APPROCCI INTERDISCIPLINARI IN REUMATOLOGIA

9ª edizione

RIABILITAZIONE E MALATTIE REUMATICHE

TORINO, 8-9 ottobre 2021

Economia o Ergonomia del movimento ?

Figure 1: Percentage of workers reporting different musculoskeletal disorders in the past 12 months, EU-28, 2010 and 2015

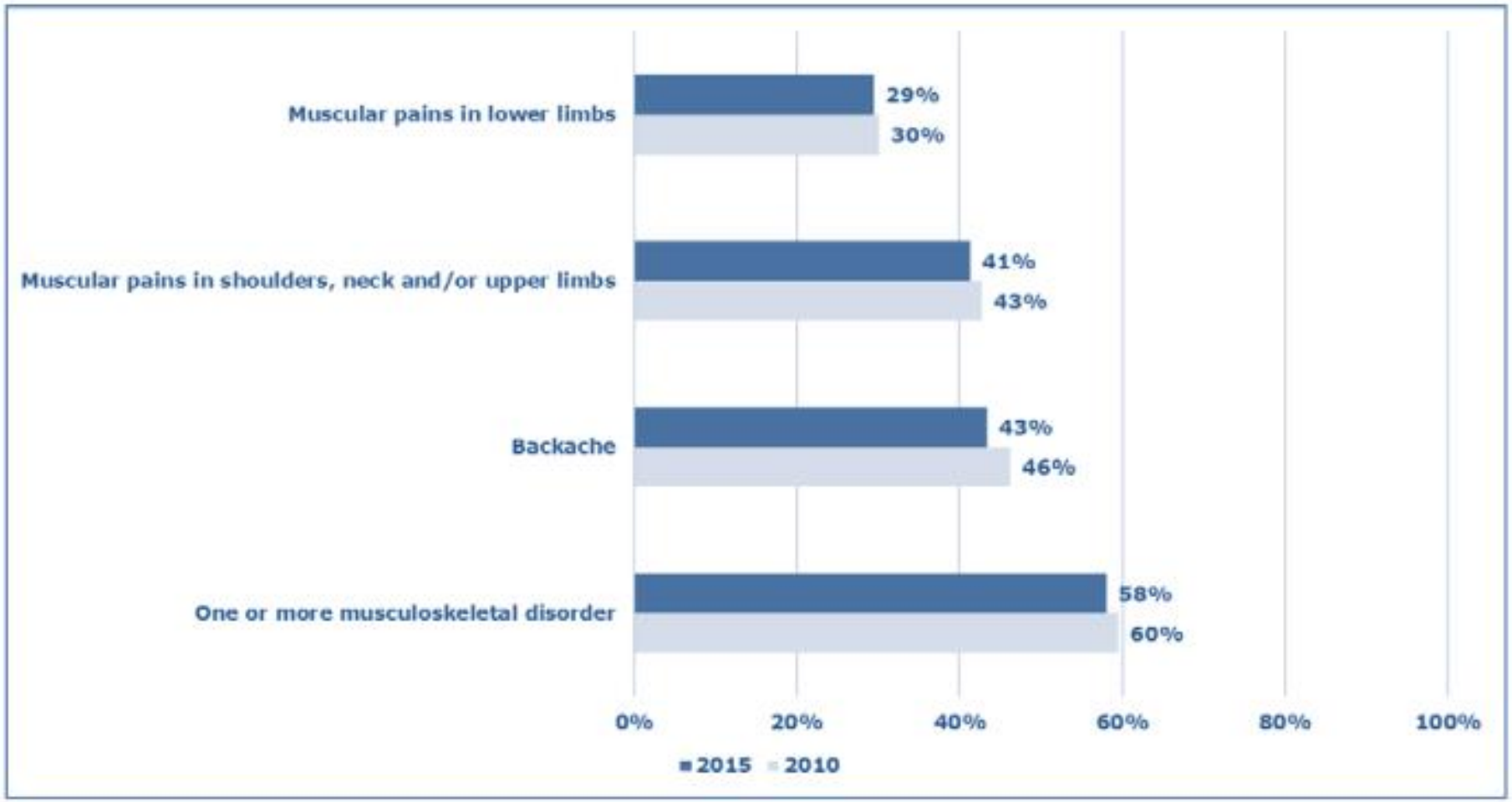
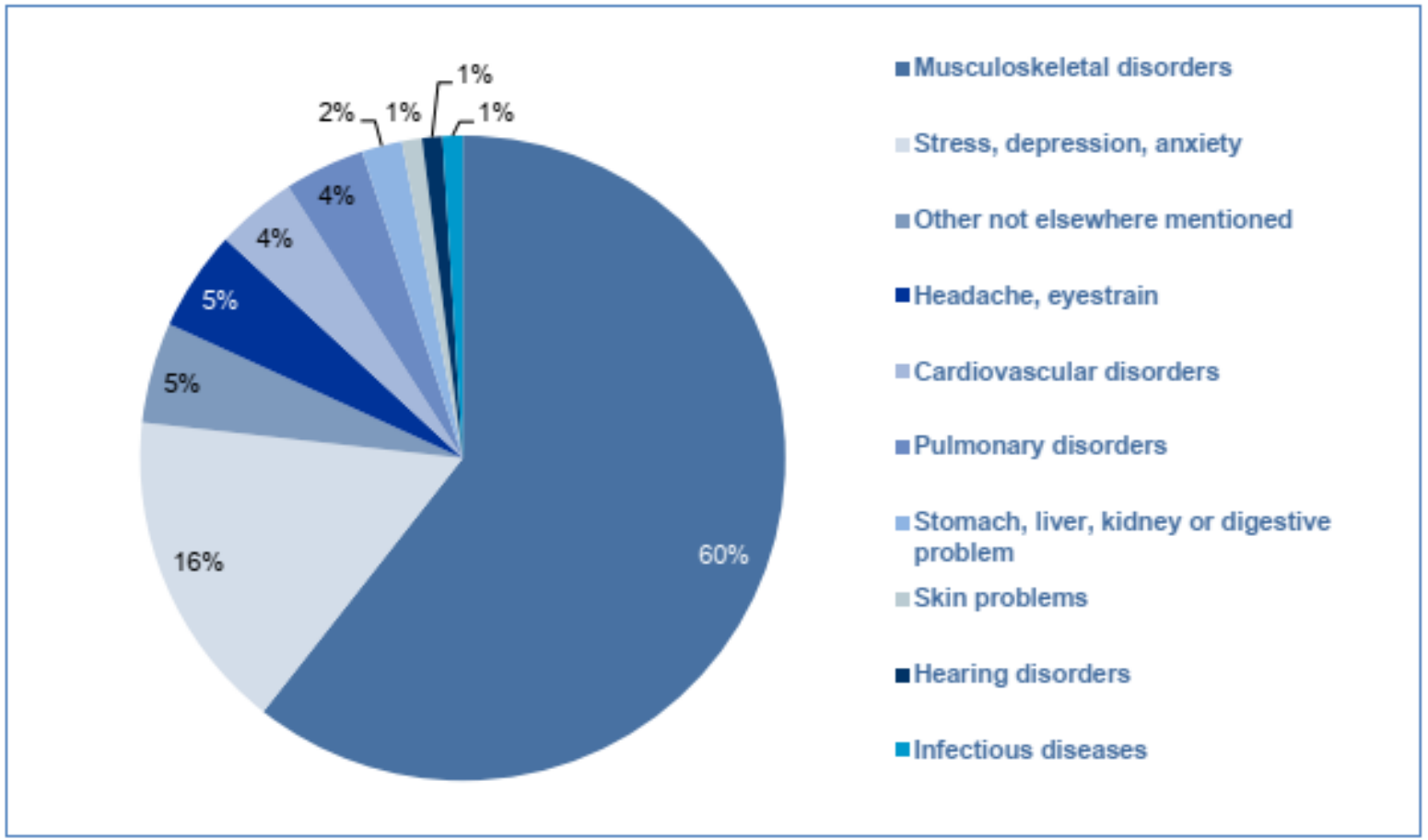


