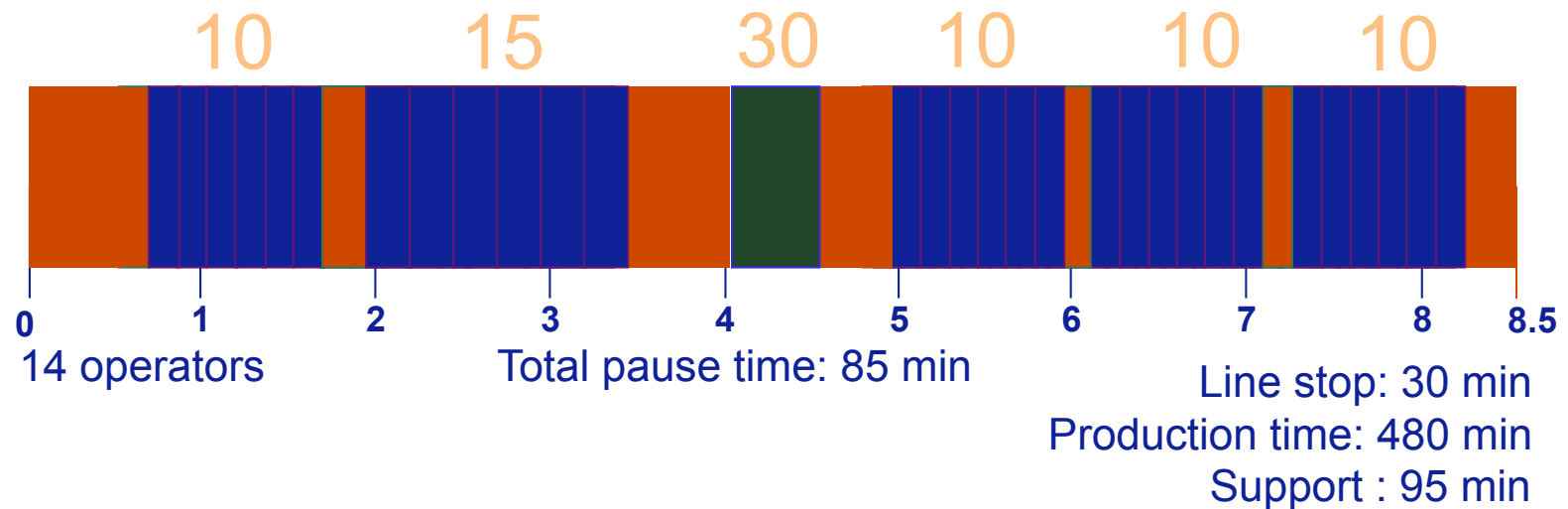


Work rest schemes

traditional



Alternating pause scheme



Effects of alternating pause scheme

productivity per worker per minute working time (i.e. pace)	+ 3%
productivity per worker per day	constant
line output (numbers of products per day)	+16 % *
quality (repair numbers)	constant
physical load - local discomfort in neck/shoulder region - total fatigue	- 28 % - 18 %
mental load	constant
costs	constant **
workers satisfaction	90% ***

* 9% by more running time, 3% by higher pace, 4% by other (reduction of 'grey pauses')

** main cost advantage: no extra shift or extra line

*** only in peak periods due to social aspects



Conclusions

- Cases show improvements of both productivity and working conditions by innovations in production systems, workstations and organization.
- Human factors (health, ergonomics) should be linked to business strategies and performance measures.
- MSD requires an integrated approach: combination of interventions on organizational, workstation and individual level.

