EASOM
European Association
of Schools of Occupational Medicine

Assessment methods of ergonomic risks

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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.

- (International Ergonomics Association, 2000)

ISO 26800:2011 - Ergonomics -- General approach, principles and concepts

Questions

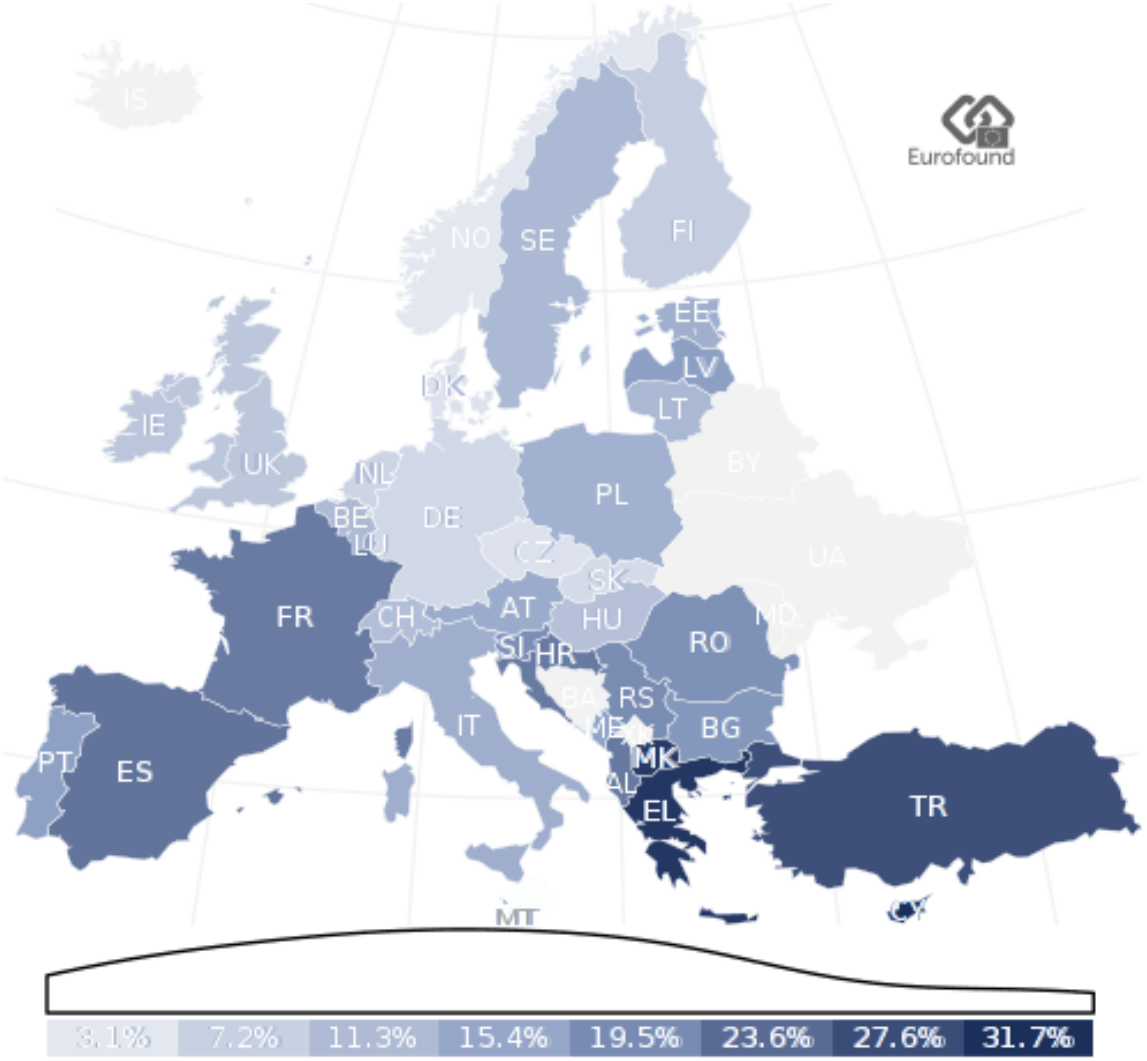
- Problem
- Knowledge
- Purpose
- Implementation

Parts of body at risk

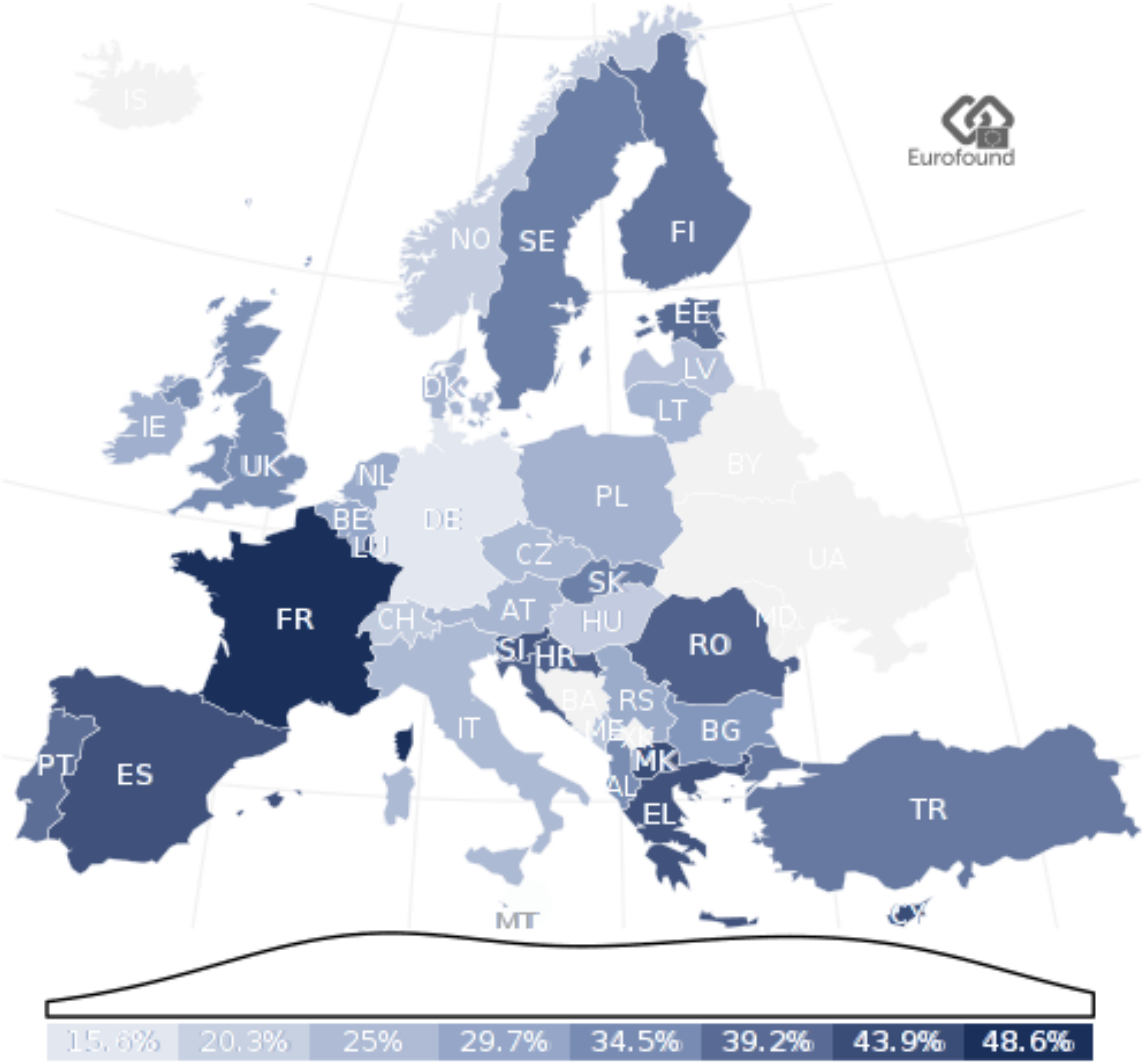
- Low back
- Neck
- Shoulder
- Elbow
- Hand
- Knee
- Ankle

- Shoulder
- Upper arm
- Forearm
- Wrist
- Hand

Does your work involve tiring or painful positions?



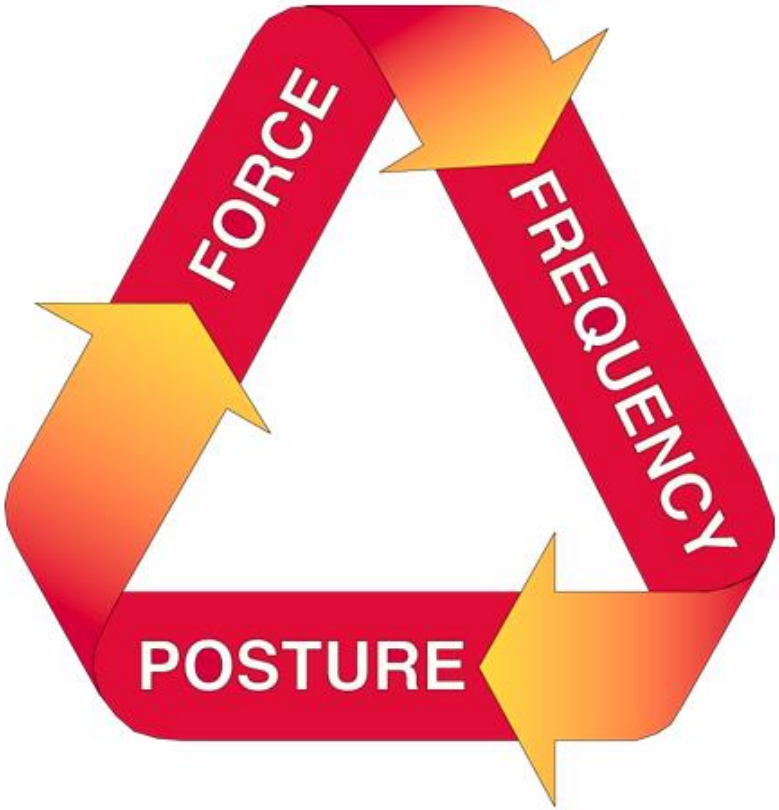
Does your work involve repetitive hand or arm movements?