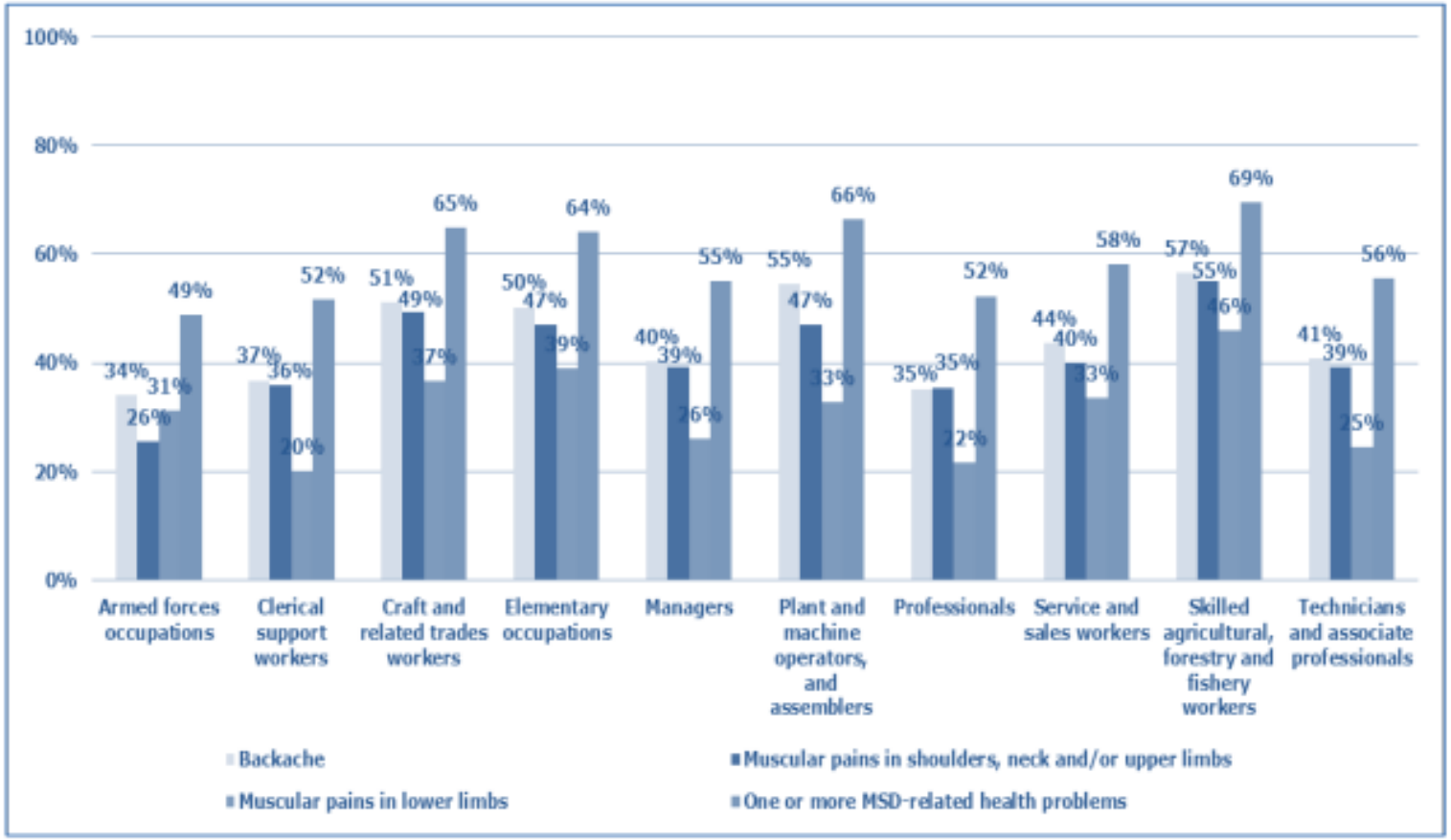
Figure 2: Percentage of workers reporting a work-related health problem, by type of problem, EU-27, 2013



Note: The population of workers includes everybody aged 15 to 64 who was working or had worked during the past 12 months before the survey took place.

Source: Eurostat, Labour Force Survey ad hoc module 'Accidents at work and other work-related health problems' (2013). All EU Member States participated in this ad hoc module except for the Netherlands.

Figure 4: Percentage of workers reporting different musculoskeletal disorders in the past 12 months, by International Standard Classification of Occupations 2008 (ISCO-08), EU-28, 2015



N = 35,536

Source: Panteia based on the sixth (2015) wave of the European Working Conditions Survey (EWCS)

Musculoskeletal disorders (MSDs) remain the most common work-related health problem in the EU, and workers in all sectors and occupations are concerned. Besides the effects on workers themselves, MSDs lead to high costs to enterprises and society as a whole.

IEA
International Ergonomics Association

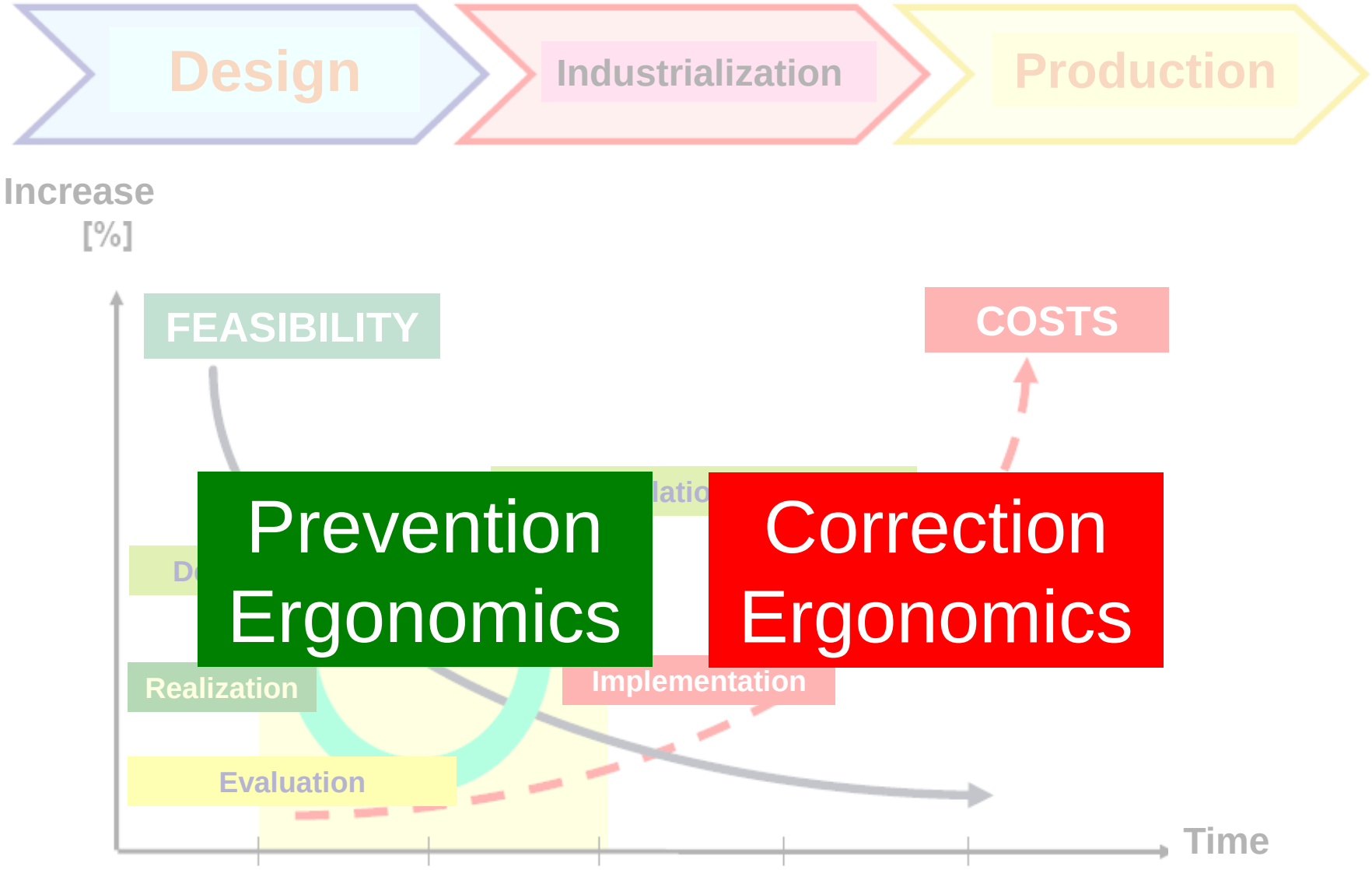
In August 2000, the IEA Council adopted an official definition of ergonomics as shown below:

The Discipline of Ergonomics

Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.

Ergonomists contribute to the design and evaluation of tasks, jobs, products, environments and systems in order to make them compatible with the needs, abilities and limitations of people.

http://www.iea.cc/ergonomics/



ISO 6385 - Adapted from Caragnano, 2006

Engineering controls

To eliminate or reduce the risk factors from the job

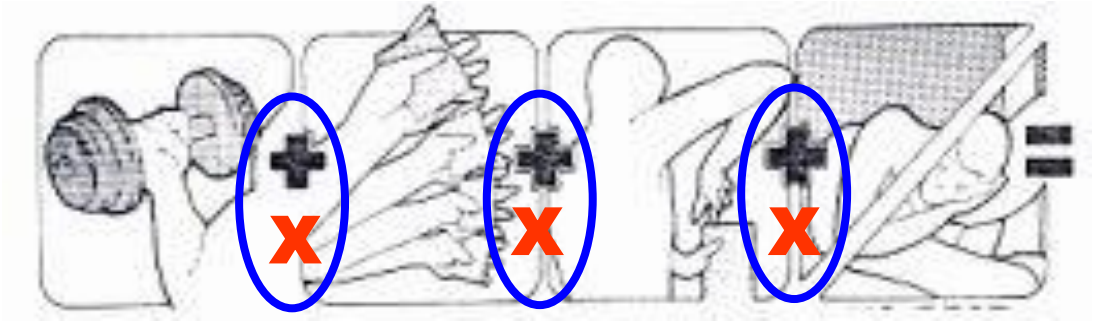
Administrative controls

To reduce the exposure time and share the exposure among a larger group of workers

Appropriate engineering and administrative controls **will vary from industry to industry and company to company**

Source: ACGIH

Cumulative Trauma Disorders



FORCE

REPETITIVENESS

AWKWARD POSTURE

INADEQUATE REST

+ Addictive model?

X Multiplicative model?

