

RISK SCREENING

The need for identifying the degree of exposition to biomechanical load has led to the development of specific ergonomic risk screening analysis related to given work tasks; aim of these tools is to analyze the risk factors that may lead to overload or even occupational diseases, in order to suggest retaliatory actions that minimize the present type of risk.

The basis of every ergonomic risk screening tool is to establish a link between the three factors that determine a work task (force, frequency, grip) and the possibility to get into overload or even to contract an occupational disease because of the present working conditions and the type of task.

The main difficulty is to establish how the different factors interact and lead to work related troubles or diseases.

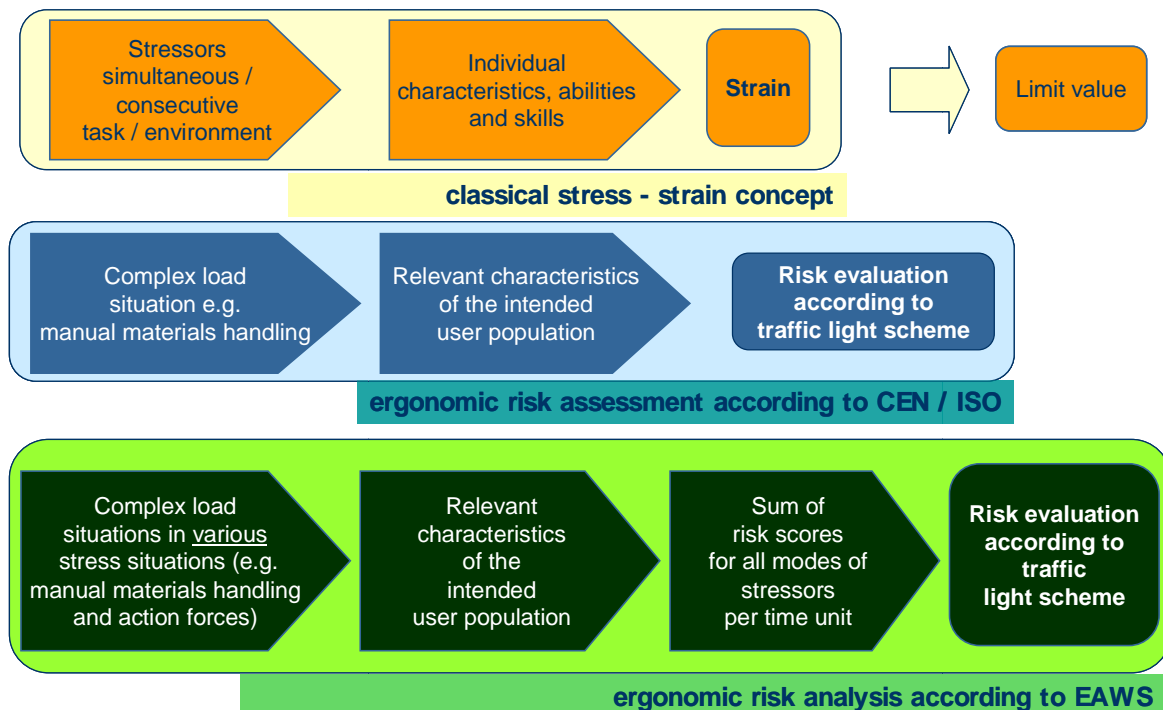


Figure 1 -Scheme of the new approach to risk evaluation of the EAWS

Certainly the perfect approach is to apply risk prevention in project / process design phase (preventive prospective ergonomics); if the product and/or process is already defined changes may cost more and be less efficient (corrective ergonomics) because process reorganizing is often limited due to high investments for modifications.

For a quantitative ergonomic risk evaluation of a specific working sequence, generally two evaluation levels are used:

- First level tools: risk evaluation tools which require a quick screening checklist.
- Second level tools: risk evaluation tools which require a detailed analysis with index calculations. They are applied where a possible risk has been already detected by a 1st level system.

The aim of First level tools is to get a very quick mapping of the different risk areas of all working tasks and to concentrate all the efforts for rapid redesigning. With Second level tools usually specific loads are analyzed in detail.

Though the EAWS is described as First level tool, in some sections it exceeds the detail of Second level tools (e.g. OWAS, RULA, Stainindex, HAL-TV) or is at minimum equal to them.

In the following table are summarized the risk areas, the correlated rules and some First and Second level analysis tools that cover the risk analysis for each sections. A description of the Automotive Assembly Worksheet (AAWS) is given in Schaub/Landau 2004.

Risk Areas	Standards		Tools	
	CEN	ISO	2 <sup>nd</sup> Level	1 <sup>st</sup> Level
Body Postures with low external effort	1005-4	11226	OWAS	AAWS
Action Forces	1005-3	11228-2	SNOOK-CIRIELLO TABLES	
Manual Material Handling (Repositioning)	1005-2	11228-1	NIOSH	
Upper limbs – high frequencies / low loads	1005-5	11228-3	OCRA STAIN INDEX HAL-TV	EAWS

Figure 2 - EAWS compatibility to International Standards and select Second level Tools



## THE EAWS PROJECT

The needs to comply with the rules push the companies to have at their disposal a 1° level ergonomic analysis system to evaluate biomechanical load for every component (static and dynamic load, force application, vibration and manual materials handling) for the whole body.

The EAWS meets these requirements. During its developments in particular the following design criteria were taken into account:

- The tool had to be accepted and considered exhaustive by:
  - Company
  - Workers
  - Unions
  - Authorities
- Applicator deviations – e.g. the gap between the analysis results of different applicators – had to be minimized, rendering the identification and measuring of technical actions, awkward postures and forces at maximum objective.
- The tool should have the capability to be used during the planning of the product/process as well as in the production process.