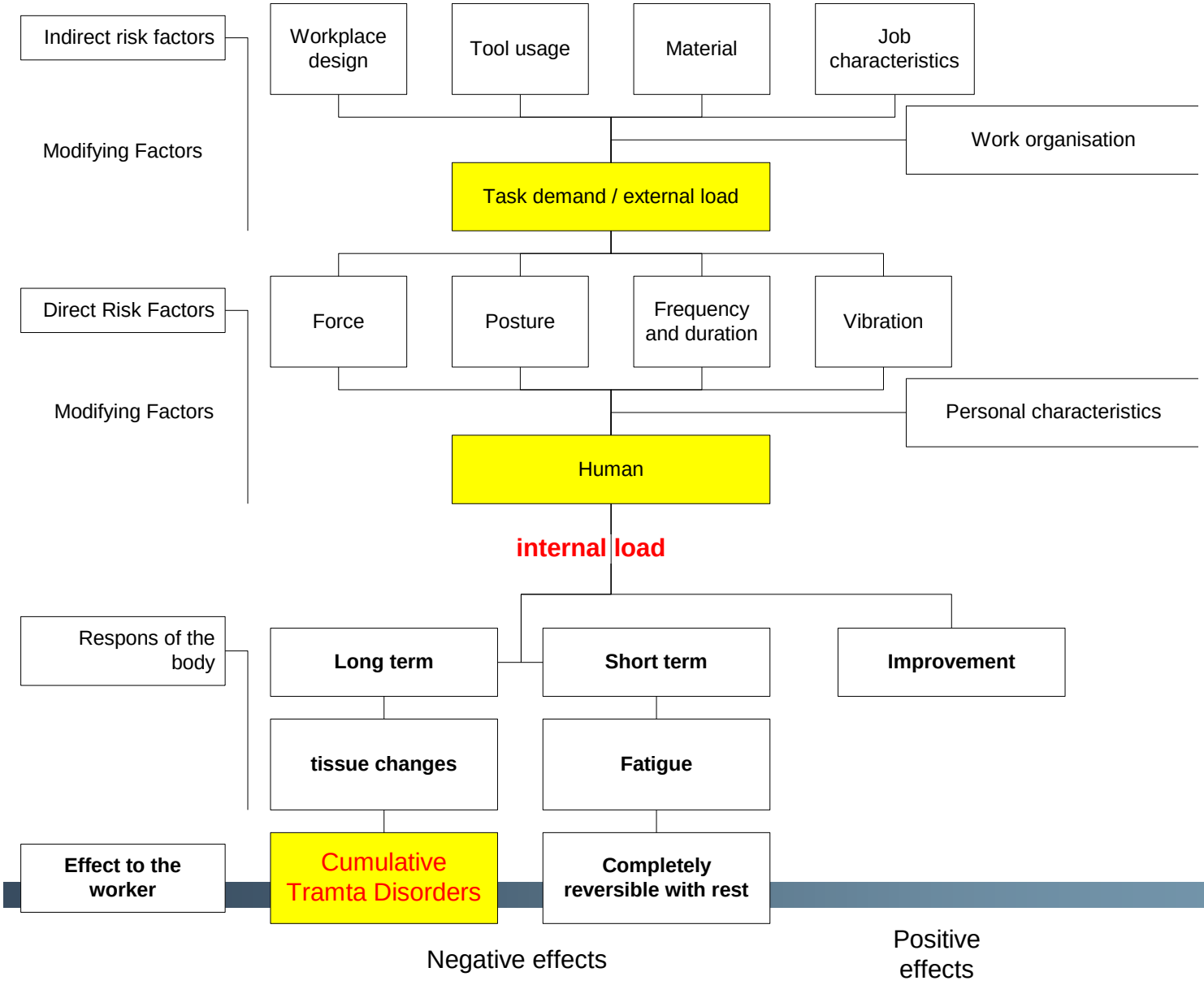
Physical risk factors

- **Repetition**
- **Force**
- **Posture**
- **Vibration**
- **Combination of factors**

- **Cumulative damage**



Factors to affect the risks of work-related musculoskeletal disorders



Requirements

- Easy usability for identification of ergonomic hazard, risks.
- The results have to be quntified or showed in green, yellow, or red.
- The terms of use has to be clear.
- Has to be legislation based, not only international experienced based.
- Has to cover a wide risk of WMSD.
- Fit the competency of user (not require special trainings).
- Fit the way of use (not require special tools).

The application

- As a part of health and safety risk assessment,
- During installation,
- During ergonomic review,
- Screening of ergonomic situations (example: accidents),
- In occupational and health studies

Checklists

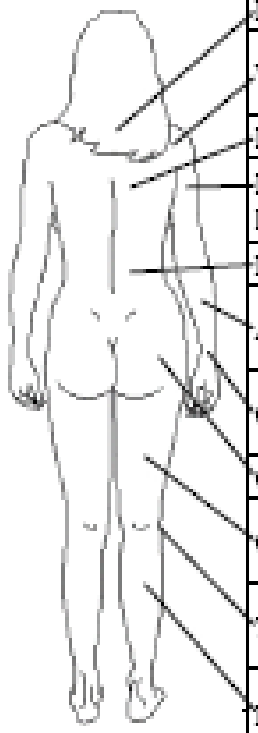

Prepared by the International Labour Office
in collaboration with
the International Ergonomics Association
ERGONOMIC
CHECKPOINTS
SECOND
REVISED
EDITION
PRACTICAL
AND EASY-TO-IMPLEMENT
SOLUTIONS FOR IMPROVING
SAFETY, HEALTH
AND WORKING CONDITIONS


Ergonomic
Checkpoints
IEA

Subjective discomfort Survey

Helyszín			
Dátum, idő		Vizsgálatvezető	

A táblázatban az érintett testrészekkel kapcsolatos kérdésekre válaszoljon a megfelelő négyzet bejelölésével!

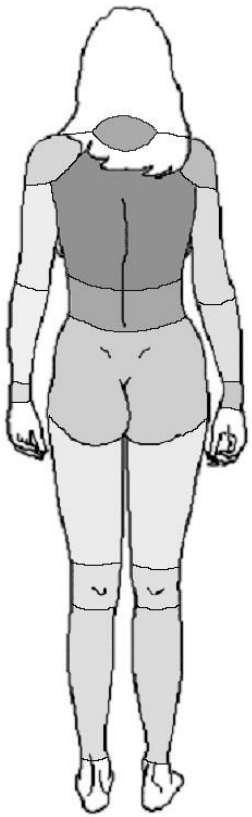


		Az elmúlt héten munkavégzés közben milyen gyakran tapasztalt fájdalmat, kellemetlen érzést az alábbi testrészeken?					*A fájdalom vagy kellemetlenség érzése mennyire volt erős?*			*Ha tapasztalt fájdalmat, akkor az mennyire zavarta munkavégzésében?*		
		Soha	1-2 alkalom	3-4 alkalom	Naponta egyszer	Naponta néhányszor	Kissé kellemetlen	Közepesen kellemetlen	Nagyon kellemetlen	Egyáltalán nem	Kissé zavart	Lényegesen zavart
Nyak		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Váll	Jobb	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
	Bal	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Hát		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Felső kar	Jobb	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
	Bal	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Derék		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Alkar	Jobb	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
	Bal	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Csuklo	Jobb	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
	Bal	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Csipő, fenék		❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Comb	Jobb	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
	Bal	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Térd	Jobb	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
	Bal	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
Lábszár	Jobb	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑
	Bal	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑	❑

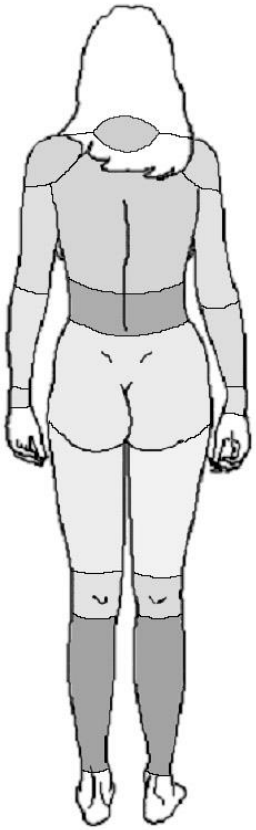
Megjegyzés:

Subjective discomfort Survey - Results

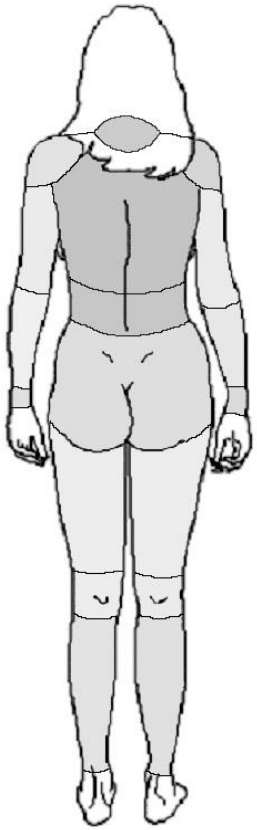
Sittig



Standing



Mixed

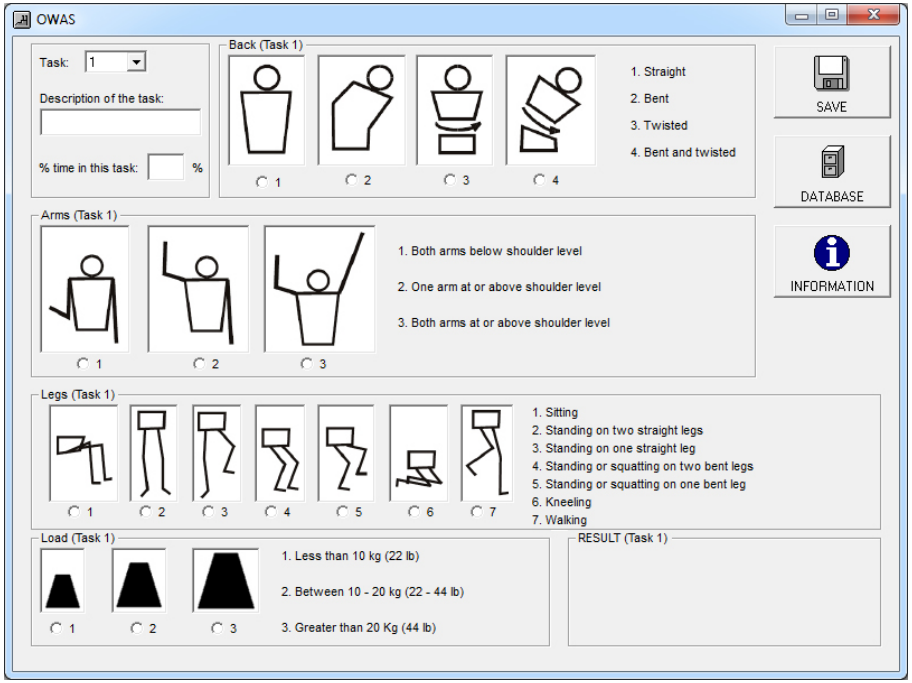


Naponta többszöri nagyon kellemetlen lényegesen zavaró fájdalom

Soha nem érez fájdalmat


RRD

OWAS



Ovako Working-postures Analysis System

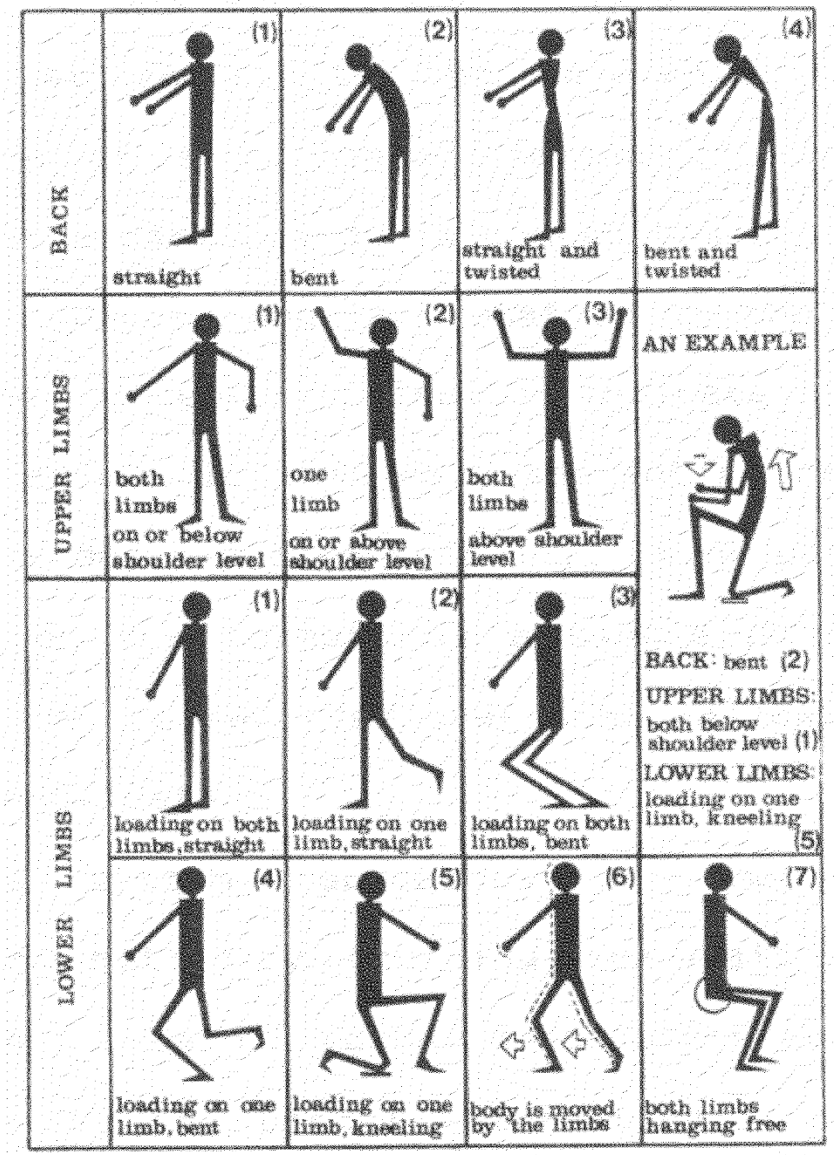
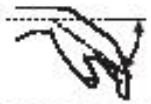
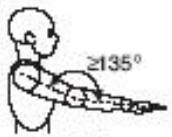
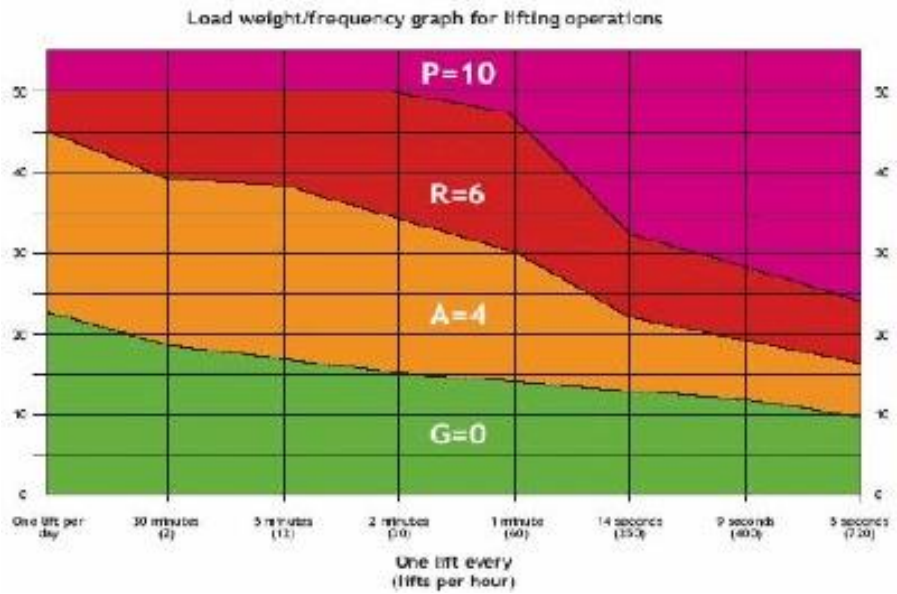


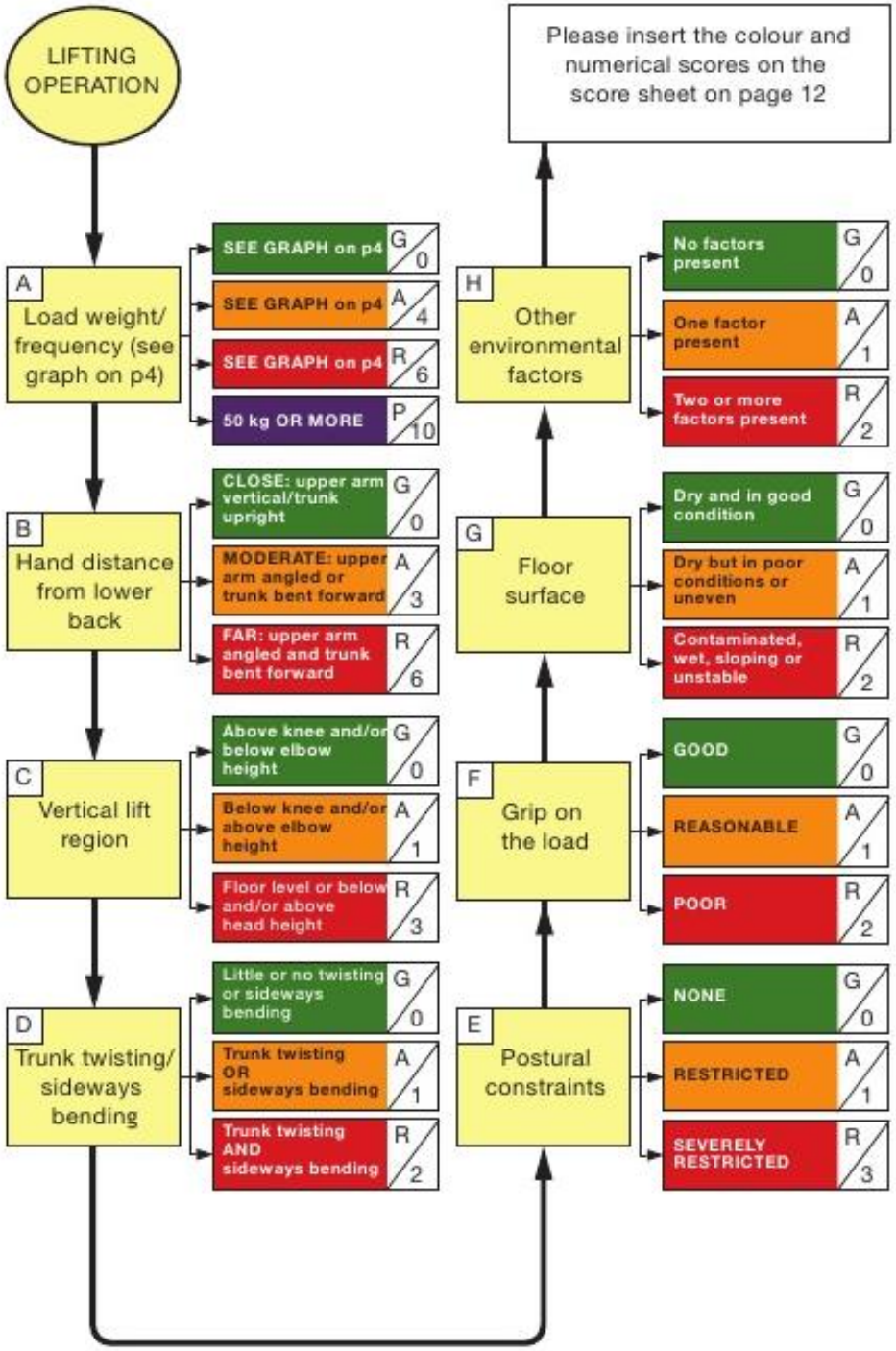
Figure 1: OWAS protocol (prior art)

BRIEF 1

Step 2	Hands and Wrists		Elbows		Shoulders	
Identify Risks ▼ **2a.** Mark Posture and Force boxes when risk factors are observed. ▼ **2b.** For body parts with Posture or Force marked, mark Duration and/or Frequency box(es) when limits are exceeded.	 Flexed ≥ 45°  Ulnar Deviation  Extended ≥ 45°  Radial Deviation		 Rotated Forearm  ≥135° Fully Extended		 Arm Behind Body   Arm Raised ≥ 45°  Shoulders Shrugged	
	Left	Right	Left	Right	Left	Right
2a. Posture	☐	☐	☐	☐	☐	☐
Force	Pinch Grip or Finger Press ≥ 2 lb (0.9 kg), or Power Grip ≥ 10 lb (4.5 kg)  ☐ ☐		≥ 10 lb (4.5 kg) ☐	≥ 10 lb (4.5 kg) ☐	≥ 10 lb (4.5 kg) ☐	≥ 10 lb (4.5 kg) ☐
2b. Duration	≥ 10 sec. ■	≥ 10 sec. ■	≥ 10 sec. ■	≥ 10 sec. ■	≥ 10 sec. ■	≥ 10 sec. ■
Frequency	≥ 30/min. ■	≥ 30/min. ■	≥ 2/min. ■	≥ 2/min. ■	≥ 2/min. ■	≥ 2/min. ■
Score	0	0	0	0	0	0
Risk Rating	H M **L**	H M **L**	H M **L**	H M **L**	H M **L**	H M **L**

Manual handling Assessment Chart





JSI – Job Strain Index

Rating	Intensity of Exertion (IE)	Duration of Exertion (DE)	Efforts/ Minute (EM)	Hand/Wrist Posture (HWP)	Speed of Work (SW)	Duration per Day (DD)
1	Light (1)	<10% (0.5)	<4 (0.5)	Very good (1)	Very slow (1)	<1 (.25)
2	Somewhat hard (3)	10-29% (1)	4-8 (1)	Good (1)	Slow (1)	1-2 (.5)
3	Hard (6)	30-49% (1.5)	9-14 (1.5)	Fair (1.5)	Fair (1)	2-4 (.75)
4	Very hard (9)	50-79% (2)	15-19 (2)	Bad (2)	Fast (1.5)	4-8 (1)
5	Near maximal (13)	80-100% (3)	>=20 (3)	Very bad (3)	Very fast (2)	>=8 (1.5)

$$JSI = IE \times DE \times EM \times HWP \times SW \times DD$$

Moore, J.S. and Garg, A. (1995) American Industrial Hygiene Journal 56:443-58.

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

Step 1: Locate Neck Position

Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

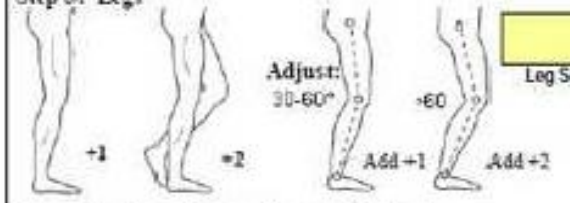
Neck Score

Step 2: Locate Trunk Position

Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

Trunk Score

Step 3: Legs



Leg Score

Step 4: Look-up Posture Score in Table A

Using values from steps 1-3 above, locate score in Table A

Posture Score A

+

Step 5: Add Force/Load Score

If load < 11 lbs : +0
If load 11 to 22 lbs : +1
If load > 22 lbs: +2
Adjust: If shock or rapid build up of force: add +1

Force/Load Score

=

Step 6: Score A, Find Row in Table C

Add values from steps 4 & 5 to obtain Score A.
Find Row in Table C

Score A

Scoring:
1 = negligible risk
2 or 3 = low risk, change may be needed
4 to 7 = medium risk, further investigation, change soon
8 to 10 = high risk, investigate and implement change
11+ = very high risk, implement change

SCORES

Table A		Neck 1				Neck 2				Neck 3			
	Legs	1	2	3	4	1	2	3	4	1	2	3	4
Trunk Posture Score	1	1	2	3	4	1	2	3	4	3	3	5	6
	2	2	3	4	5	3	4	5	6	4	5	6	7
	3	2	4	5	6	4	5	6	7	5	6	7	8
	4	3	5	6	7	5	6	7	8	6	7	8	9
	5	4	6	7	8	6	7	8	9	7	8	9	9

Table B		Lower Arm 1			Lower Arm 2		
	Wrist	1	2	3	1	2	3
Upper Arm Score	1	1	2	2	1	2	3
	2	1	2	3	2	3	4
	3	3	4	5	4	5	5
	4	4	5	5	5	6	7
	5	6	7	8	7	8	8
	6	7	8	8	8	9	9

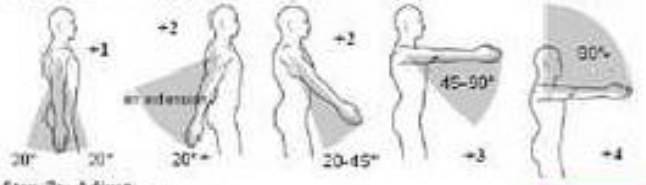
Score A (score from table A +load/force score)	Table C: Score B, (table B value +coupling score)											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

Table C Score + Activity Score

Final REBA Score

B. Arm and Wrist Analysis

Step 7: Locate Upper Arm Position:



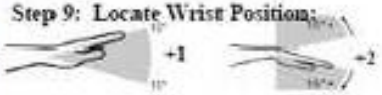
Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

Upper Arm Score

Step 8: Locate Lower Arm Position:

Lower Arm Score

Step 9: Locate Wrist Position:



Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

Wrist Score

Step 10: Look-up Posture Score in Table B

Using values from steps 7-9 above, locate score in Table B

Posture Score B

+

Step 11: Add Coupling Score

Well fitting Handle and mid rang power grip, *good: +0*
Acceptable but not ideal hand hold or coupling
acceptable with another body part, *fair: +1*
Hand hold not acceptable but possible, *poor: +2*
No handles, awkward, unsafe with any body part,
Unacceptable: +3

Coupling Score

=

Step 12: Score B, Find Column in Table C

Add values from steps 10 &11 to obtain
Score B. Find column in Table C and match with Score A in
row from step 6 to obtain Table C Score.