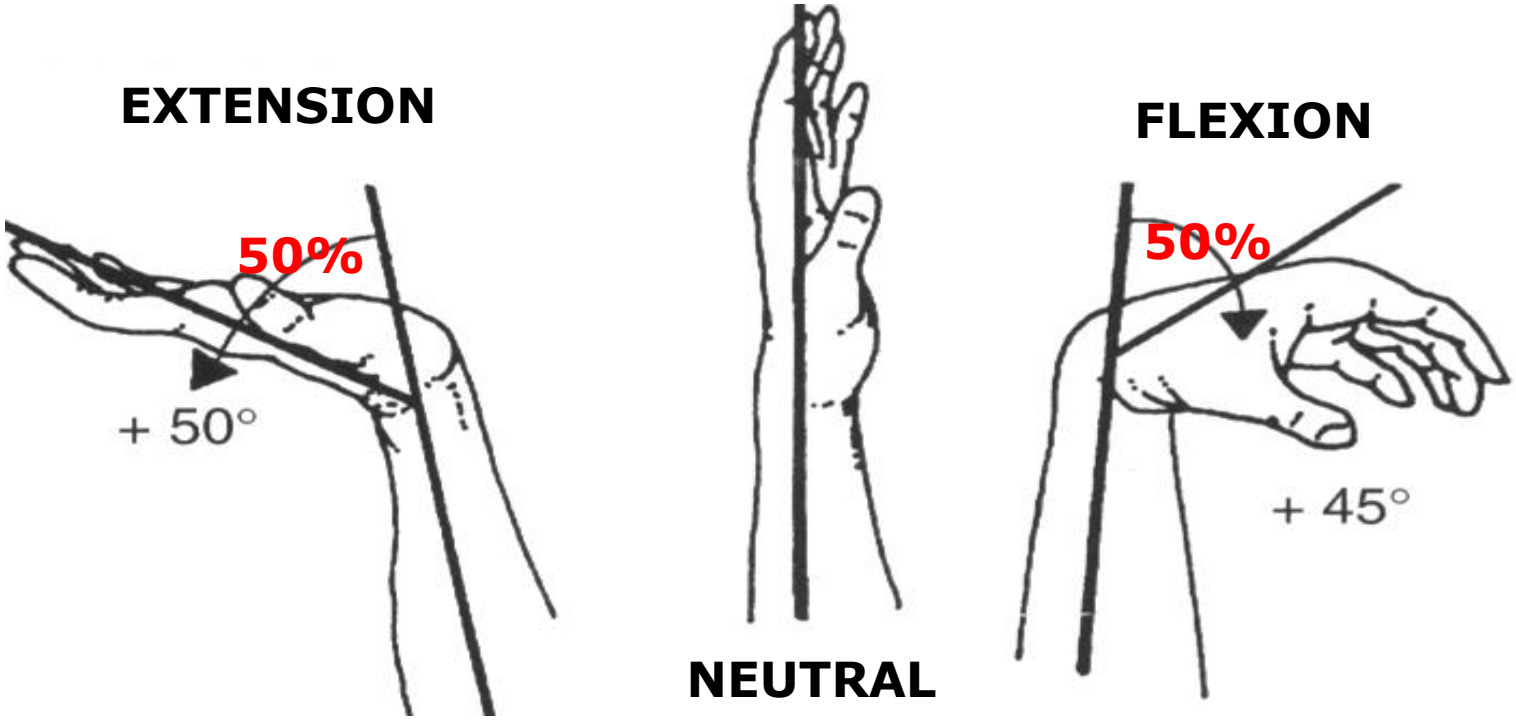
Principal reference rules

General principles	**EN ISO 6385** **EN ISO 14738** **EN 614**
Postures	**EN 1005-4** **ISO 11226**
Forces	**EN 1005-3**
Manual handling (load more than 3 kg)	**EN 1005-2** **ISO 11228-1** **ISO 11228-2**
Low loads (less than 3 kg) at high frequency	**EN 1005-5** **ISO 11228-3**

Acceptable posture

The posture should be kept within 50% of the articular range

Drury 1987



EN 1005-5 Safety of machinery - Human physical performance - Part 5: Risk assessment for repetitive handling at high frequency

Absence of awkward postures and movements considering the same conditions exposed in prEN 1005-4 as summarized below:

1) The upper arm postures and movements are in the range between 0° and 20° (Zone 1 in Figure 6, prEN 1005-4);

2) The articular movements of the elbow and wrist do not exceed 50 % of the maximum articular range [9], (Table 1 and Annex B);

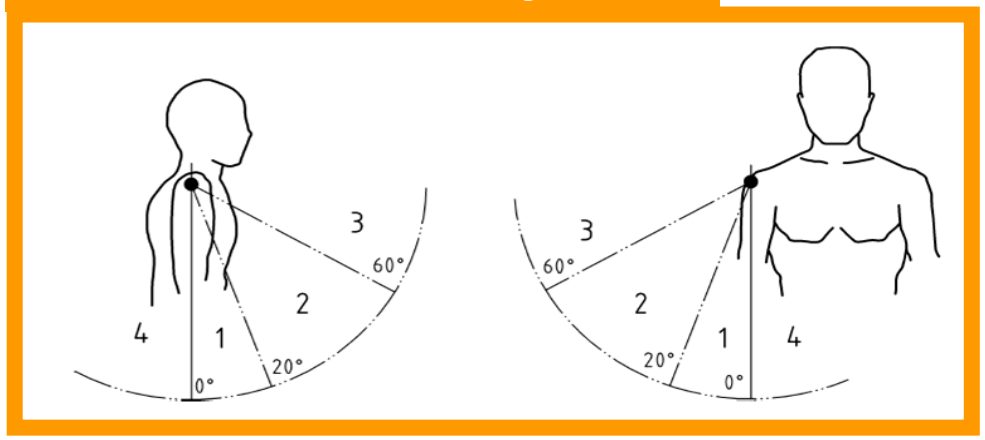
3) The kinds of grasp are "power grip", or "pinch lasting no more than 1/3 of the cycle time", (Table 1 and Annex B). [4, 7, 10].

POSTURES TO AVOID

- **Activities that mean you «overreach» with your shoulder**
- Taking carried out from behind the trunk
- Complete pronosupination of the forearm
- Use of the palm or the wrist as a hammer

EN 1005-4

Avoid activities near or above shoulder's height



Putz Anderson 1988

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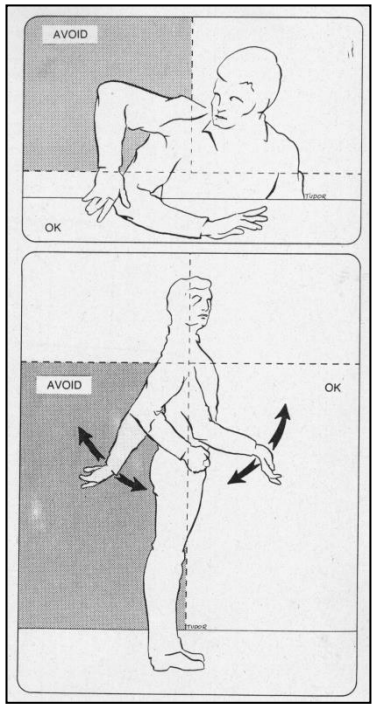