The main aims of the development of the EAWS system were:

- Compliance with labor legislation (national and international), e.g.:
  - EU Machinery Directive (2006/42/EC, former 98/37/EU, 89/392/EEC)
  - EU Framework Directive (89/391/EEC)
- Allow to document and evaluate the working conditions, taking into account the operator work load as it is described by the rules in force
- Ensuring ergonomic working conditions
- Developing an extension of the Automotive Assembly Worksheet (AAWS) for repetitive loads on the upper limbs in accordance with EN 1005-5 and the corresponding ISO standard 11228-3.
- Making this tool usable in any kind of company, from mass production to one of a kind production
- Developing a free tool without any kind of copyright
- Linking EAWS to MTM:
  - MTM-2 : mass production systems
  - UAS: batch production systems
  - MEK: one of a kind production systems



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## PROJECT DEVELOPMENT HISTORY

EAWS is originally an extension of the Automotive Assembly Worksheet (AAWS) developed by the IAD (Institut of Ergonomics at the Darmstadt University of Technology) on the basis of the “New Production Worksheet”, initiated 1997 by General Motors Europe (GME), and the “DesignCheck”, realized at the same time at Porsche. The development of the EAWS was carried out between 2006 and 2008, by occupational health, biomechanical and industrial engineering international experts from all over the world, coordinated by the IMD (International MTM Directorate).

The field test was run in multinational companies that allowed the team to analyze relevant processes that represented different production contexts. In this way all the necessary tests were performed before the last release of the tool (Field Application Group).

In addition, software companies were involved during EAWS development in order to implement and develop specific software solutions based on EAWS structure (Engineering Application Group).

IMD and national MTM Associations, together with the experts that worked with the team, gave all the tests results to the reference teams that represent the EAWS users main process partners (Reference Groups). The general project organization during the development phase was the following:

## EAWS – Project organization

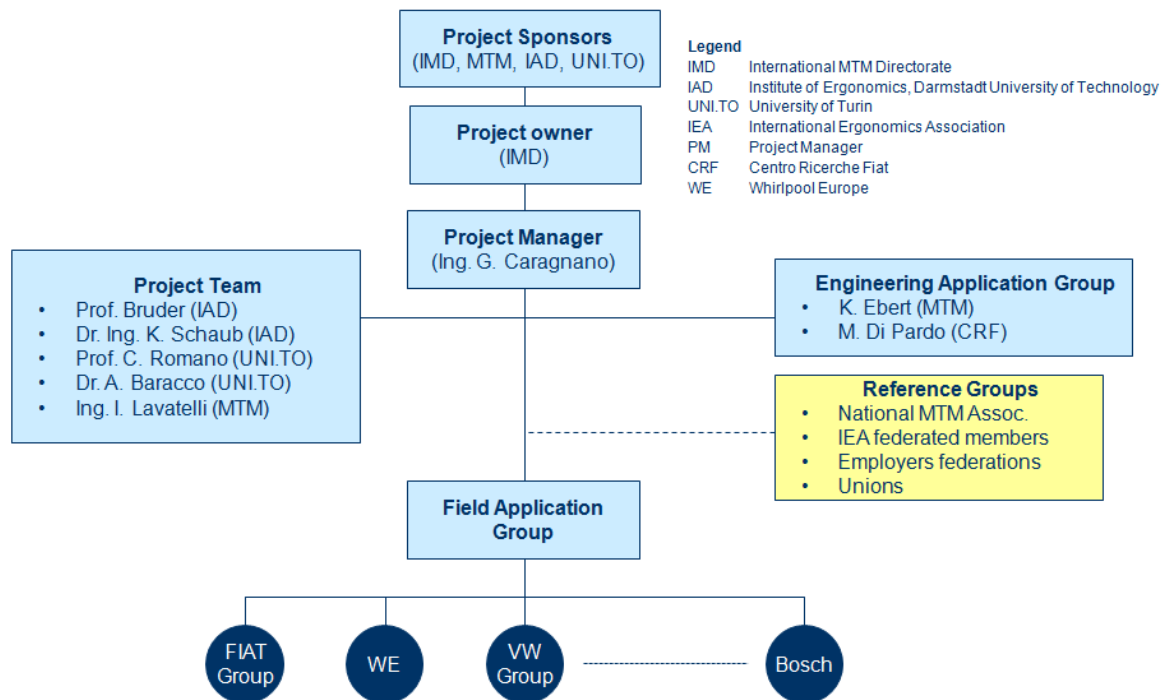


Figure 3: EAWS project development organization

Field Application Group:

### ITALY AND FRANCE

- MTM Italia
  - I. Lavatelli, International MTM Instructor
  - A. Tassinari, International MTM Instructor
  - C. Rubano, MTM Instructor
- FIAT auto, Mirafiori Torino Plant
  - Ergonomy: S. Torrisi and S. Spada
  - Planning & Control: L. Galante, R. Bonetti, M. Capoccia, M. Vitello
- BOSCH Diesel Technologies and Breaking Systems (BA)
  - Industrial Engineering : M. Mancino and V. Nicassio
- WE: Whirlpool Europe (Home Appliances), Amiens plant, France
  - R. Delrue
- IVECO: commercial vehicles, Suzzara plant
  - H&S: S. Cencetti,