Score B

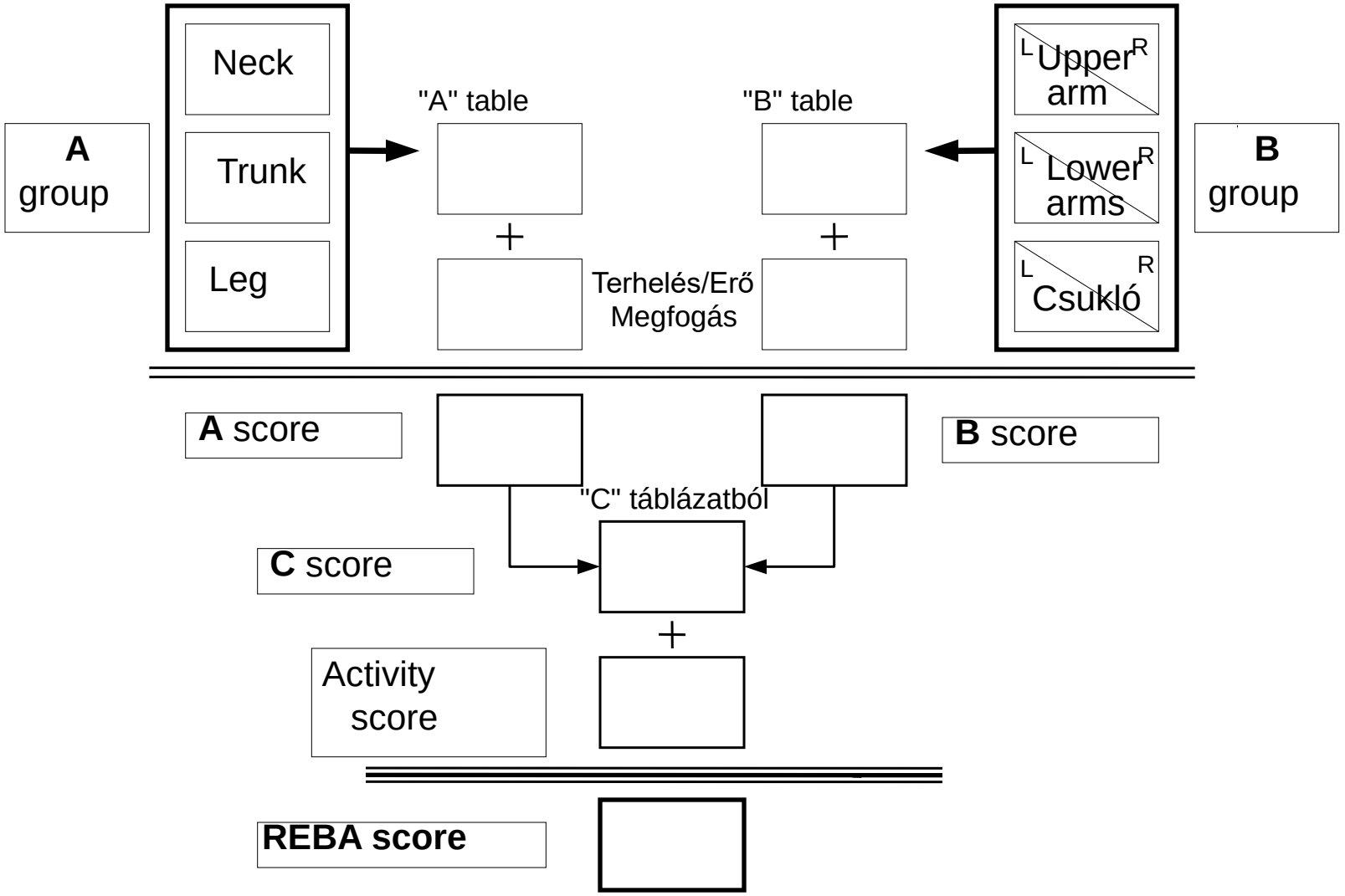
Step 13: Activity Score

+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Task name: _____ Reviewer: _____ Date: ____/____/____

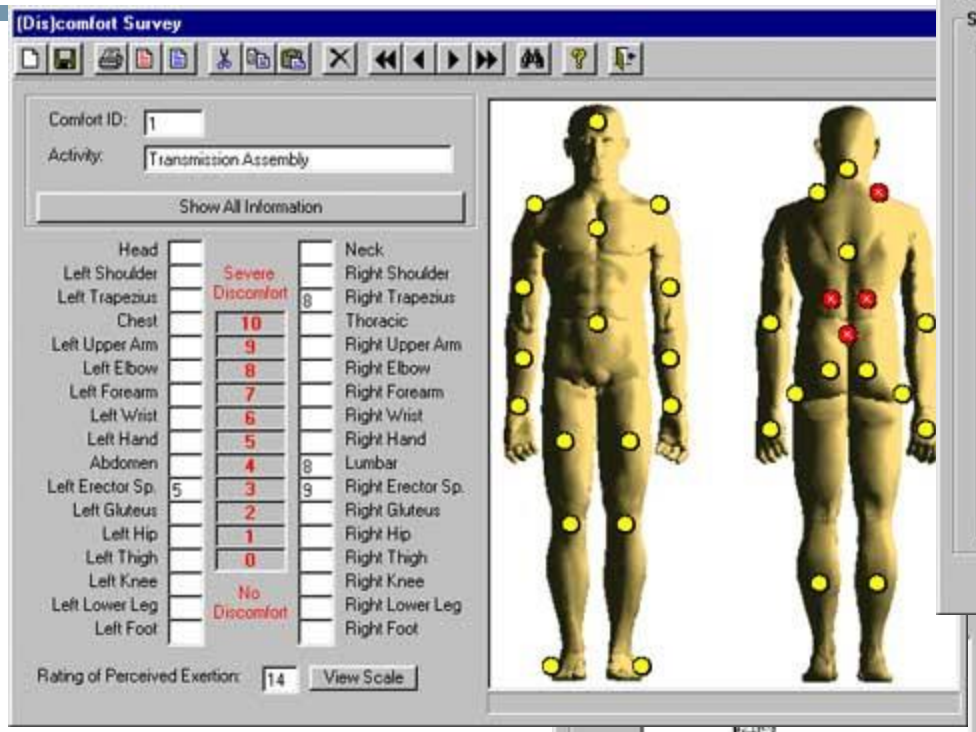
provided by Practical Ergonomics
rburker@ergosmart.com (816) 444-1667

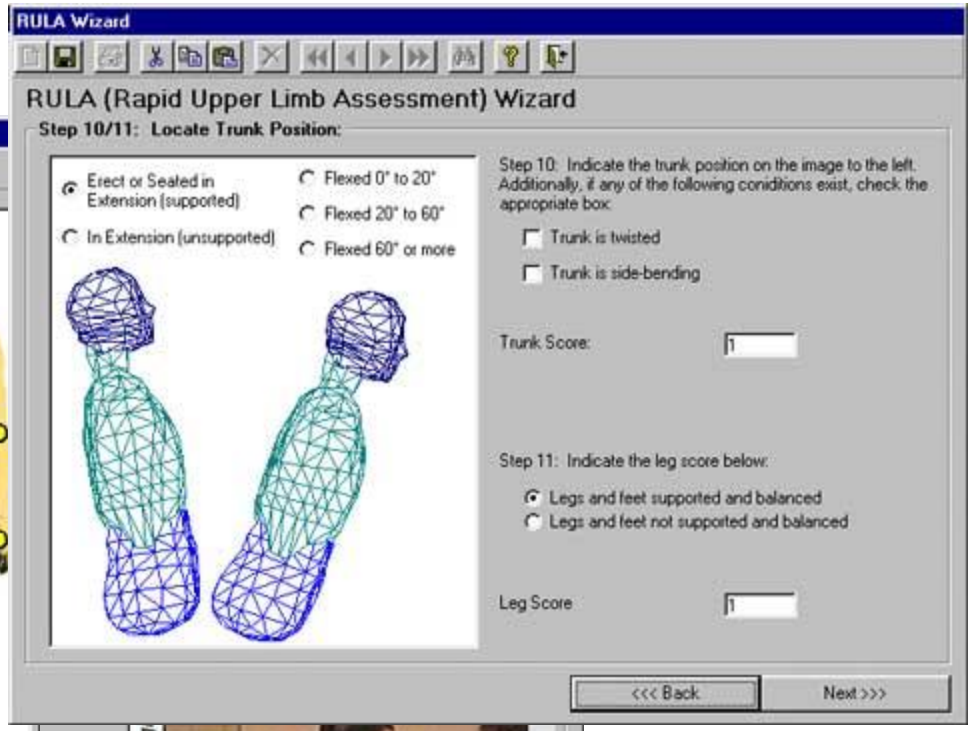
REBA – Rapid Entire Body Assessment

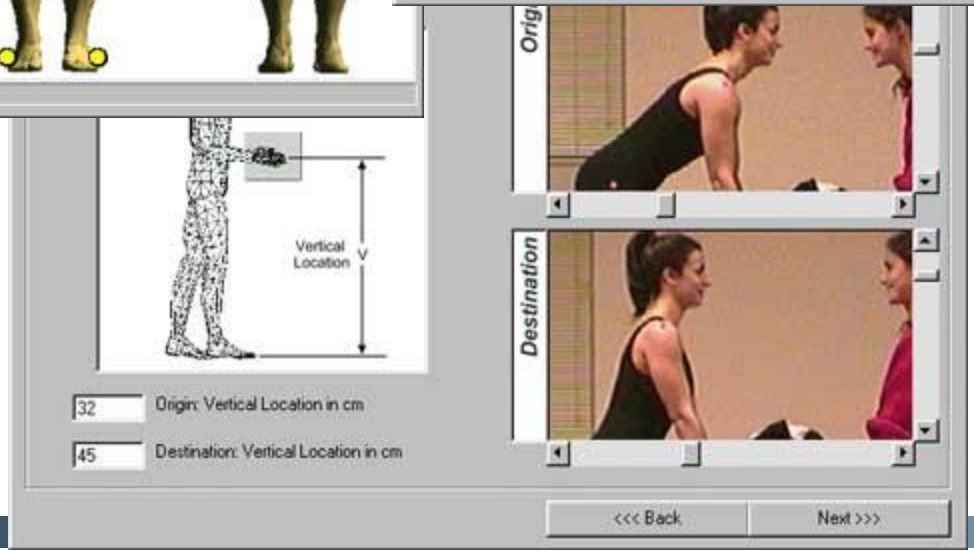


OCRA (Occupational Repetitive Actions)