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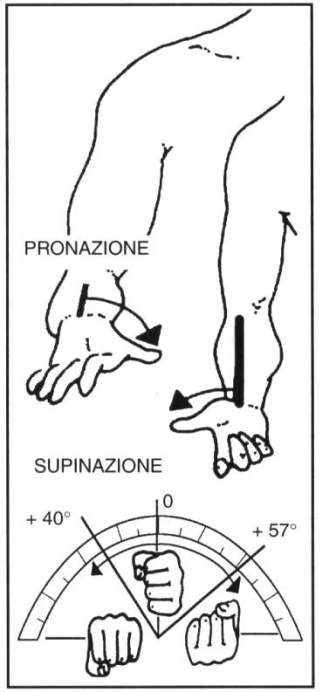
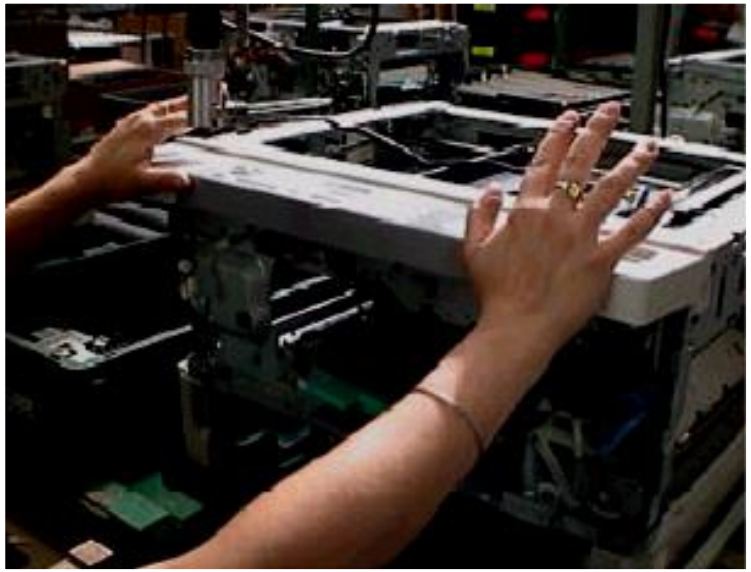
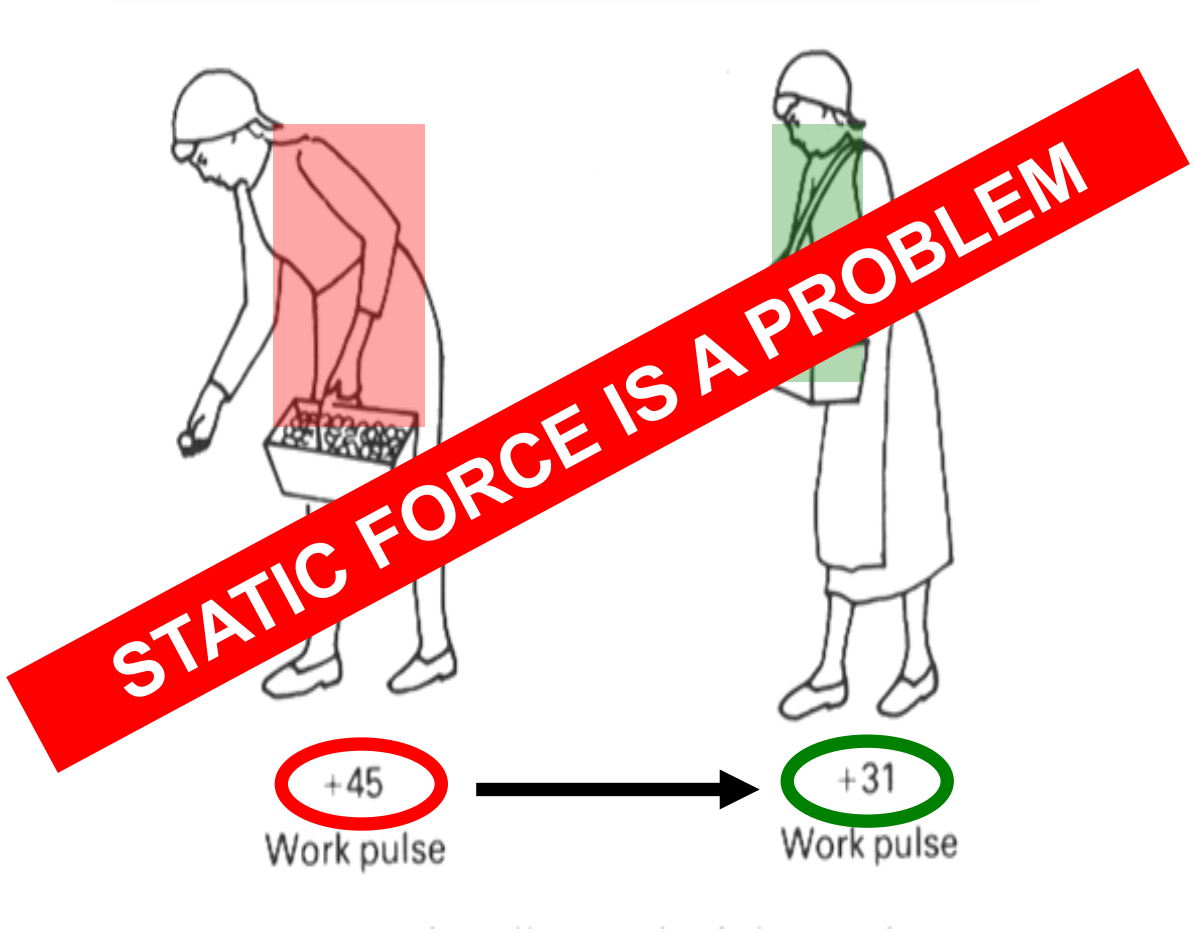