- Ergonomy: F. Leoni
- Work Analysis: G. Condò

## GERMANY

- IAD
  - R. Bruder
  - K. Schaub
  - H. Rademacher
  - K. Ahmadi
- Volkswagen: automotive (IAD)
  - Industrial Engineering: J. Nanasi
  - Ergonomy: B. Toledo Munoz, R. Filus
- Bosch: (IAD)
  - Bosch components
  - Bosch- Siemens home appliances
  - Bosch Rexroth tools

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## EAWS MAINTENANCE PROCESS

The maintenance process of EAWS is managed by the EAWS Technical Board, which is composed of

- G. Caragnano, IMD – Distribution and coordination
- K. Schaub, IAD – EAWS form (figures and relations), scientific consulting and approval
- I. Lavatelli, AMI – Manual, slides and IVGA file

The Customer Care (CC) function is granted by AMI and IAD ([EAWS@mtmitalia.com](mailto:EAWS@mtmitalia.com))

This function is a reference for the users in case they want to contact the EAWS Technical Board to submit proposals, articles or they have any question regarding the application.

The CC function is also in charge of editing the modifications to the training set and EAWS form and to keep a Log file of all the modifications (release notes).

Additionally, a User Board will be composed by organizations with EAWS instructors and practitioners, such as:

- National MTM Associations (translation, qualification procedure and certification)
- FGA and VW (reports from the field application)

The Engineering Application Group is composed of software developers who use EAWS in their software product and the software product is certified by the IMD.

The maintenance process regards the following items:

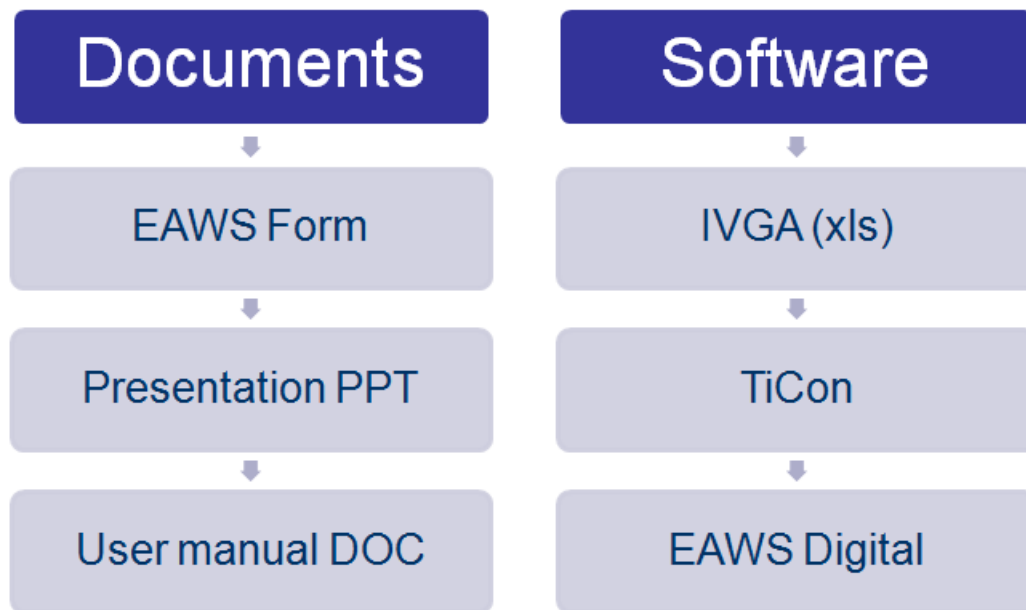


Figure 4 – EAWS set of items

The EAWS governance system is represented as follows:

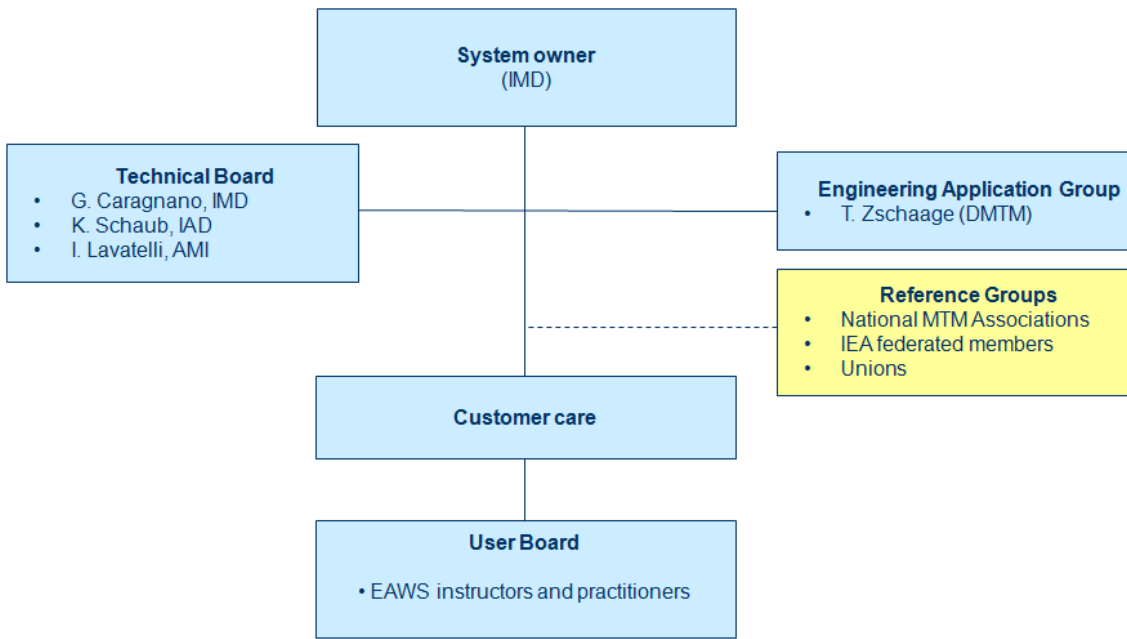


Figure 5 – EAWS governance

The maintenance process cycle is the following:

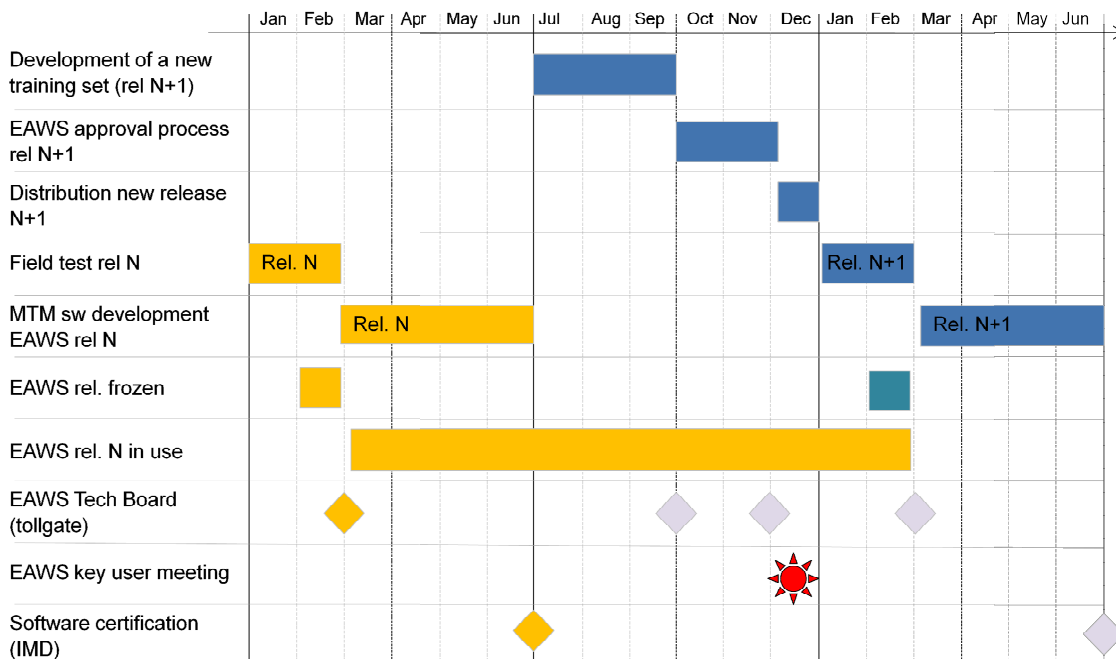


Figure 6 – EAWS maintenance process cycle





The key tollgates are the following:

- Concept Evaluation Tollgate (CET), at the end of September, to define the new concept
- Release Evaluation Tollgate (RET), at the end of November, to release the new EAWS documents
- Business Evaluation Tollgate (BET), at the end of February, to release the tested EAWS documents to the software developers
- Software Certification Tollgate (SCT) to certify software products using the officially released EAWS version

The EAWS key user meeting is intended to present to the main users the changes of the EAWS and to collect a feed-back from the field application.

## EAWS: STRUCTURE AND BASIC PRINCIPLES

*Note: The pictures of the EAWS form in the manual do not necessarily represent the latest release, which is instead annexed to the present manual in the Appendix.*

EAWS is an ergonomic 1° level system for screening the risk due to biomechanical overload, developed to provide an overall risk evaluation that includes every biomechanical risk to which an operator may be exposed during a working task.

Up to a certain extent EAWS can also be used as 2nd level analysis tool, since it is quite analytical and detailed; EAWS gives the necessary information to redesign the work task, making the second level systems seldom necessary.