And the others on-line

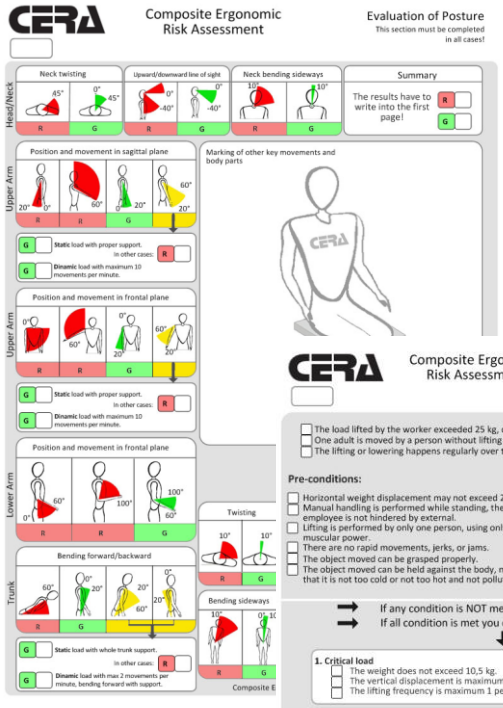


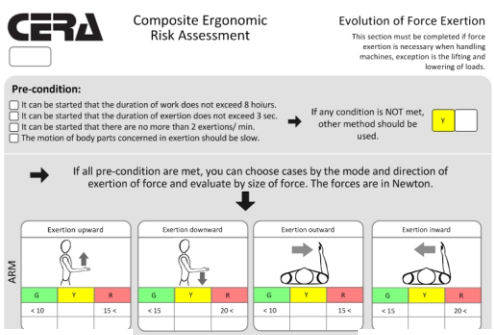


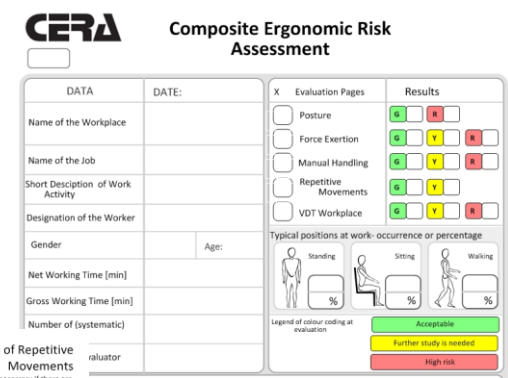


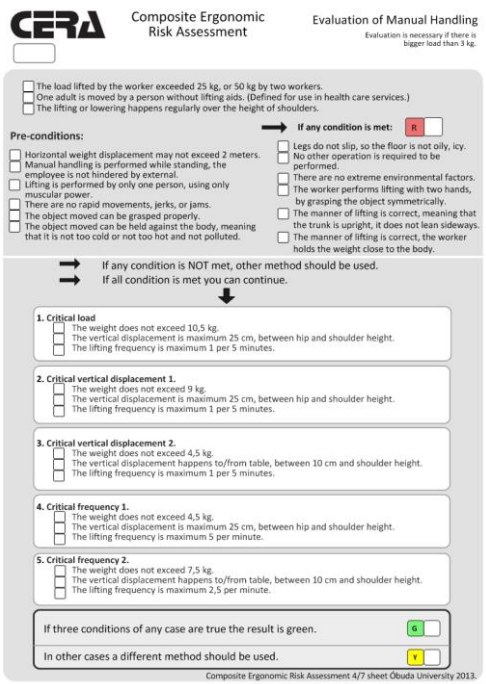
http://www.nexgenergo.com/ergonomics/ergomast.html

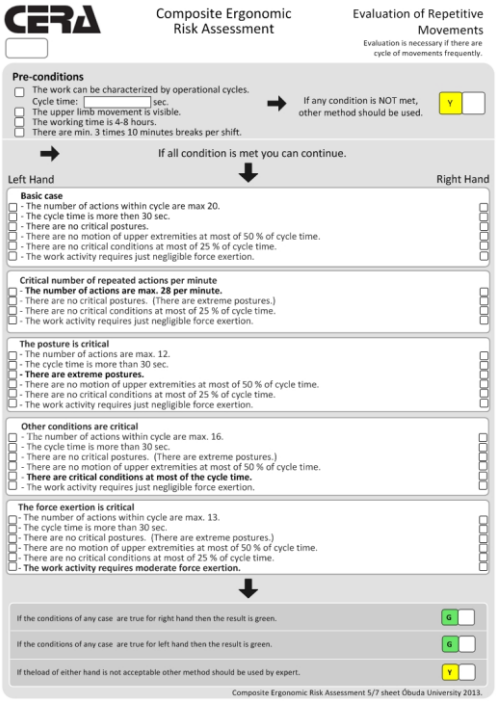
Composite Ergonomics Risk Assessment

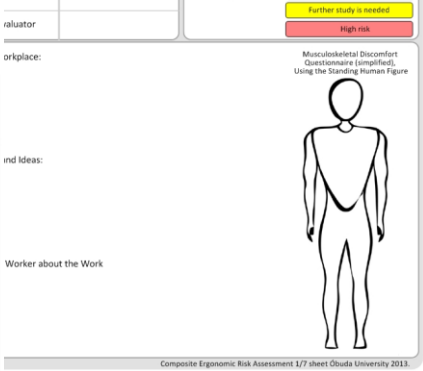












wMSDs still persists

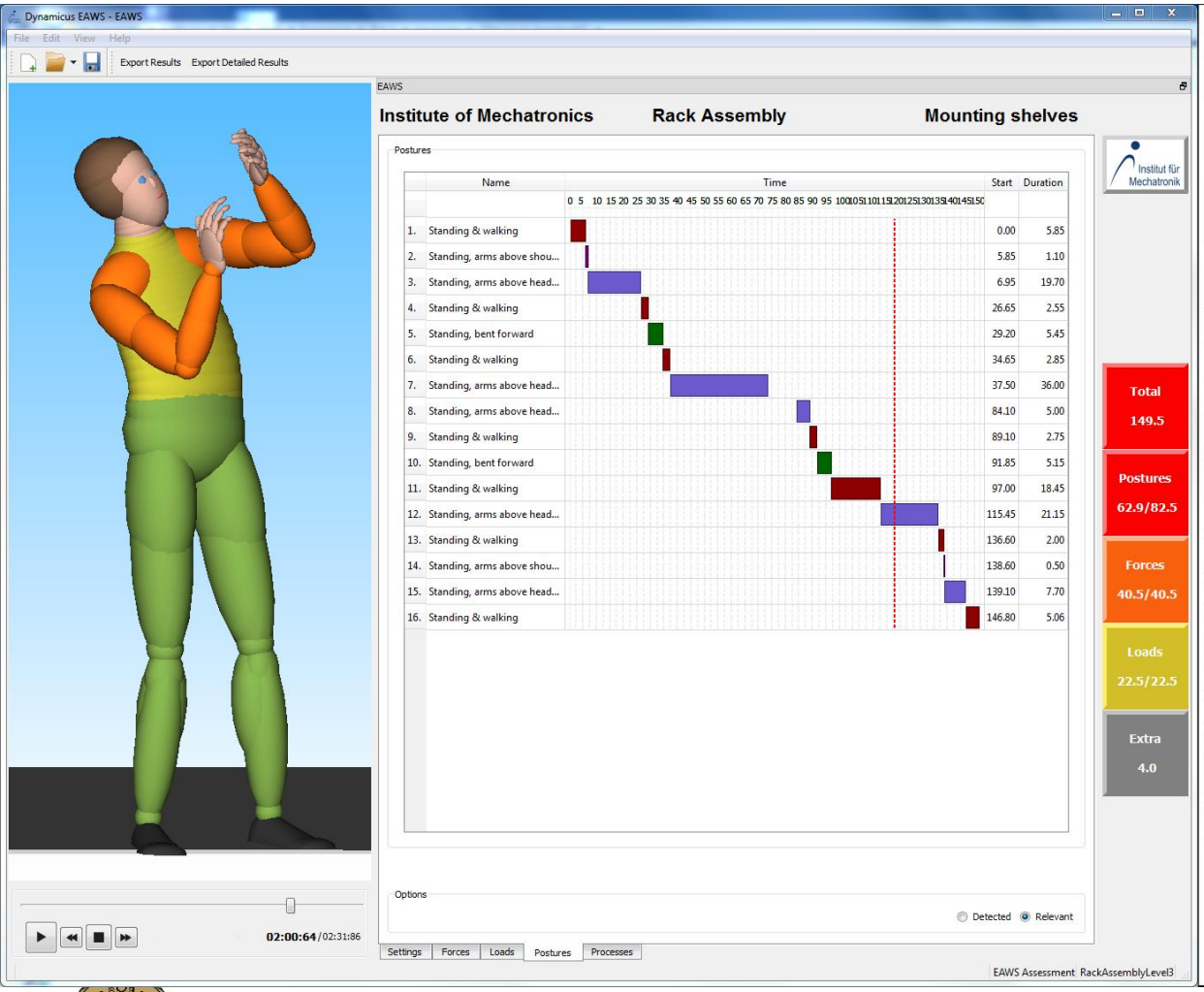
The Composite Ergonomic Risk Assessment

- A paper-pencil method which is easy to use for anyone after some practice, and which gives a simple evaluation after a separate determination of the different ergonomic risks.
- A workbook which allows detailed assessments and provide risk levels in borderline cases, according to the standard methods given a detailed evaluation, which method occupational safety and health professionals can use after a few days training.
- An imaging-based method, which is based on observations of real activity.

The Composite Ergonomic Risk Assessment

- The method according to EN 1005 series of standards for appropriate assessment of the elements, namely:
  - posture,
  - manual handling,
  - effort,
  - repetitive movements,
- Plus
  - Subjective discomfort,
  - Workplace history,
  - Improvement ideas

Ergonomic Assessment Worksheet



Ergonomic Assessment Worksheet V1.3.3

Basic Positions / Postures and movements of trunk and arms (per shift) (incl. loads of 3-4 kg and action forces of 30-40 N)		Evaluation of static postures and/or high frequent movements of trunk/arms: Duration [sec/min] / cycle time = duration of posture(s) x 60	Sum of lines	Postures: Asymmetry effects – Trunk Rotation 1), Lateral Bending 1), Far Reach 2)
Static postures: > 4sec High frequent movements: 2 trunk bendings or 10 arm liftings > 60° per min	[%] [sec/min] [min/8h]	5 | 7,5 | 10 | 15 | 20 | 27 | 33 | 50 | 67 | 83 3 | 4,5 | 6 | 9 | 12 | 16 | 20 | 30 | 40 | 50 24 | 36 | 48 | 72 | 96 | 130 | 160 | 240 | 320 | 400		int | dur (0-5 | 0-3) Intensity x Duration
Standing (and walking)				
1 Standing & walking in alteration, standing with support		0 | 0 | 0 | 0 | 0,5 | 1 | 1 | 1 | 1,5 | 2	0,9	1,8 | 0,8 = 1,4 ; 0,0 | 0,0 = 0,0 ; 0,3 | 2,2 = 0,7
2 Standing, no body support (for other restrict. see Extra Points)		0,7 | 1 | 1,5 | 2 | 3 | 4 | 6 | 8 | 11 | 13	0,0	0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0
3 Bent forward (20-60°)		2 | 3 | 5 | 7 | 9,5 | 12 | 18 | 23 | 32 | 40	2,8	1,5 | 2,5 = 3,8 ; 0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0
with suitable support		1,3 | 2 | 3,5 | 5 | 6,5 | 8 | 12 | 15 | 20 | 25		
4 Strongly bent forward (>60°)		3,3 | 5 | 8,5 | 12 | 17 | 21 | 30 | 38 | 51 | 63	0,0	0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0
with suitable support		2 | 3 | 5 | 7 | 9,5 | 12 | 18 | 23 | 31 | 38		
5 Upright with elbow at / above shoulder level		3,3 | 5 | 8,5 | 12 | 17 | 21 | 30 | 38 | 51 | 63	0,8	0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0 ; 0,2 | 2,0 = 0,4
6 Upright with hands above head level		5,3 | 8 | 14 | 19 | 26 | 33 | 47 | 60 | 80 | 100	70,5	3,0 | 0,4 = 1,2 ; 0,0 | 0,0 = 0,0
Sitting				
7 Upright with back support slightly bent forward or backward		0 | 0 | 0 | 0 | 0 | 0 | 0,5 | 1 | 1,5 | 2	0,0	0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0
8 Upright no back support (for other restrict. see Extra Points)		0 | 0 | 0,5 | 1 | 1,5 | 2 | 3 | 4 | 5,5 | 7	0,0	0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0
9 Bent forward		0,7 | 1 | 1,5 | 2 | 3 | 4 | 6 | 8 | 11 | 13	0,0	0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0
10 Elbow at / above shoulder level		2,7 | 4 | 7 | 10 | 13 | 16 | 23 | 30 | 40 | 50	0,0	0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0
11 Hands above head level		4 | 6 | 10 | 14 | 20 | 25 | 35 | 45 | 60 | 75	0,0	0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0
Kneeling or crouching				
12 Upright		3,3 | 5 | 7 | 9 | 12 | 15 | 21 | 27 | 36 | 45	0,0	0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0
13 Bent forward		4 | 6 | 10 | 14 | 20 | 25 | 35 | 45 | 60 | 75	0,0	0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0
14 Elbow at / above shoulder level		6 | 9 | 16 | 23 | 33 | 43 | 62 | 80 | 108 | 135	0,0	0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0
Lying or climbing				
15 (Lying on back, breast or side) arms above head		6 | 9 | 15 | 21 | 29 | 37 | 53 | 68 | 91 | 113	0,0	0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0
16 Climbing		6,7 | 10 | 22 | 33 | 50 | 66	0,0	0,0 | 0,0 = 0,0 ; 0,0 | 0,0 = 0,0