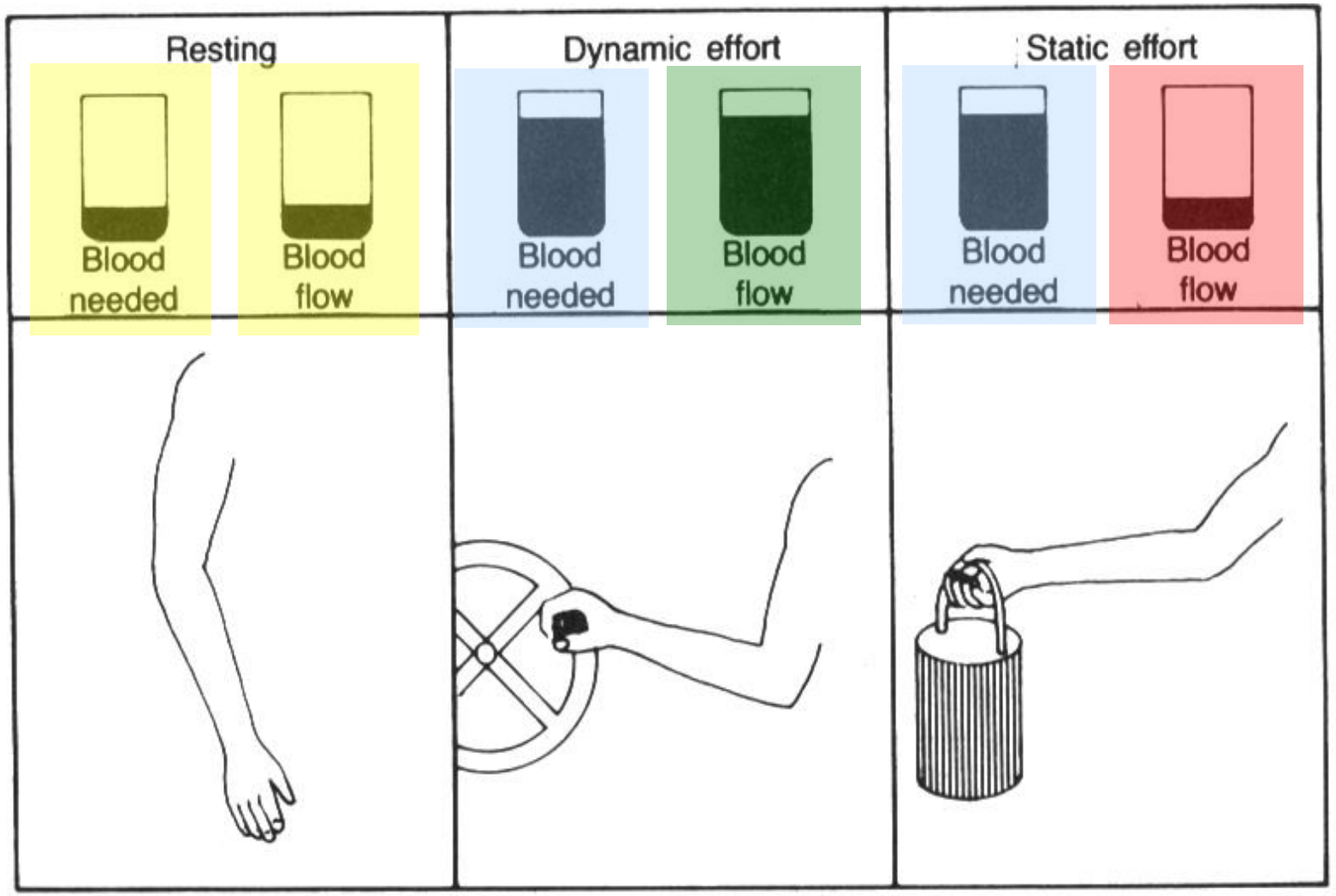


Two ways to hold the sowing-basket spreading the seeds



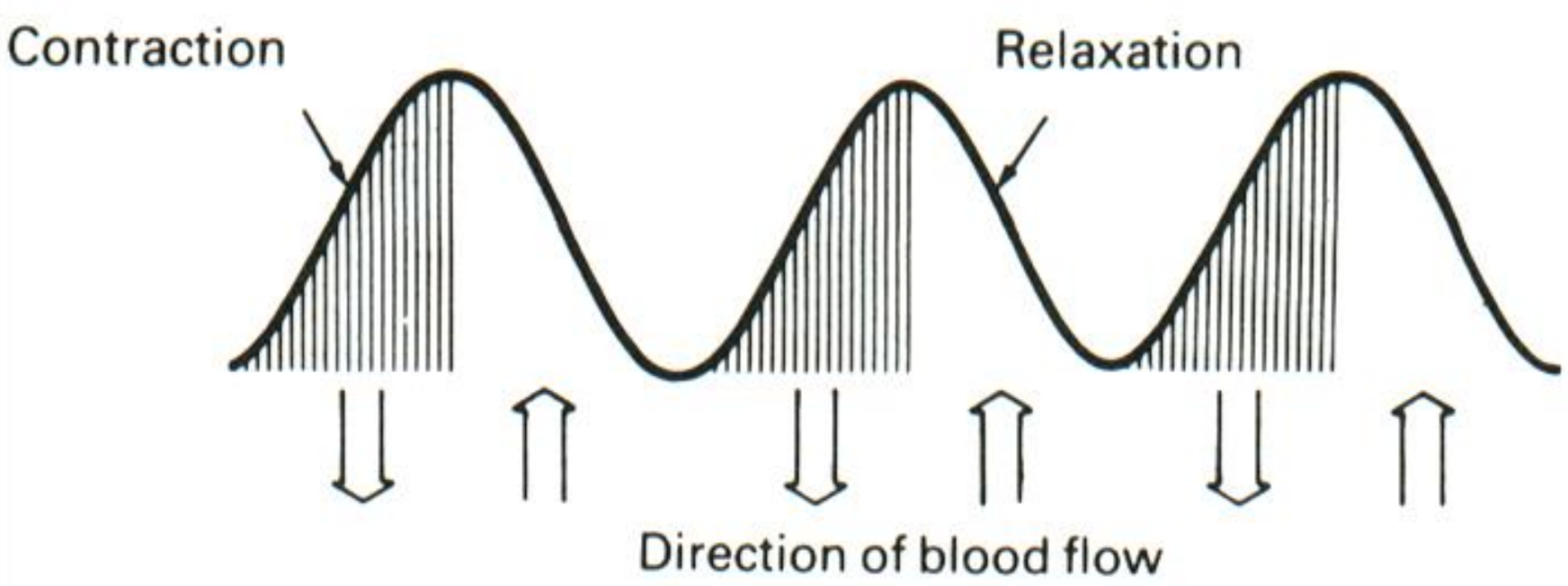
Hettinger, 1960

Dynamic and static work



Kroemer & Grandjean, 1997

Dynamic and static **work**



Kroemer & Grandjean, 1997

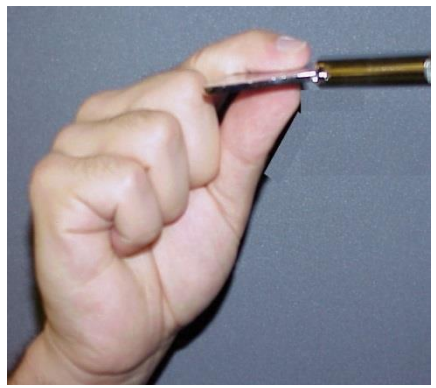
Il problema della misura della forza:

valutazione soggettiva – scala di Borg

valutazione oggettiva – EMG di superficie

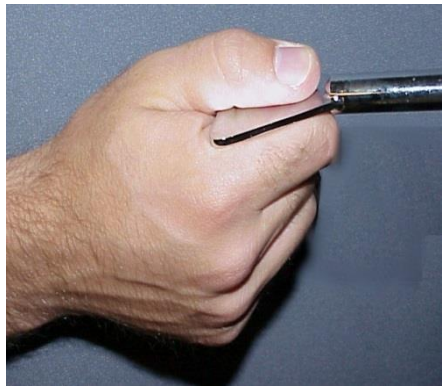
- **Pulp (thumb-index) pinch** (put a screw in a hole)
- **Lateral pinch (key grip)** (hold a key to open a lock)
- **Palmar pinch (chuck grip)** (use a pencil)
- **Multifinger grip** (hold a test-tube)

- **Power grip** (use a hammer)
- **Oblique grip (transversal grip)** (use a manual screwdriver)



Thumb-index pulp pinch

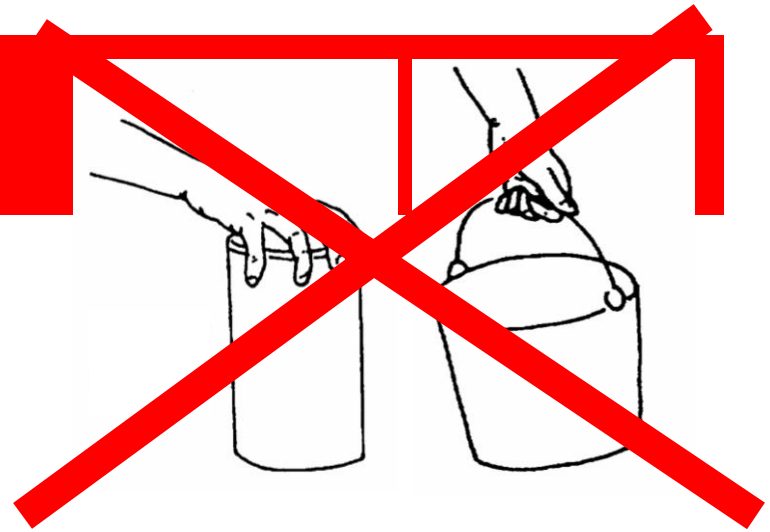
Chuck pinch



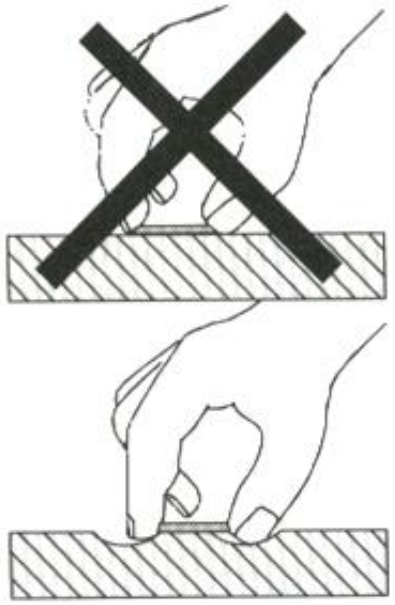
Lateral (key) Ppinch

Power Grip

- **Palm (up or down) grip** (take a can)
- **Hook grip** (take a bucket handle)



Help the taking and reduce the frequency and time spent in pinch



SIE Congress 2002

RECOVERY TIME

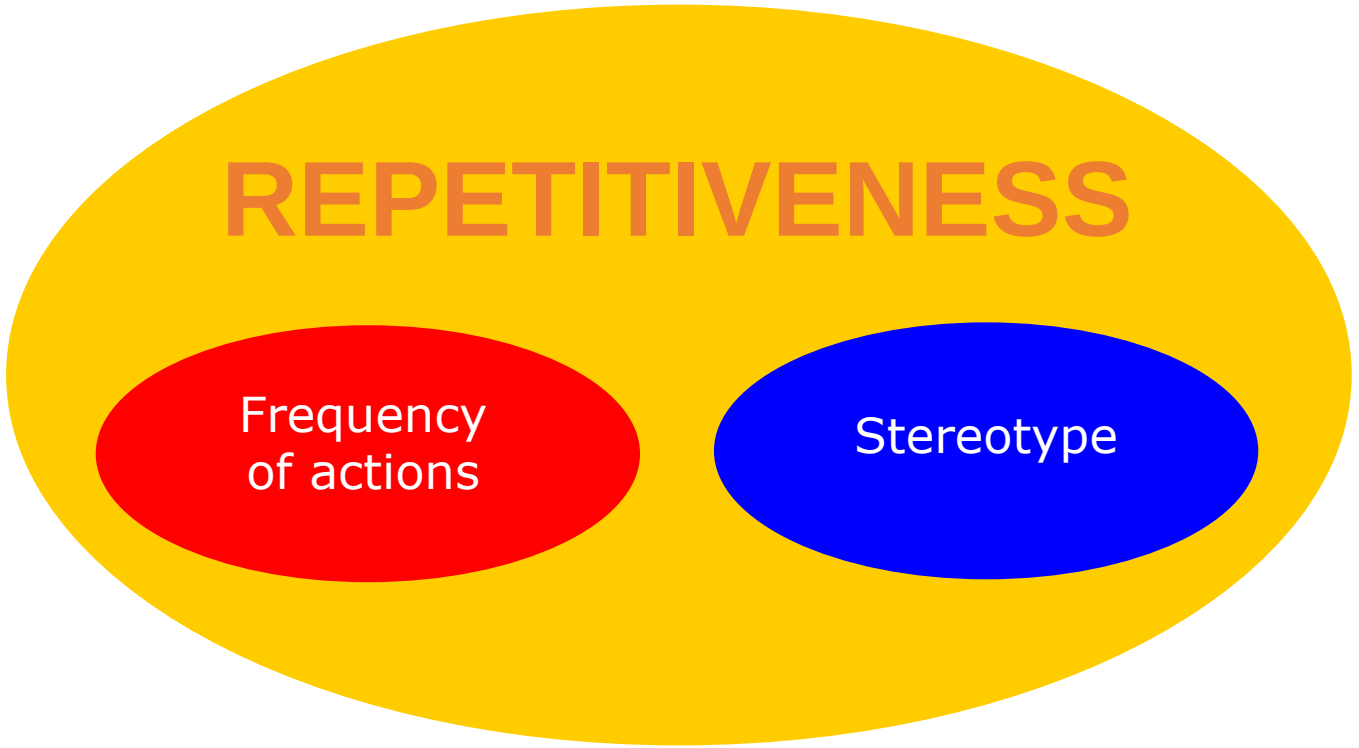
Any repetitive movements for more than 60 minutes should be avoided

The rate holding time / recovery time should be 5 / 1

Victorian Occupational Health and Safety Commission 1992

Allow workers to **pause or stretch** their muscles as necessary at least **once every hour**

American Conference of Industrial Hygienists (ACGIH)


REPETITIVENESS
Frequency of actions
Stereotype

FREQUENCY OF ACTION

- Low: until 900 actions per hour (15 act/min)

- Medium: until 900-1800 act/h (15-30 act/min)

- High: more than 1800 act/h (30 act/min)

Draft ANSI Z-365 (1995)

STEREOTYPE

The repetitiveness (**STEREOTYPE**) is high when:
- cycle time lasts less than 30 secs
- the same action is done for more than 50% of the cycle time

Silverstein 1986

Manual lifting

Manual material handling (MMH)

ISO 11228-1 – Ergonomics – Manual handling
Part 1: Lifting and carrying

ISO 11228-2 – Ergonomics – Manual handling
Part 2: Pushing and pulling

EN 1005-2 – Safety of machinery – Human physical performance
Part 2: Manual handling of machinery and component parts of machinery

ISO 11228-1

1 Scope

This part of ISO 11228 specifies recommended limits for manual lifting and carrying while taking into account, respectively, the intensity, the frequency and the duration of the task. This part of ISO 11228 is designed to provide guidance on the assessment of several task variables, allowing the health risks for the working population to be evaluated.