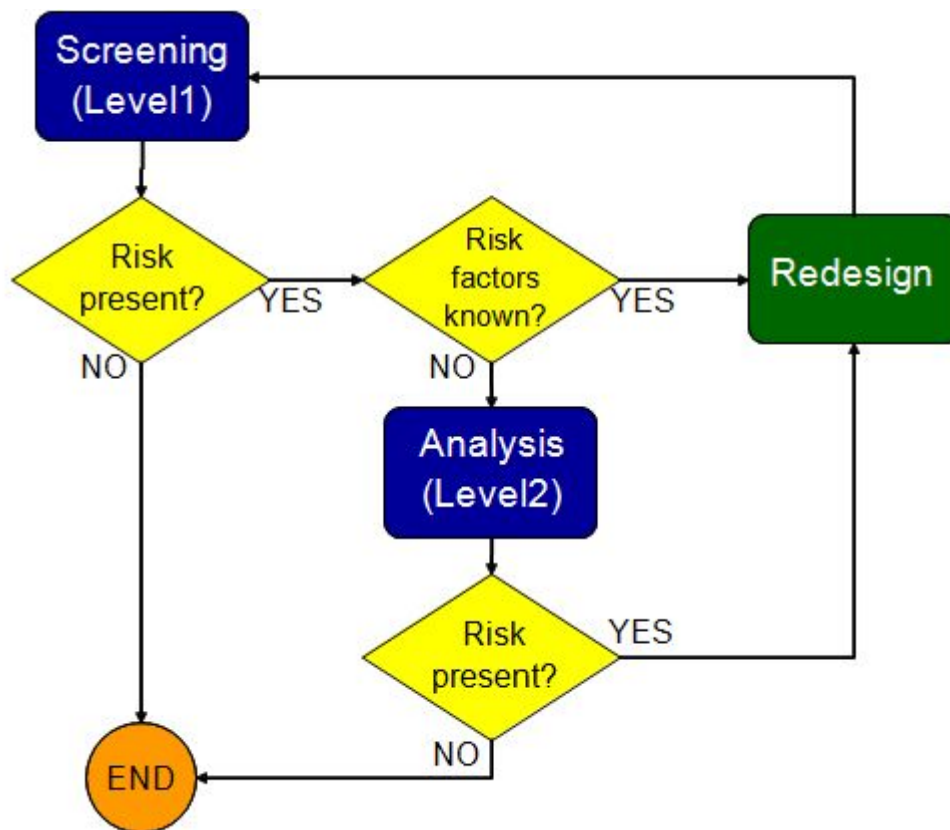


Figure 7 - EAWS Risk assessment model

The risk assessment model is defined more comprehensive in the International Standard ISO 11228 Part 2 (Pushing and Pulling) at page 3.

The structure of the analysis is as follows:

- Macro-Section "Whole body":
  - Section 0: Extra Points
  - Section 1: Postures (static load)
  - Section 2: Action forces
  - Section 3: Manual materials handling
- Macro-Section "Upper limbs"
  - Section 4: Upper limb load in repetitive tasks

The EAWS sheet provides one score resulting for each Macro-Section which is exposed in a traffic light scheme (green, yellow, red) according to the Machinery Directive 2006/42/EC (EN 614).

0-25 points	<b>Green</b>	No risk or low risk - recommended; No action is needed
>25-50 points	<b>Yellow</b>	Possible risk - not recommended; redesign if possible, otherwise take other measures to control the risk
>50 points	<b>Red</b>	High risk – to be avoided; Action to lower the risk is necessary

Figure 8 – Overall Evaluation

Whole body and upper limbs scores are evaluated on the same scale.

### 1.1. EAWS MODES OF USE AND BASIC STRUCTURE

The EAWS system can be used in two different modes which are different concerning scope and calculation:

#### “INSTANTANEOUS” RISK MAPPING\PRELIMINARY WORKSTATION RE-DESIGN FOR A SPECIFIC WORKER

- For a quick ergonomic risk assessment on an observed specific worker performing the work task on the shop-floor (observational method)
- Paper & pencil tool → two double-sided A4 sheets with interpolation possibilities.
- Analysis refers to observed work task (deviation risk from planned method)
- Risk factors estimated by users (forces, durations, frequencies, etc...)

#### QUICK WORKSTATION RE-DESIGN

- For a middle-range ergonomic risk assessment on a generic worker performing the standard work task (MTM method)
- Software tool: IVGA
- Task and work method are given by an MTM analysis. MTM analysis isn't the IVGA input.
- Useful in case of improvement proposals for what-if analysis

#### ERGO-MTM WORKSTATION DESIGN

- For a prior and analytic ergonomic risk assessment on an anthropometric group of operators performing a work task (MTM method)



- Software tool: TiCon - MTMergonomics
- Inputs needed:
  - MTM task analysis
  - Production plan for frequencies calculation
  - MTM codes ergonomic characterization (geometries, forces, weights, etc...)
  - Production flow macro-geometries (heights) and product positions (high, low, etc...)

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## EAWS BASIC STRUCTURE

The basic reference structure for analysis results is the paper form of the Worksheet, built up in the following way:

- FIRST PAGE:
  - Header
  - Result of overall evaluation (where results of each section are reported)
  - Section 0: Extra Points
  - Comments
  - Additional information for scoring repetitive tasks (cycle time, produced units, breaks, etc.)
- SECOND PAGE:
  - Section 1: Postures and movements
- THIRD PAGE:
  - Section 2: Action forces
  - Section 3: Manual materials handling
- FOURTH PAGE:
  - Section 4: Upper limb load in repetitive tasks

Below you find the EAWS paper form, with indications of related standards and level 2 systems:

**Ergonomic Assessment Worksheet V1.3.4**

Plant: \_\_\_\_\_ Gender of operator:  f  m Body height: \_\_\_\_\_  
 Line: \_\_\_\_\_ MTM Analysis: \_\_\_\_\_ Analyst: \_\_\_\_\_  
 Task / Workplace: \_\_\_\_\_ Task duration [sec]: \_\_\_\_\_ Date: \_\_\_\_\_

**Result of overall evaluation:** Consider the total score of the whole body assessment and compare it to the upper limit score. The overall result is determined by the higher value for frequency and/or static posture assessment.

<input type="checkbox"/> Green	<input type="checkbox"/> Whole Body	<input type="checkbox"/> Postures	<input type="checkbox"/> Forces	<input type="checkbox"/> Loads	<input type="checkbox"/> Extra	<input type="checkbox"/> Upper Limbs
<input type="checkbox"/> Red	=	+	+	+	+	+

**EAWs score:**  
 0-25 Points: Green Low risk, recommended, no action is needed.  
 25-55 Points: Yellow Possible risk, not recommended, mitigate if possible, otherwise take other measures to control the risk.  
 >55 Points: Red High risk, to be avoided, action to lower the risk is necessary.