1) Trunk: int 0 slightly <10° \| 1 medium 15° \| 3 strongly 25° \| 5 extreme >30°; dur 0 never \| 1,5 4s \| 2,5 10s \| 3 13s; 0% 6% 15% 20%

2) Far Reach: int 0 close \| 1 60% \| 3 80% \| 5 arm stretched; dur 0 never \| 1 4s \| 1,5 10s \| 2 13s; 0% 6% 15% 20%

Σ 75,0 (a) — Asymmetry effects: Σ 6,4 (max=15) ; 0,0 (max=15) ; 1,1 (max=10); Σ (max=40) 7,5 (b)

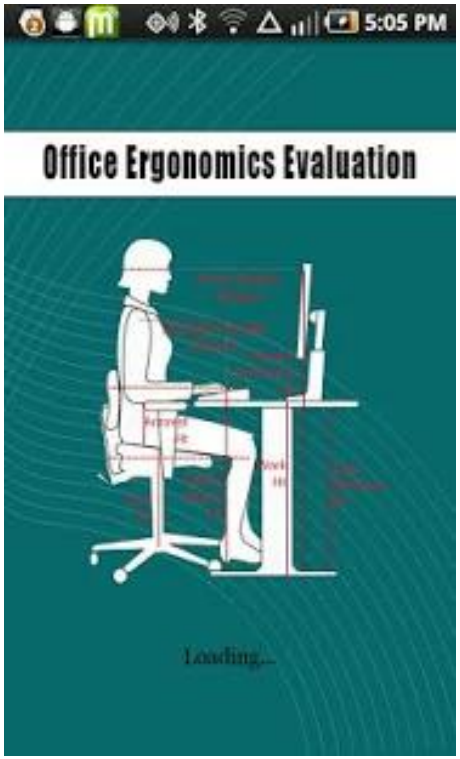
Attention: Max. duration of evaluation = duration of task or 100%! — Attention: correct evaluation, if duration of evaluation ≠ 60s

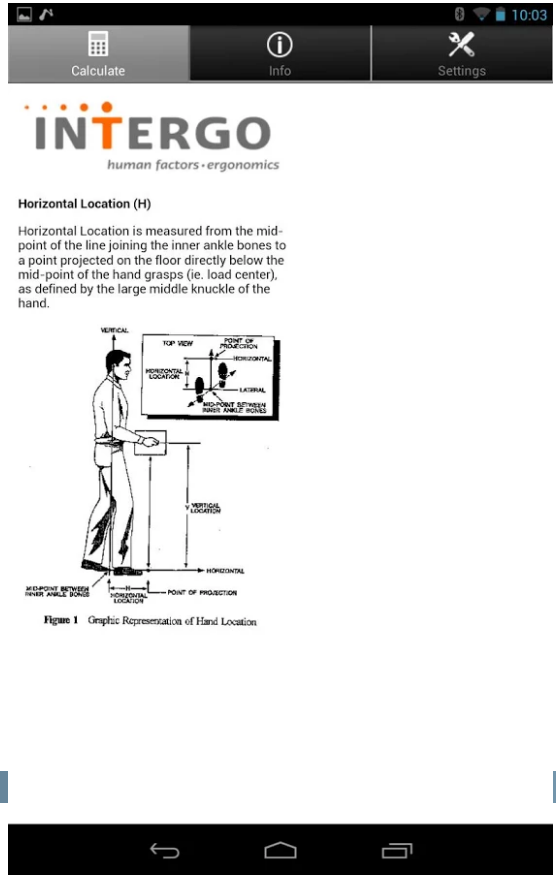
Postures = Σ lines 1 - 16 75,0 (a) + 7,5 (b) = **82,5**