This part of ISO 11228 applies to manual handling of objects with a mass of 3 kg or more.

This part of ISO 11228 applies to moderate walking speed, i.e. 0,5 m/s to 1,0 m/s on a horizontal level surface.

This part of ISO 11228 does not include holding of objects (without walking), pushing or pulling of objects, lifting with one hand, manual handling while seated, and lifting by two or more people. Holding, pushing and pulling of objects will be included in other parts of ISO 11228.

This part of ISO 11228 is based on an 8 h working day. It does not concern analysis of combined tasks in a shift during a day.

ISO 11228-1

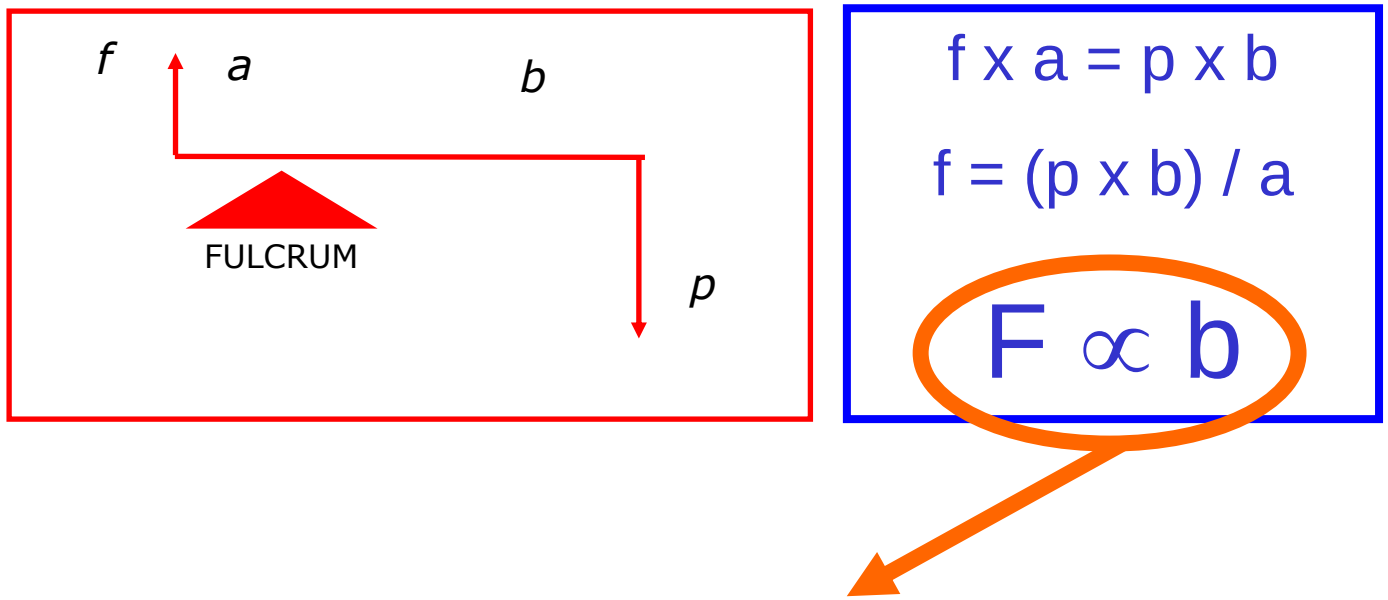
Table C.1 — Reference mass (m_{ref}) for different populations

Field of application	m_{ref} kg	Percentage of user population protected			Population group	
		F and M[a]	F	M		
Non-occupational use	5	Data not available			Children and the elderly	Total population
	10	99	99	99	General domestic population	
Professional use	15					General working population
	20	95	90	99	General working population, including the young and old	
	23					
	25	85	70	95	Adult working population	
	30	See NOTE			Specialized working population	Specialized working population under special circumstances
	35					
	40					

NOTE Special circumstances. While every effort should be made to avoid manual-handling activities or reduce the risks to the lowest possible levels, there may be exceptional circumstances where the reference mass may exceed 25 kg (e.g. where technological developments or interventions are not sufficiently advanced). In these exceptional circumstances, increased attention and consideration must be given to the education and training of the individual (e.g. specialized knowledge concerning risk identification and risk reduction), the working conditions which prevail and the capabilities of the individual.

[a] F: Female, M: Male

	M	F
Normal adult population	**25**	**20**
> 45 y population	**20**	**15**
Workers with special needs	**15**	**10**



Stress levels on the back increase substantially as the distance between the object and the body increases.

ISO 11228-1

3.5
ideal posture for manual handling
standing symmetrically and upright, keeping the horizontal distance between the centre of mass of the object being handled and the centre of mass of the worker less than 0,25 m, and the height of the grip less than 0,25 m above knuckle height

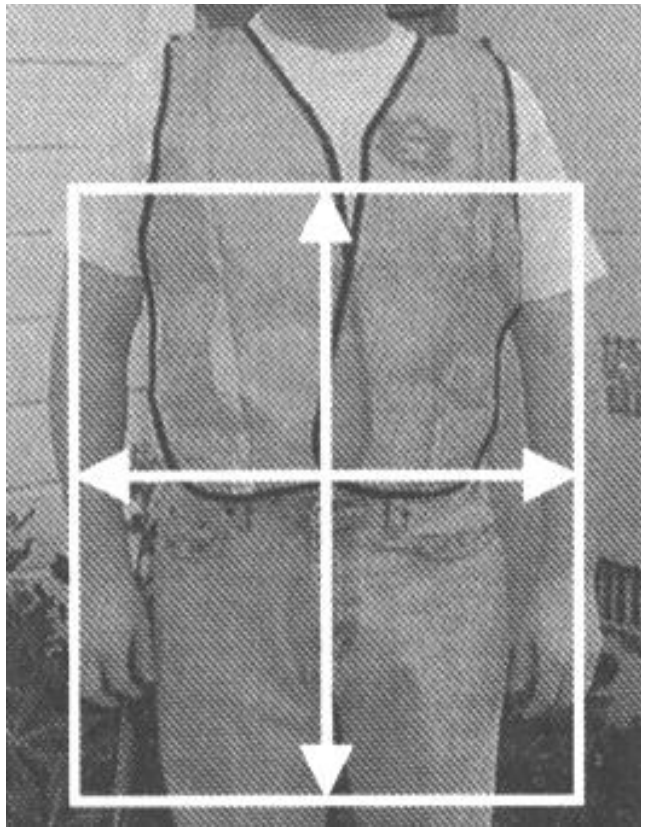
NOTE 1 The location of the centre of mass of the object is approximated by the vertical projection of the midpoint of the line between the hands at the grasping location. The location of the centre of the mass of the worker is approximated by the midpoint of the line between the inner points of the ankles.

3.7
ideal conditions for manual handling
conditions that include ideal posture for manual handling, a firm grip on the object in neutral wrist posture, and favourable environmental conditions

ISO 11228-1 – A.3.1 Task

The best height for storage is between the mid-thigh and chest height of the workers involved, with lighter items being stored above or below this region.