**Extra points "Whole body" (per minute / shift)**

a8	Adverse effects by working on moving objects	0	2	5	10	Intensity
a9	Accessibility (e.g. entering motor or passenger compartment)	0	2	5	10	Status
b0	Countersinks, requests, vibrations	0	1	2	5	Intensity x frequency
b1	Joint position (especially wrist)	0	1	2	5	Intensity x duration or frequency
b2	Other physical work load (please describe in detail)	0	5	10	15	Intensity

**For scoring of repetitive tasks only**

Description	Formula	Result
Rest shift duration [min]	-	-
Lunch break [min]	-	-
Other official pauses [min]	-	-
Non repetitive tasks (i.e. cleaning, supplies, etc.) [min]	-	-
Net duration of repetitive tasks (A) [min]	-	-
No. of rest shifts (or cycles) (B)	-	-
Net cycle time [sec]	(A x B) / 60	-
Observed cycle time [sec]	-	-

**Comments / proposals for improvements:**

**Basic Positions / Postures and movements of trunk and arms (per shift)**

(incl. leads of <math>C</math> 1q forces into fingers of <math>C</math> 20 5s and whole body forces of <math>445</math> N)

Static postures: > 4sec  
 High frequency movements: Trunk bendings (> 60°) x 2times, Movements into knee/elbow x 2times, Arms (Shoulder > 60°) > 10times.

Duration (min/shift)	Deviation (Probability)				Deviation of postures (> 60°) (min/shift)					
	0	1	2	3	4	5	6	7		
neutral	3	4.5	6	9	12	16	20	30	40	50
neutral	24	36	48	72	96	130	160	240	300	400

**Standing (and walking)**

1	Standing & walking in alteration, standing & walking with support	0	0	0	0.5	1	1	1.5	2		
2	Standing, no body support (for other restrict, see Extra Points)	0.7	1	1.5	2	3	4	6	8	11	13
3	Bent forward (20-60°) with manual support	2	3	5	7	9.5	12	18	23	32	40
4	Spine bent forward (> 60°) with manual support	3.3	5	8.5	12	17	24	36	51	63	
5	Upright with elbow at/above shoulder level	3.3	5	8.5	12	17	24	36	51	63	
6	Upright with hands above head level	5.3	8	14	19	26	33	47	60	80	100

**Sitting**

7	Upright with back support slightly bent forward or backward	0	0	0	0	0.5	1	1.5	2		
8	Upright no back support (for other restrict, see Extra Points)	0	0.5	1	1.5	2	3	4	5.5	7	
9	Bent forward	0.7	1	1.5	2	3	4	6	8	11	13
10	Elbow at/above shoulder level	2.7	4	7	10	13	16	23	30	40	50
11	Hands above head level	4	6	10	14	20	26	35	45	60	75

**Knocking or scooping**

12	Upright	3.3	5	7	9	12	15	21	27	36	46
13	Bent forward	4	6	10	14	20	25	35	45	60	75
14	Elbow at/above shoulder level	6	9	16	22	33	43	60	80	100	135

**Lying or climbing**

15	Lying on back, breast or side) arms above head	6	9	16	21	29	37	53	68	91	112
16	Climbing	6.7	10	22	33	50	66	-	-	-	-

**Postures = Σ lines 1 - 16**

0	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81	83	85	87	89	91	93	95	97	99	101	103	105	107	109	111	113	115	117	119	121	123	125	127	129	131	133	135	137	139	141	143	145	147	149	151	153	155	157	159	161	163	165	167	169	171	173	175	177	179	181	183	185	187	189	191	193	195	197	199	201	203	205	207	209	211	213	215	217	219	221	223	225	227	229	231	233	235	237	239	241	243	245	247	249	251	253	255	257	259	261	263	265	267	269	271	273	275	277	279	281	283	285	287	289	291	293	295	297	299	301	303	305	307	309	311	313	315	317	319	321	323	325	327	329	331	333	335	337	339	341	343	345	347	349	351	353	355	357	359	361	363	365	367	369	371	373	375	377	379	381	383	385	387	389	391	393	395	397	399	401	403	405	407	409	411	413	415	417	419	421	423	425	427	429	431	433	435	437	439	441	443	445	447	449	451	453	455	457	459	461	463	465	467	469	471	473	475	477	479	481	483	485	487	489	491	493	495	497	499	501	503	505	507	509	511	513	515	517	519	521	523	525	527	529	531	533	535	537	539	541	543	545	547	549	551	553	555	557	559	561	563	565	567	569	571	573	575	577	579	581	583	585	587	589	591	593	595	597	599	601	603	605	607	609	611	613	615	617	619	621	623	625	627	629	631	633	635	637	639	641	643	645	647	649	651	653	655	657	659	661	663	665	667	669	671	673	675	677	679	681	683	685	687	689	691	693	695	697	699	701	703	705	707	709	711	713	715	717	719	721	723	725	727	729	731	733	735	737	739	741	743	745	747	749	751	753	755	757	759	761	763	765	767	769	771	773	775	777	779	781	783	785	787	789	791	793	795	797	799	801	803	805	807	809	811	813	815	817	819	821	823	825	827	829	831	833	835	837	839	841	843	845	847	849	851	853	855	857	859	861	863	865	867	869	871	873	875	877	879	881	883	885	887	889	891	893	895	897	899	901	903	905	907	909	911	913	915	917	919	921	923	925	927	929	931	933	935	937	939	941	943	945	947	949	951	953	955	957	959	961	963	965	967	969	971	973	975	977	979	981	983	985	987	989	991	993	995	997	999
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**POSTURES**