Apps

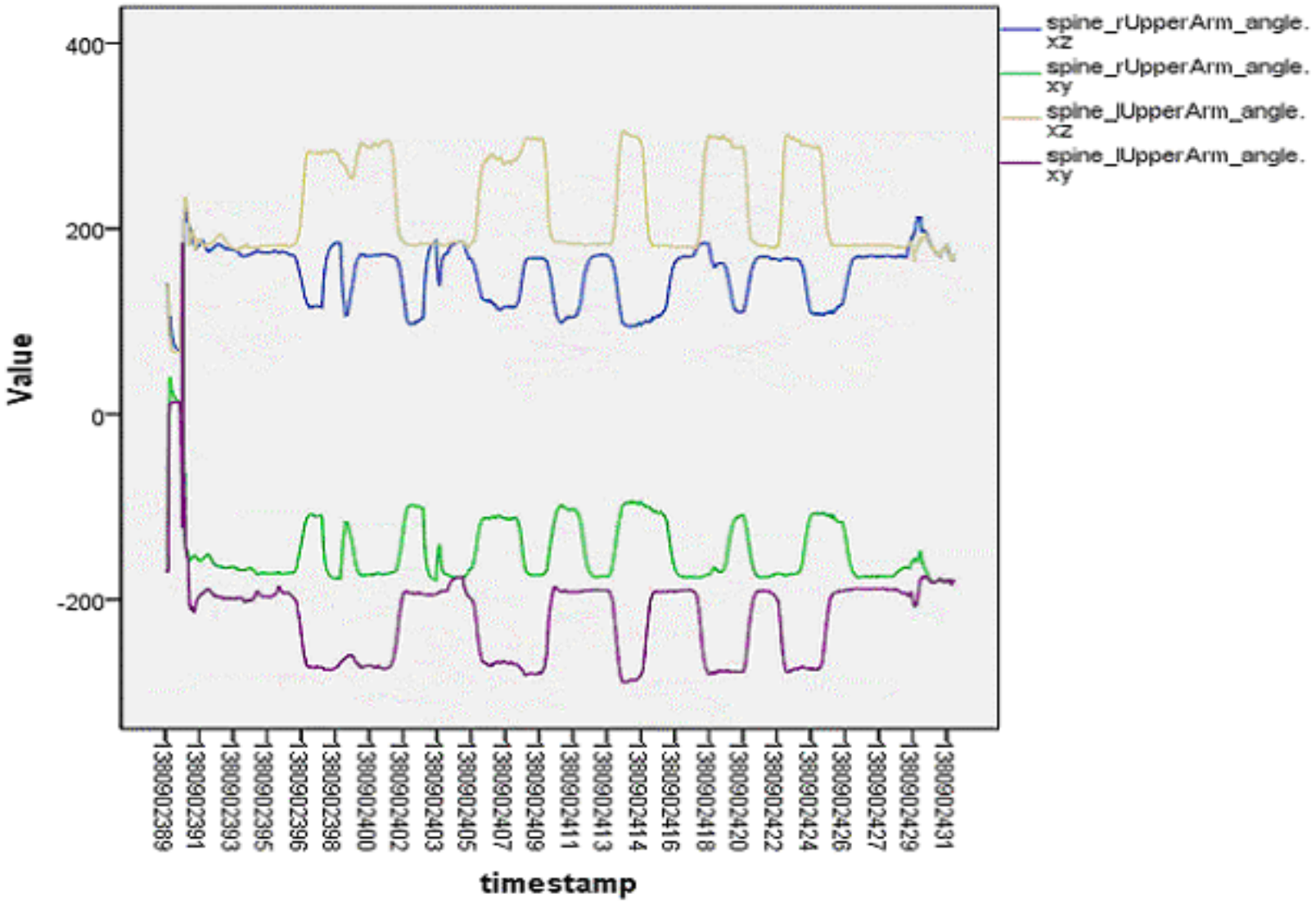
HSE RULA

Rapid
Upper
Limp
Assessment

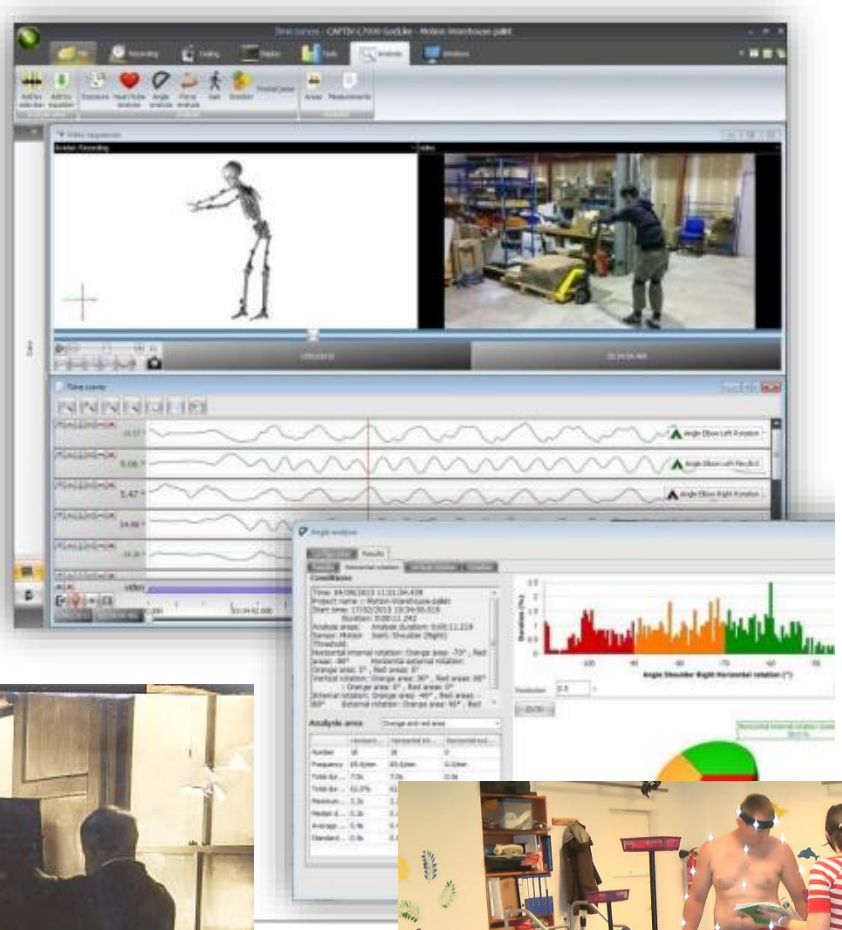




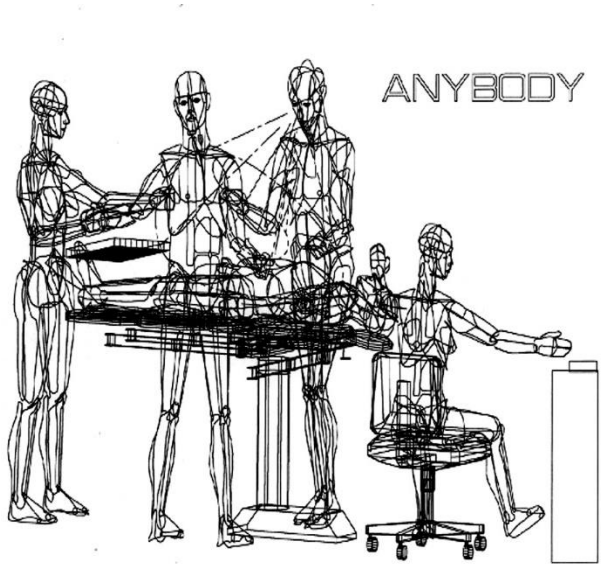
Graphs of some calculated joint degrees

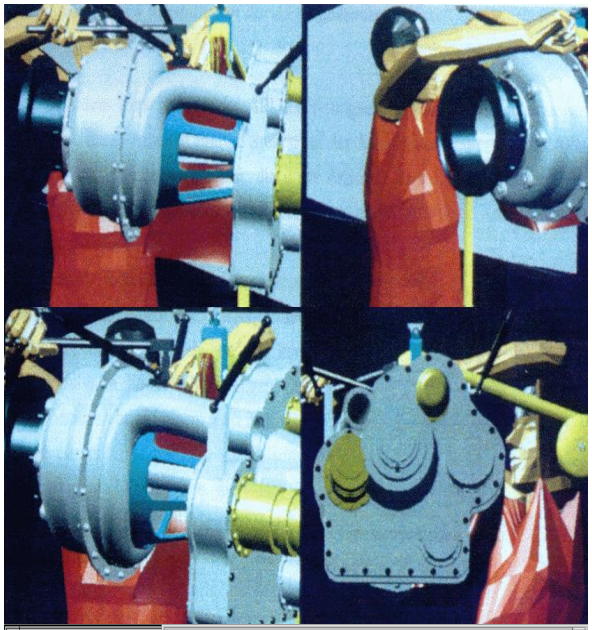


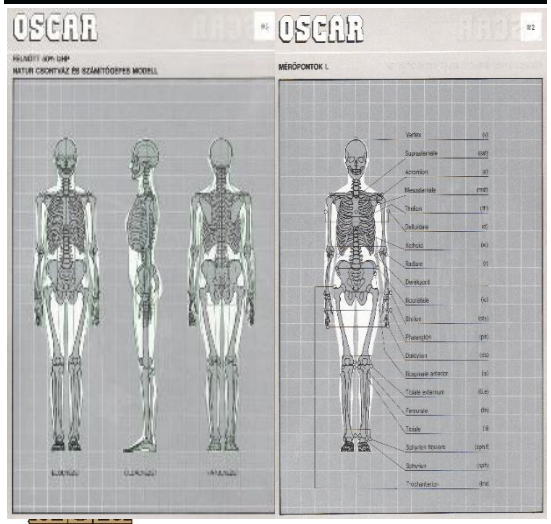
Motion Capture

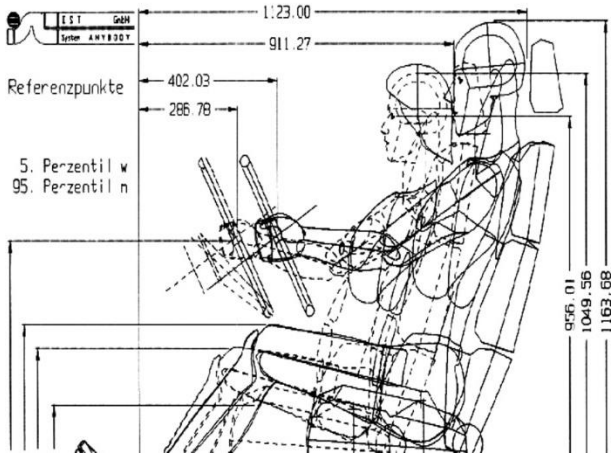


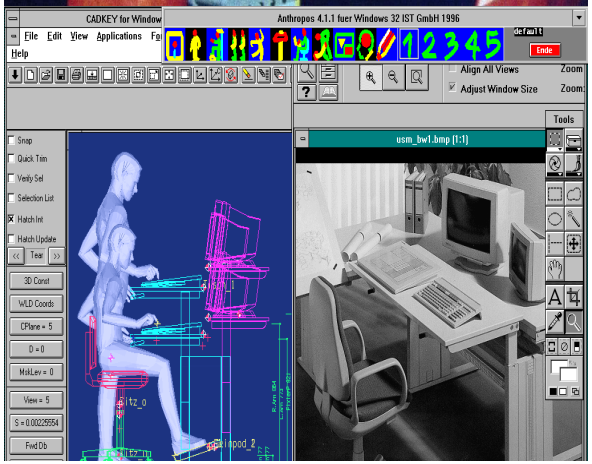
Avatar history
(human engineering szoftwares 1981-1989)





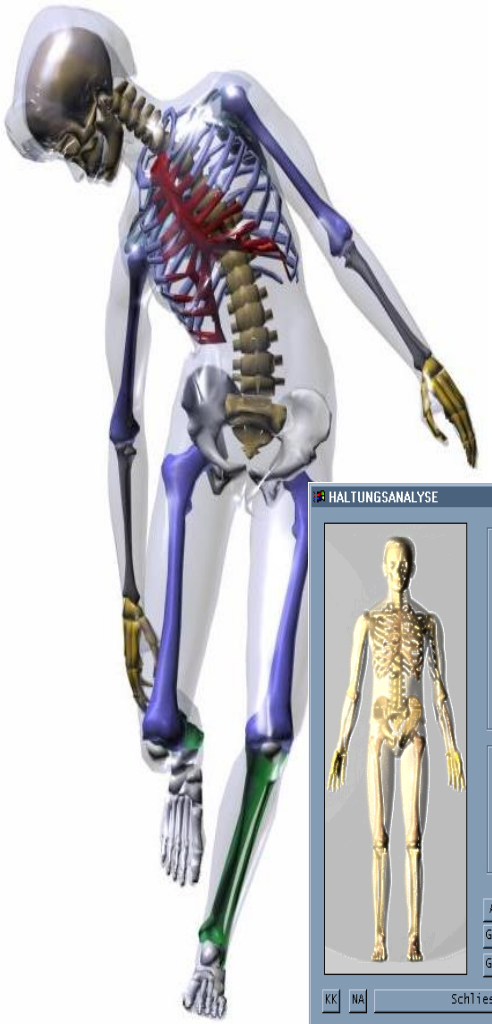


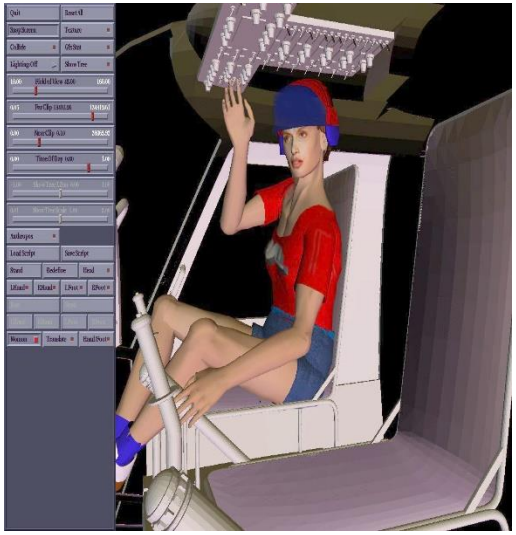


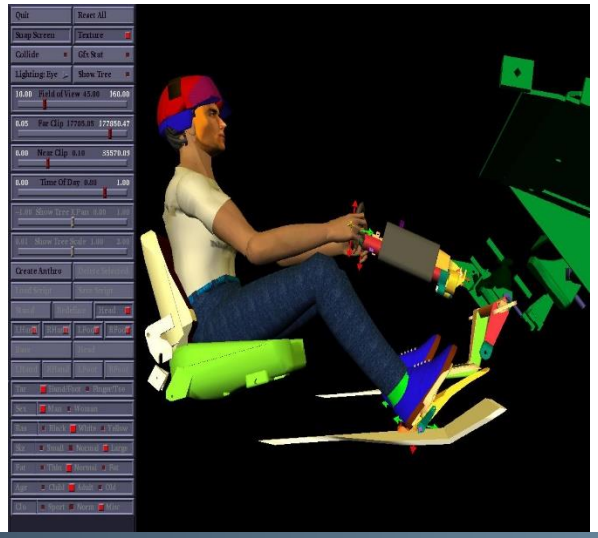


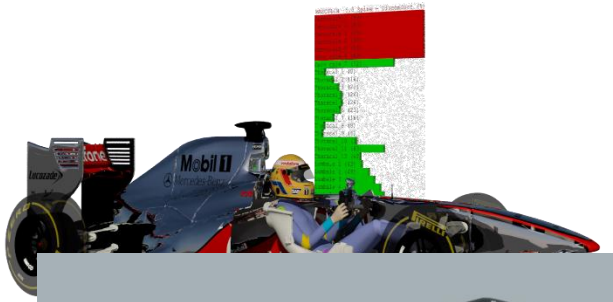
OSCAR 1981-86 Anybody 1987-89 Anthropos 1990-99

Avatar history
(human engineering szoftwares 1996-2001)



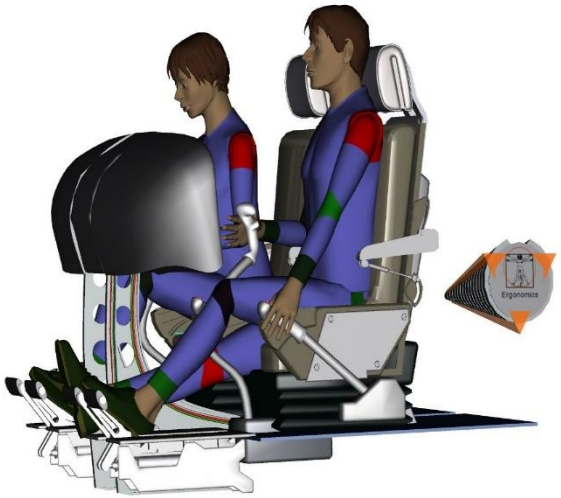


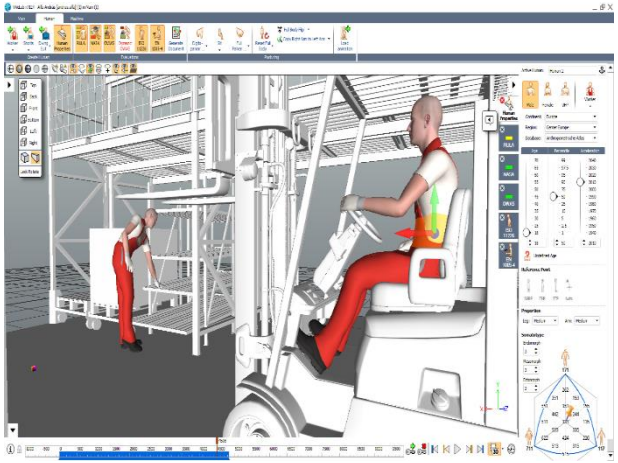


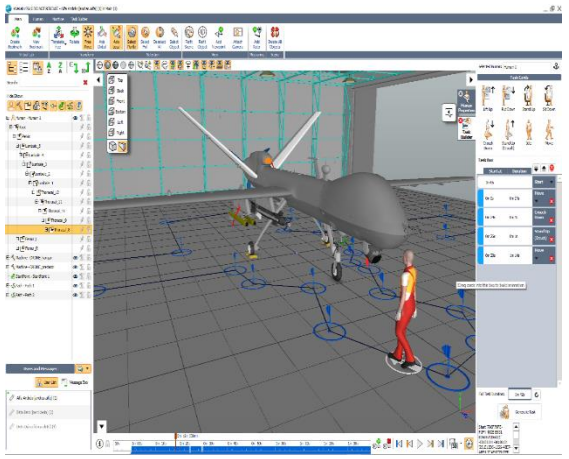


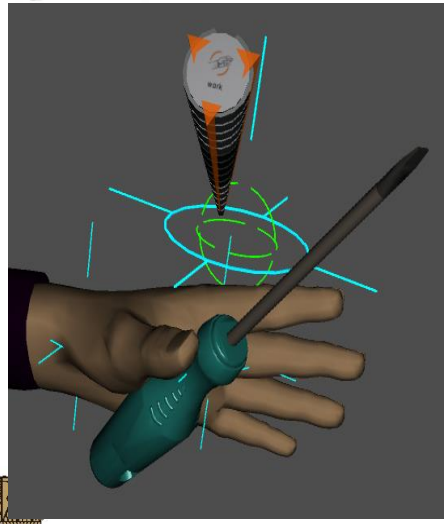
Ergomax 1999 - 2001 Ergonaut 1996 - 2001 CharAT 2001 -