POWER ZONE

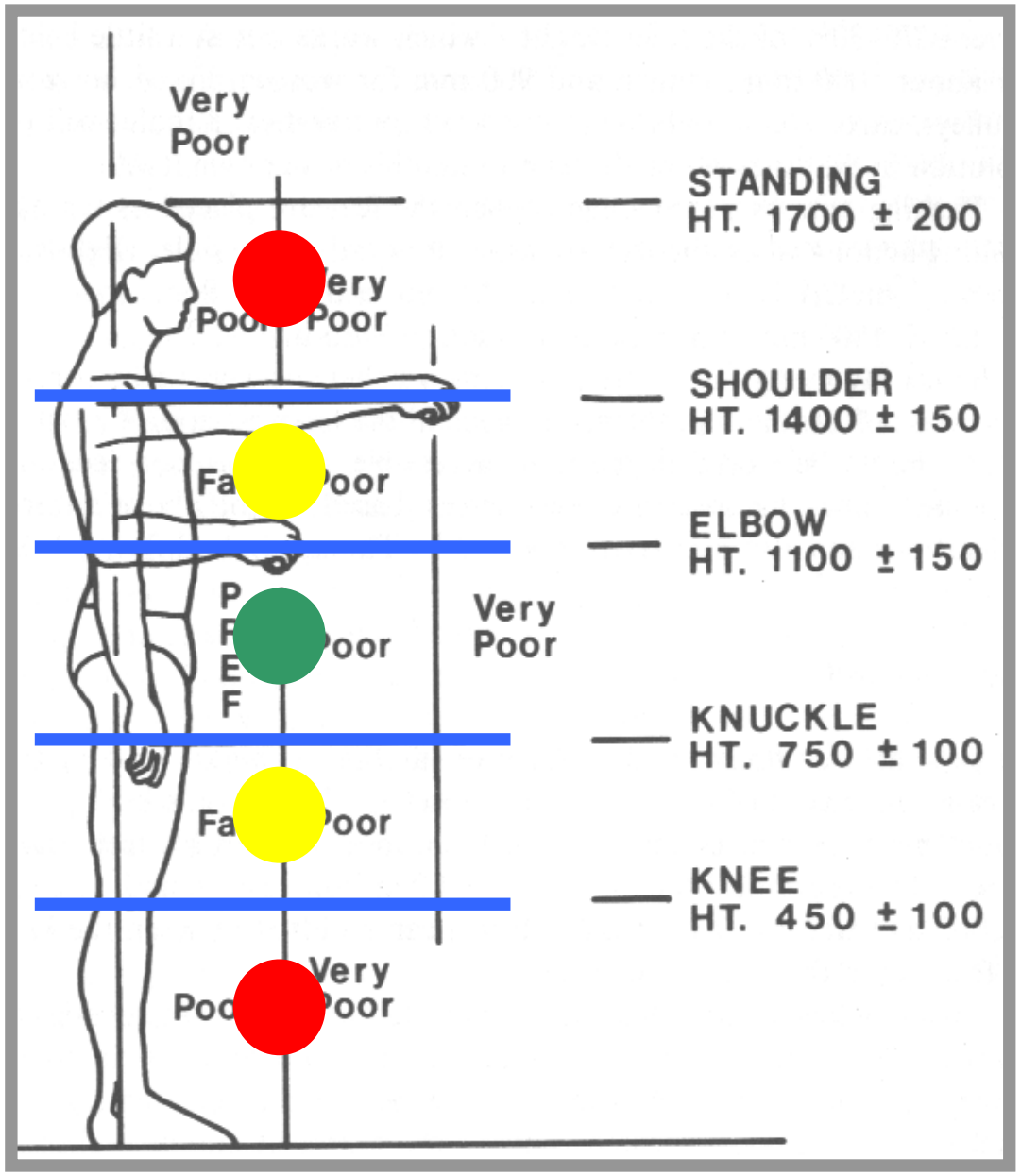


Chest height

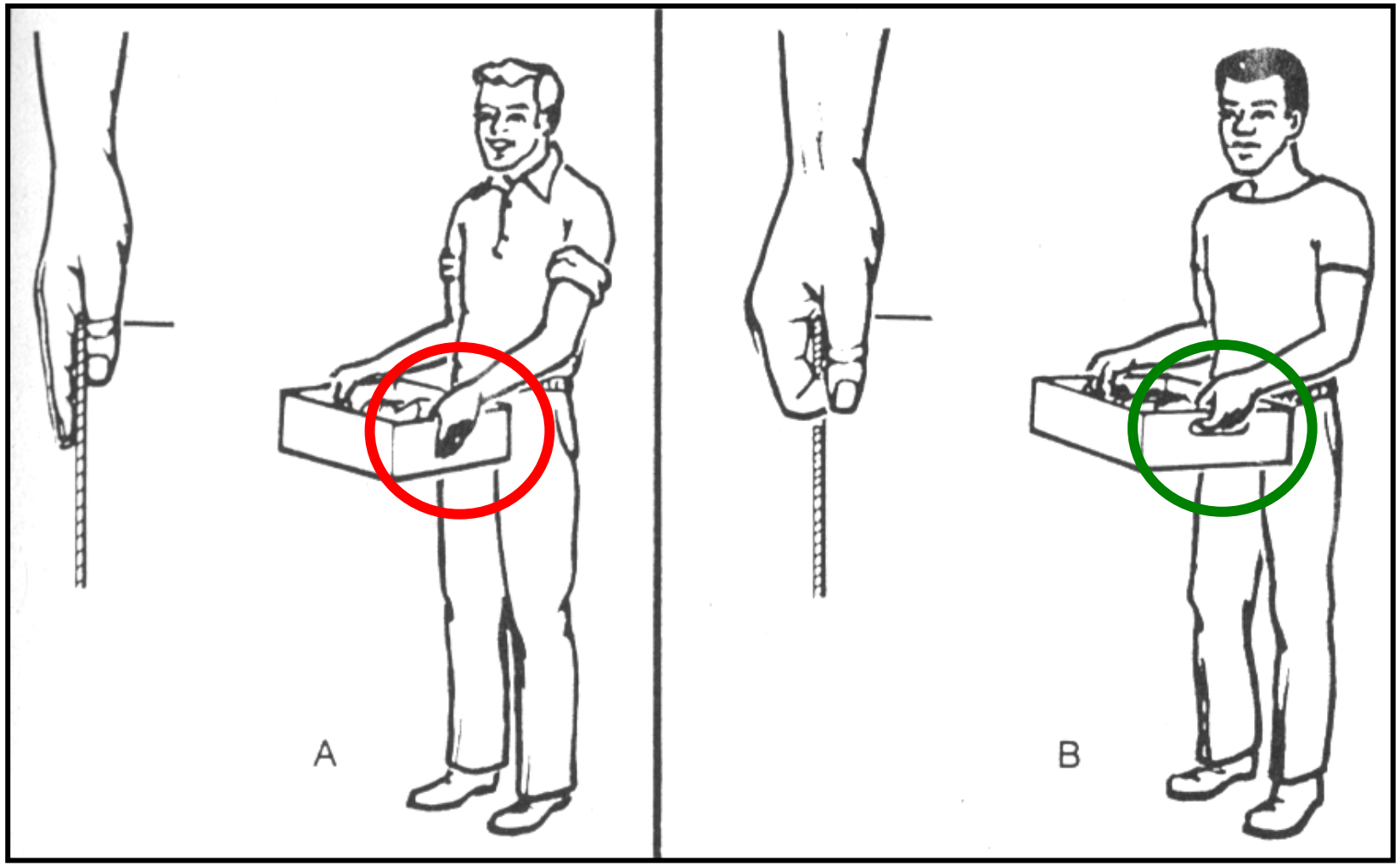
Mid-thigh height

T. Hilgen, 2001

POWER ZONE



HSE, 2000



Eastman Kodak Company, 1983

ISO 11228-1

For **ideal conditions** andling, the following criteria are recommended:

- moderate ambient thermal environment;
- two-handed operation only;
- unrestricted standing posture;
- handling by one person only;
- smooth lifting;
- good coupling between the hands and the objects handled;
- good coupling between the feet and the floor;
- manual handling activities, other than lifting, are minimal;
- the objects to be lifted are not cold, hot or contaminated;
- vertical displacement of the load is less than or equal 0,25 m and does not occur below knuckle or above shoulder height;
- the trunk is upright and not rotated;
- the load is kept close to the body.