- EN 1005-4
- ISO 11226

**CORRELATED 2° LEVEL TOOLS**

- OWAS

Figure 9 - EAWs pages 1 and 2

**ACTION FORCES**  
EN 1005-3  
ISO 11228-2  
  
**CORRELATED 2° LEVEL TOOLS**  
RULA; SCHULTZTUS

**MANUAL MATERIALS HANDLING**  
EN 1005-2  
ISO 11228-1/2  
  
**CORRELATED 2° LEVEL TOOLS**  
NIOSH;  
SNOOK & CIRIELLO

Ergonomic Assessment Worksheet V1.3.4																																					
Action forces (per minute / shift)		Intensity x time					Forces																														
17	Forces onto fingers (e.g. clips, plugs)	<table border="1"> <tr><th>0</th><th>7</th><th>15</th><th>25</th><th>50</th></tr> <tr><td>0</td><td>1.5</td><td>3</td><td>4.5</td><td>9</td></tr> <tr><td>0</td><td>3</td><td>6</td><td>9</td><td>12</td></tr> <tr><td>0</td><td>6</td><td>9</td><td>15</td><td>20</td></tr> <tr><td>0</td><td>15</td><td>15</td><td>20</td><td>30</td></tr> </table>					0	7	15	25	50	0	1.5	3	4.5	9	0	3	6	9	12	0	6	9	15	20	0	15	15	20	30	Intensity x time			Forces		
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18	Forces onto arms / whole body forces	<table border="1"> <tr><th>0</th><th>6</th><th>15</th><th>25</th><th>50</th></tr> <tr><td>0</td><td>1.5</td><td>3</td><td>4.5</td><td>9</td></tr> <tr><td>0</td><td>3</td><td>6</td><td>9</td><td>12</td></tr> <tr><td>0</td><td>6</td><td>9</td><td>15</td><td>20</td></tr> <tr><td>0</td><td>15</td><td>15</td><td>20</td><td>30</td></tr> </table>					0	6	15	25	50	0	1.5	3	4.5	9	0	3	6	9	12	0	6	9	15	20	0	15	15	20	30	Intensity x time			Forces		
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0	6	9	15	20																																	
0	15	15	20	30																																	
<p>Forces (Newtons) onto wrist / whole body forces (postural to gender)</p> <p>Hand position: 1 (flexion) 2 (extension) 3 (neutral)</p> <p>Wrist position: 1 (flexion) 2 (extension) 3 (neutral)</p> <p>Shoulder position: 1 (flexion) 2 (extension) 3 (neutral)</p> <p>Trunk position: 1 (flexion) 2 (extension) 3 (neutral)</p> <p>Head position: 1 (flexion) 2 (extension) 3 (neutral)</p> <p>Neck position: 1 (flexion) 2 (extension) 3 (neutral)</p> <p>Hand position: 1 (flexion) 2 (extension) 3 (neutral)</p> <p>Wrist position: 1 (flexion) 2 (extension) 3 (neutral)</p> <p>Shoulder position: 1 (flexion) 2 (extension) 3 (neutral)</p> <p>Trunk position: 1 (flexion) 2 (extension) 3 (neutral)</p> <p>Head position: 1 (flexion) 2 (extension) 3 (neutral)</p> <p>Neck position: 1 (flexion) 2 (extension) 3 (neutral)</p>																																					
<p>Action forces = Σ lines 17 - 18</p> <p>Attention: correct evaluation, if duration of evaluation ≠ 60s</p>																																					
Manual Material Handling (per shift)		Weights of loads (kg)					Loads																														
<p>Weights of loads (kg) for repositioning/lifting/lowering, carrying and holding as well as pushing and pulling</p> <p>Reposition, carrying &amp; holding</p> <table border="1"> <tr><th>Male</th><th>Female</th><th>1.5</th><th>2</th><th>3</th><th>4</th><th>5.5</th><th>7</th><th>8.5</th><th>25</th></tr> <tr><td>3</td><td>2</td><td>1.5</td><td>2</td><td>3</td><td>4</td><td>5.5</td><td>7</td><td>8.5</td><td>25</td></tr> </table>										Male	Female	1.5	2	3	4	5.5	7	8.5	25	3	2	1.5	2	3	4	5.5	7	8.5	25								
Male	Female	1.5	2	3	4	5.5	7	8.5	25																												
3	2	1.5	2	3	4	5.5	7	8.5	25																												
<p>Pushing and pulling</p> <table border="1"> <tr><th>Male</th><th>Female</th><th>1.5</th><th>2</th><th>3</th><th>4</th><th>5.5</th><th>7</th><th>8.5</th><th>25</th></tr> <tr><td>100</td><td>75</td><td>50</td><td>75</td><td>100</td><td>125</td><td>150</td><td>200</td><td>250</td><td>500</td></tr> </table>										Male	Female	1.5	2	3	4	5.5	7	8.5	25	100	75	50	75	100	125	150	200	250	500								
Male	Female	1.5	2	3	4	5.5	7	8.5	25																												
100	75	50	75	100	125	150	200	250	500																												
<p>Means of transport</p> <table border="1"> <tr><th>1.5</th><th>2</th><th>3</th><th>4</th><th>5.5</th><th>7</th><th>8.5</th><th>25</th></tr> <tr><td>1.5</td><td>2</td><td>3</td><td>4</td><td>5.5</td><td>7</td><td>8.5</td><td>25</td></tr> </table>										1.5	2	3	4	5.5	7	8.5	25	1.5	2	3	4	5.5	7	8.5	25												
1.5	2	3	4	5.5	7	8.5	25																														
1.5	2	3	4	5.5	7	8.5	25																														
<p>Posture (position of load relative to body position)</p> <p>1: trunk upright and/or not held; 2: little trunk bending or holding load in or close to the body; 3: bending trunk, deep or far forward, little trunk bending forward and trunk holding; 4: simultaneously load far from body or above shoulder level; 5: bending trunk far forward and holding load far from the body, tilted posteriorly at stability while standing, crouching or kneeling</p>																																					
<p>Working Conditions (pushing and pulling only)</p> <p>(*) 1: very low rolling resistance; 2: rolling (pushing/pulling on level) slick floor; 3: rough floor and above small part of leg; 4: on structured sheet metal, into/out of a; 5: rolling have to be turned on when starting, strongly damaged floor; 6: very high rolling resistance</p>																																					
<p>Frequency of load manipulations (in shift) holding time (min) or travel distance (meter/shift)</p> <table border="1"> <tr><th>Frequency of manipulation / pushing &amp; pulling (per shift)</th><th>2.5</th><th>10</th><th>20</th><th>30</th><th>100</th><th>1500</th><th>2000</th><th>2500</th><th>3000</th></tr> <tr><td>2.5</td><td>10</td><td>20</td><td>30</td><td>100</td><td>1500</td><td>2000</td><td>2500</td><td>3000</td><td></td></tr> </table>										Frequency of manipulation / pushing & pulling (per shift)	2.5	10	20	30	100	1500	2000	2500	3000	2.5	10	20	30	100	1500	2000	2500	3000									
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2.5	10	20	30	100	1500	2000	2500	3000																													
<p>Manual Material Handling (result)</p> <p>Handling = Σ line 19</p> <p>1: Manual manipulation (no points) for all tasks of repositioning, holding, carrying as well as pushing &amp; pulling at together = 0</p>																																					