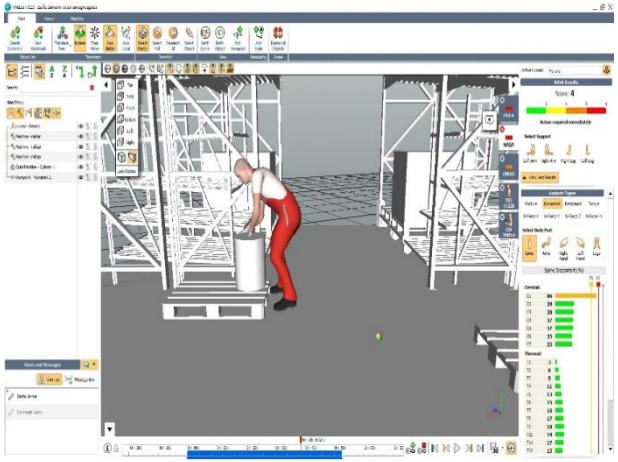
Avatar history
(human engineering szoftwares 2004-)

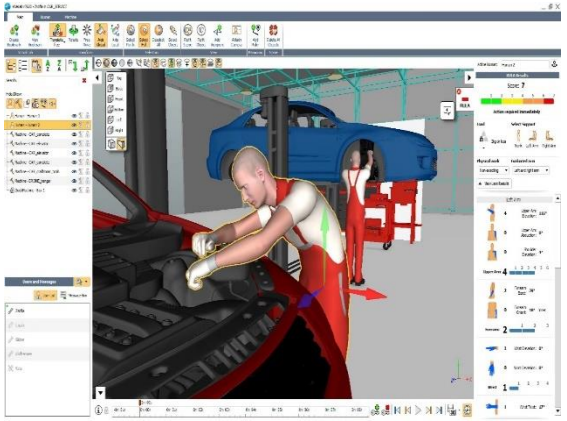






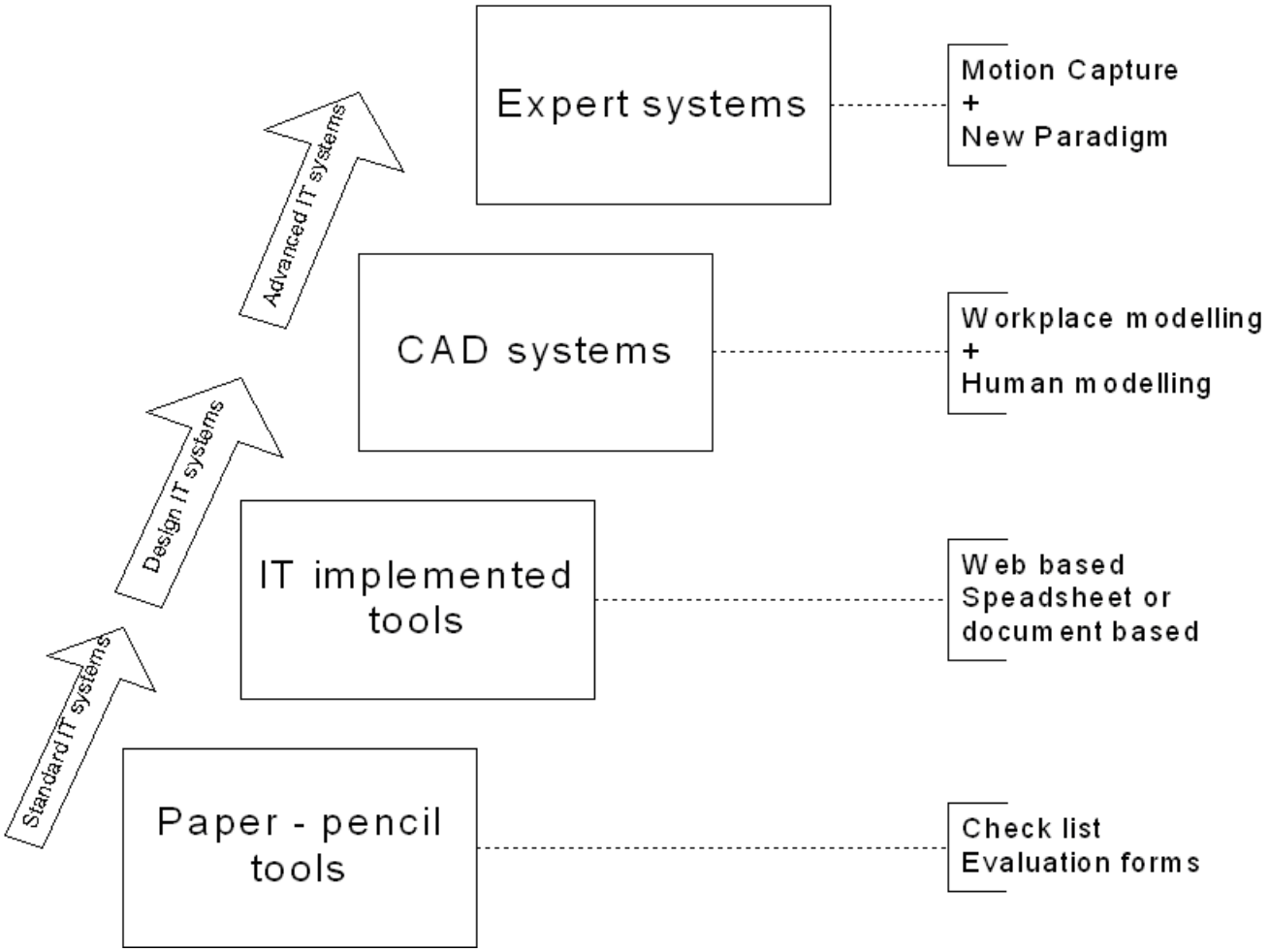






IDO-Ergonomics 2004 - ViVeLab - ViVeHuman 2016 -

Evolution of Ergonomic Risk Assessment Tools



The background

$$R_{MSD} = \frac{N_{ME}}{T_C * C_{TT} * C_I * C_{BT} * C_E * C_{PH} * C_{MI}}$$

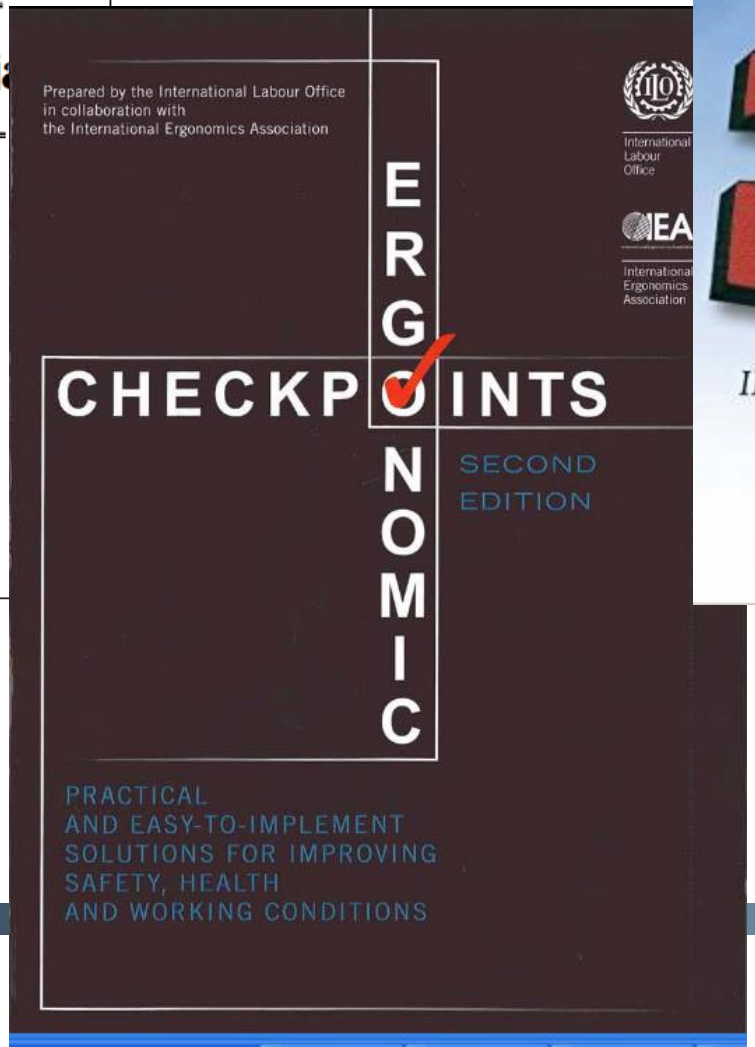
$$F_{Br} = F_B * m_v * m_f * m_d$$

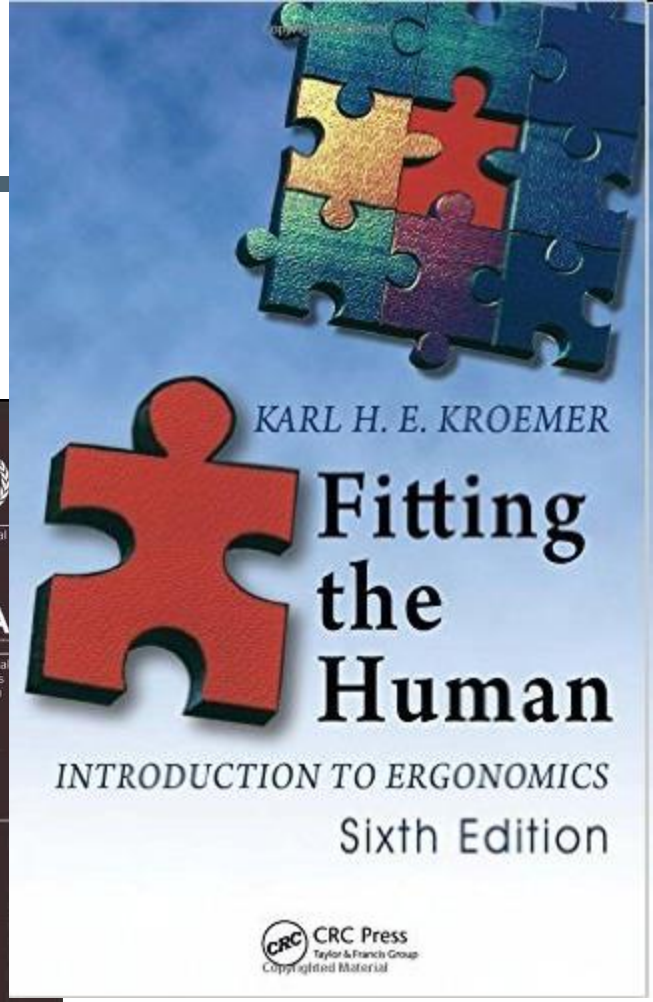
$$M_{ME} = M_{ref} * C_M * C_T * C_V * C_A * C_{MF} * C_F$$

STUDENT MANUAL

Ergonomics Essenti

April 2009





Thank you for your attention!

And don’t forget to make some good, too.