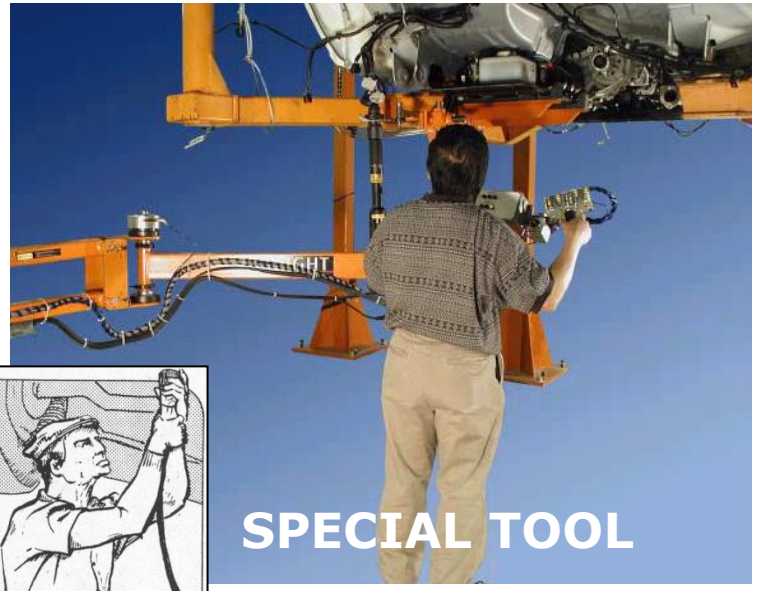
Recognition of possible solutions

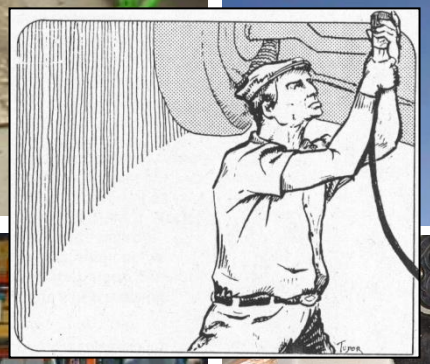
SITTING

STANDING/SITTING

Adjustable stool

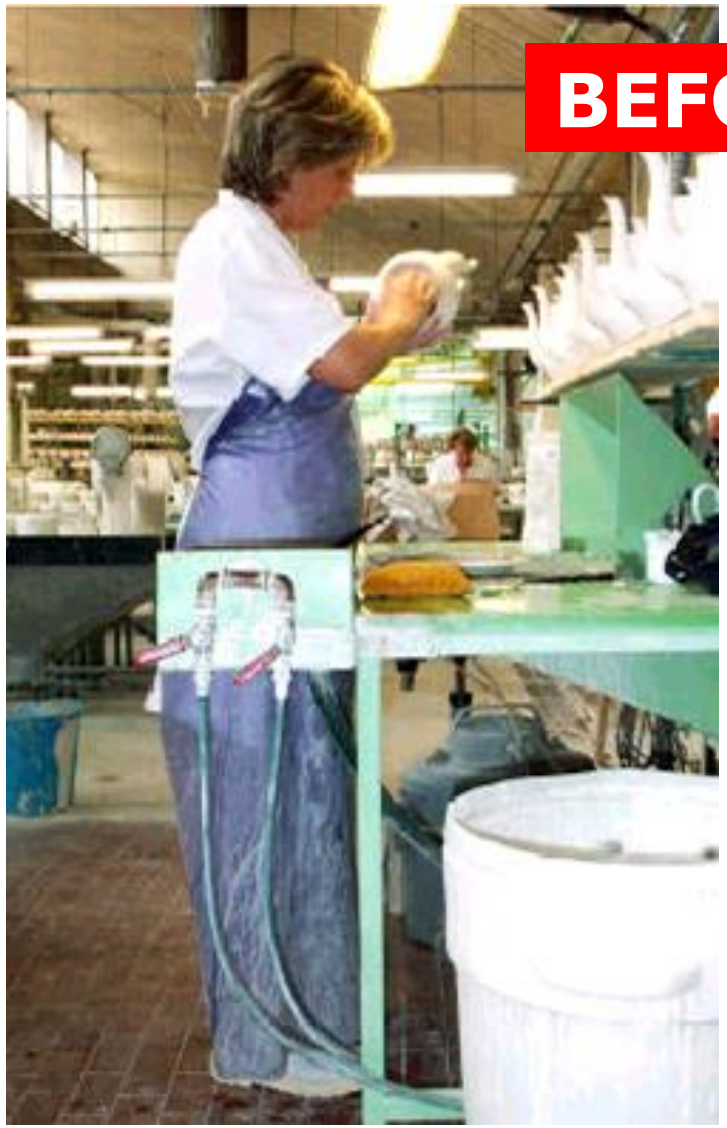

FOOTBOARD


SPECIAL TOOL




SPECIAL TOOL


TILTING



BEFORE

Why should the worker stand?

SIE Congress 2002

AFTER

Administrative controls

- Implementing work standards that permit workers to **pause or stretch as necessary**
- **Re-allocating work assignements** (e.g. using worker rotation or work enlargement) so that a worker dose not spend an entire work shift performing high-demand tasks

Allow workers to **pause or stretch** their muscles as necessary at least **once every hour**

Source: American Conference of Industrial Hygienists (ACGIH)

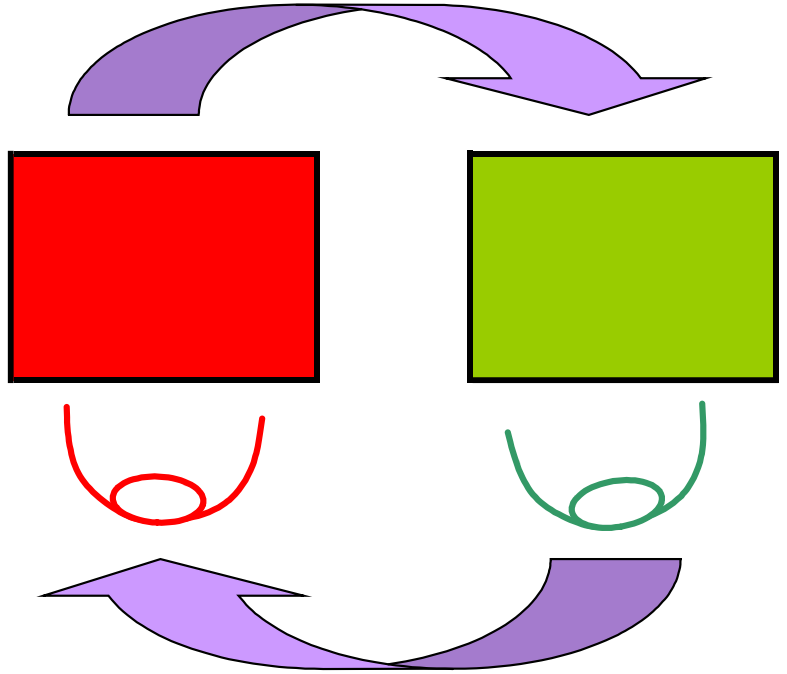
COMBINATION OF DIFFERENT JOBS

- JOB ROTATION

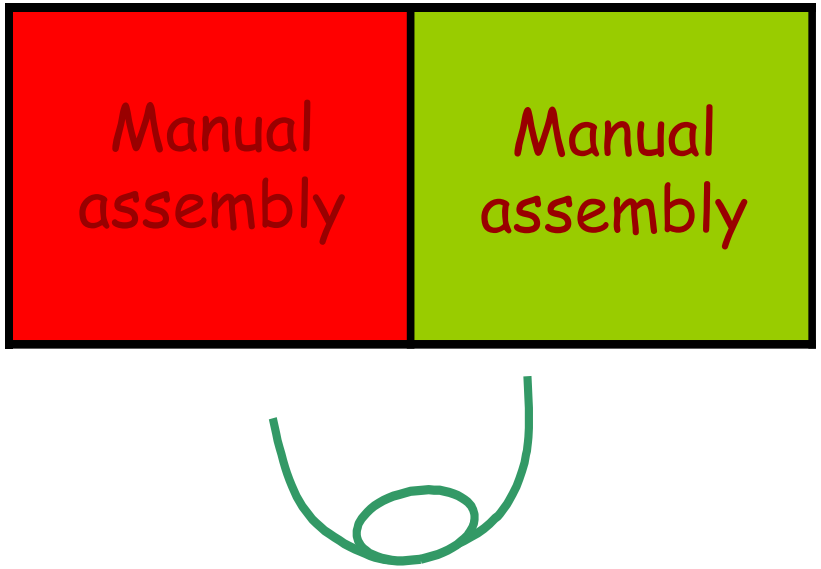
- JOB ENLARGEMENT

- JOB ENRICHMENT

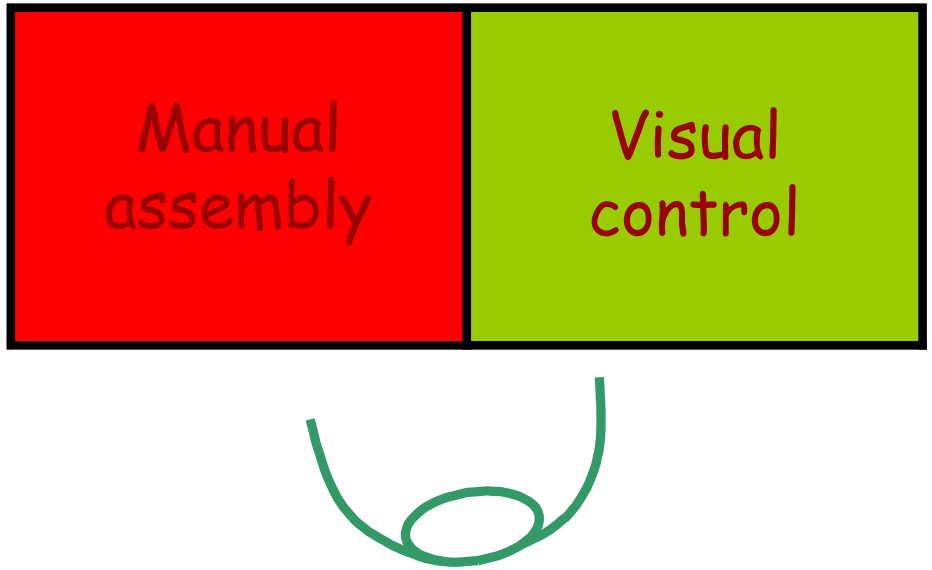
JOB ROTATION



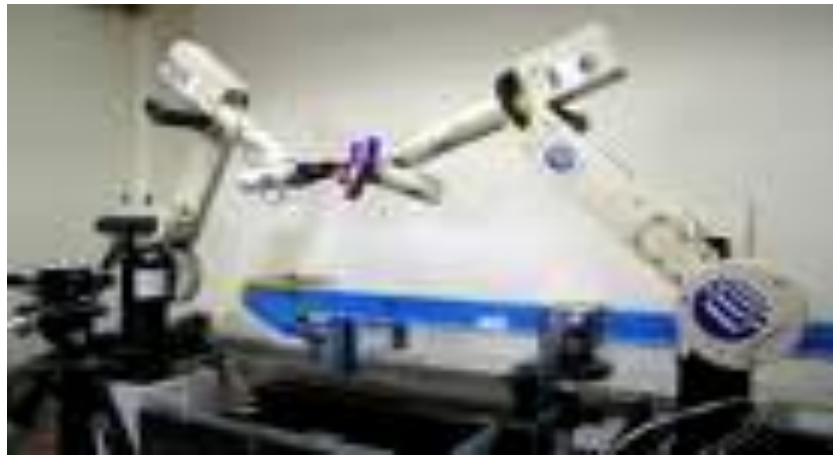
JOB ENLARGEMENT



JOB ENRICHMENT



Robots



MATE
COMAU
MATE


HEAVY
TOP
BOTTOM
gettyimages
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DIGITAL
TRANSFORMATION


dove e come mi curo