Figure 10 - EAWS page 3

**Ergonomic Assessment Worksheet V1.3.4**

**Upper limb load in repetitive tasks** Upper Limbs

**Force & Frequency & Grip (FFFG)** (Basic: number of real actions per minute or percent static actions (analyze only the most loaded limb))

**Force [N]**

Force [N]	Calc. Stat		Static actions (actions/min)										Dynamic actions (real actions/min)										Calc. Dyn						
	FFS	GG %	145	30	20	10	5	3	2	1	0	abc	4	3	2	1	0	10	15	20	25	30	35	40	FFG %	FFGp			
0 - 5			1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3	4	7				
> 5 - 20			4	2	1	1	0	0	0	0	0	0	0	0	0	0	0	1	2	3	4	6	9						
> 20 - 35			7	3	2	1	1	0	0	0	0	0	0	0	0	0	0	1	2	3	4	6	12						
> 35 - 90			11	5	3	2	1	1	0	0	0	0	0	0	0	0	0	1	2	3	5	7	9	12	18				
> 90 - 135			16	11	7	4	3	2	1	1	0	0	0	0	0	0	0	1	2	3	5	7	9	12	15	24			
> 135 - 225			21	14	10	6	4	3	2	1	1	0	0	0	0	0	0	1	2	3	5	7	9	12	14	20	32		
> 225 - 300			26	18	12	8	5	4	3	2	1	1	0	0	0	0	0	1	2	3	5	7	9	12	16	26	40		

204  $FFG = \sum FFGp$   $FFG = FFS + GG + FFGp$   $FFG = FFS + GG + FFGp$

**Hand / arm / shoulder postures (use duration for worst case of wrist / elbow / shoulder)**

Wrist (deviation, flex/extension) Elbow (pron, sup, flex/extension) Shoulder (flexion, extension, abduction)

Posture points: 0, 0.5, 1, 2, 3, 4

**Additional factors**

Gloves inadequate (which interfere with the handling ability required) are used for over half the time  2

Working gestures required imply a countershock. Frequency of 2 time per minute or more (i.e. hammering over hard surface)  2

Working gestures imply a countershock (using the hand as a tool) with freq. of 10 time per hour or more  2

Exposure to cold or refrigeration (less than 0 degree) for over half the time  2

Vibrating tools are used for 1/3 of the time or more  2

Tools with a very high level of vibrations  4

Tools employed cause compressions of the skin (rednesses, calluses, blisters, etc.)  2

Precision tasks are carried out for over half the time (tasks over areas smaller than 2-3 mm)  2

More than one additional factor is present at the same time and overall occupy the whole of the time  3

Additional points (choose the highest value) =  4

**Repetitive tasks duration**

Duration (h/shift)  1  1.5  3  5  7  8  10

Duration Points  1  1.5  3  5  7  10

Work Organization  Breaks as possible at every time  Breaks as possible at given conditions  Breaks lead to a stop of the production

Work Organization Points  0  1  2  3  4  5  6  7  8  10

Breaks (x 8 min) [R/N/H]  0  1  2  3  4  5  6  7  8  10

Break points cycle time < 30 sec  3  2  1  0  -1  -2  -3  -4

Break points cycle time > 30 sec  0  0  -0.5  -1  -1.5  -2

Duration Points  0  1  2  3  4  5  6  7  8  10

**Upper limb load in repetitive tasks**

(1) Force & Frequency & Grip (2) Posture (3) Additional factors (4) Duration (5) Upper Limbs

FFFG \* Posture \* Additional factors \* Duration \* Upper Limbs

**HIGH FREQUENCY AND SMALL LOADS ON UPPER LIMBS**

- EN 1005-5
- ISO 11228-3

**CORRELATED 2° LEVEL TOOLS**

- OCRA
- SI (Strain Index)
- HAL/TV (\*)

(\*) Hand Activity Level/ Threshold Value

Figure 11 - EAWS page 4



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