



## 2. Mapping of exposure parameters

(AIHA 4<sup>th</sup> edition, EN689:2018 clause 5.1).

NVvA 2024 – PBC Woudschoten 9-4-2024

IOHA 2024 – PDC-150 Dublin 9-6-2024

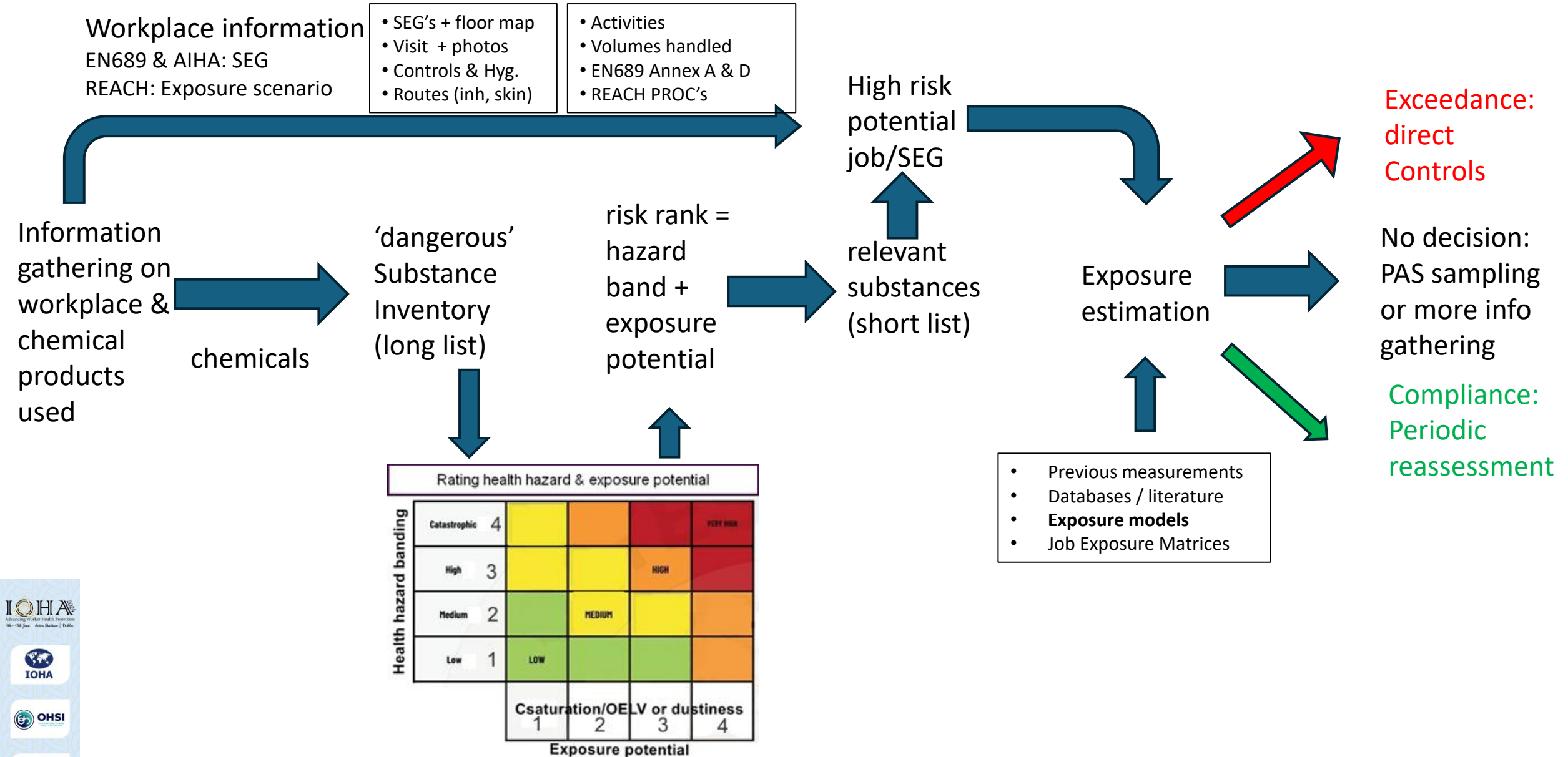
Peter van Balen

Robbert Emonds

Theo Scheffers

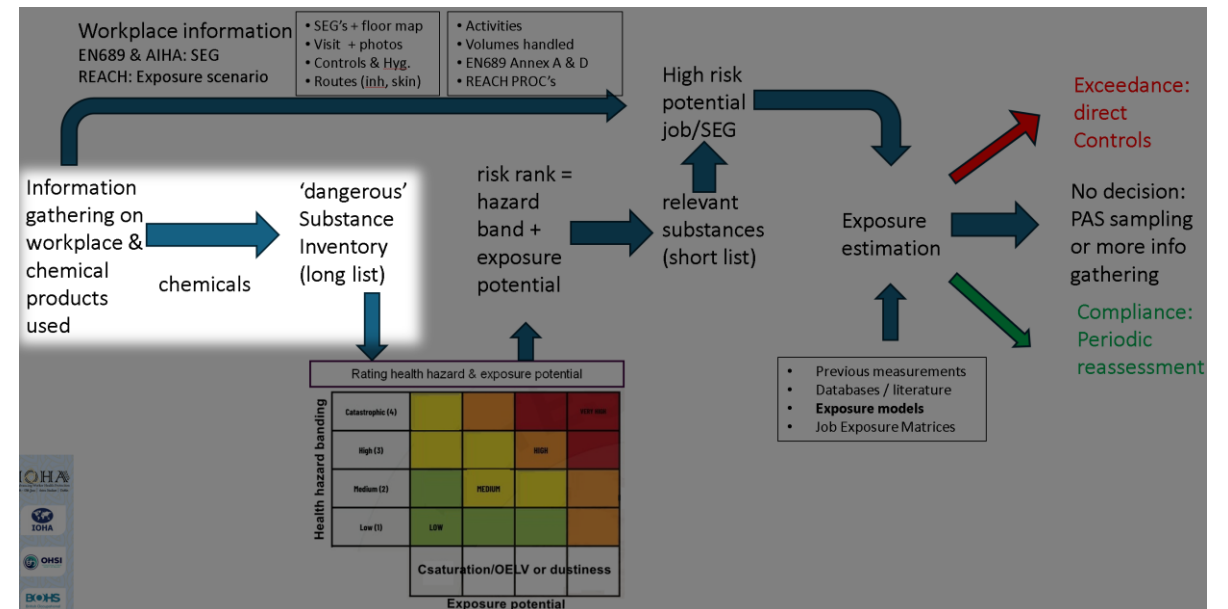


# Generic basic characterisation



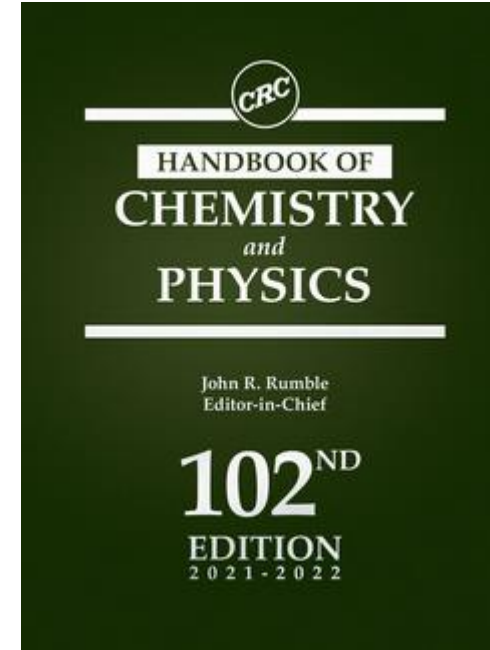
# Properties of chemical hazards

- Process flow: Materials in → handling → Products out
- Identification
  - Raw products, primary products, impurities, intermediates, final products, reaction and process products and by-products, including substances without owners (DME, wooddust, welding fumes; bio allergens from flowers and moulds, ....)
  - Concentration in mixtures or products
  - Individual chemicals:
    - CAS# , EINECS#
- **Physical-Chemical properties:** molecular weight, vapour pressure, state solid-liquid-gas, water solubility.....
- Health hazards of chemical agents:
  - GHS-classification & **H3##**-codes
  - IARC-classification
- **OELV** (8 hours – 15 minutes – STEL):
  - National
  - Private









# Sources substance properties

- Handbook Chemistry & Physics
- [eChemPortal](#)
- [EU ECHA](#)
- [IFA Gestis](#)
- [EPA CompTox](#)
- [DOHSBase](#)



# Online databases with properties of workplace chemicals

properties and sources	Worldwide 	US 	EU 	countries	<a href="#">DOHSBase</a> 
Identification	<a href="#">EchemPortal</a>	CAS 4 million			350000
GHS health hazard classifications			<a href="#">ECHA-CLP</a> 200000+	Among others	250000
physchem		EPISuite 40000	<a href="#">ECHA REACH</a> <25000	<a href="#">IFA-Gestis</a>  <a href="#">INRS</a>  1500-3000	Up to 50000
OELV	(EchemPortal)	<a href="#">ACGIH</a> 1000+ NIOSH, WEEL	DN/MEL 5600 BLV/IOLV 100+		OELV 14000 kickoff 95000
measurement methods	-	NIOSH			4300



# Occupational Exposure Limit Values

EU Working conditions legal compliance

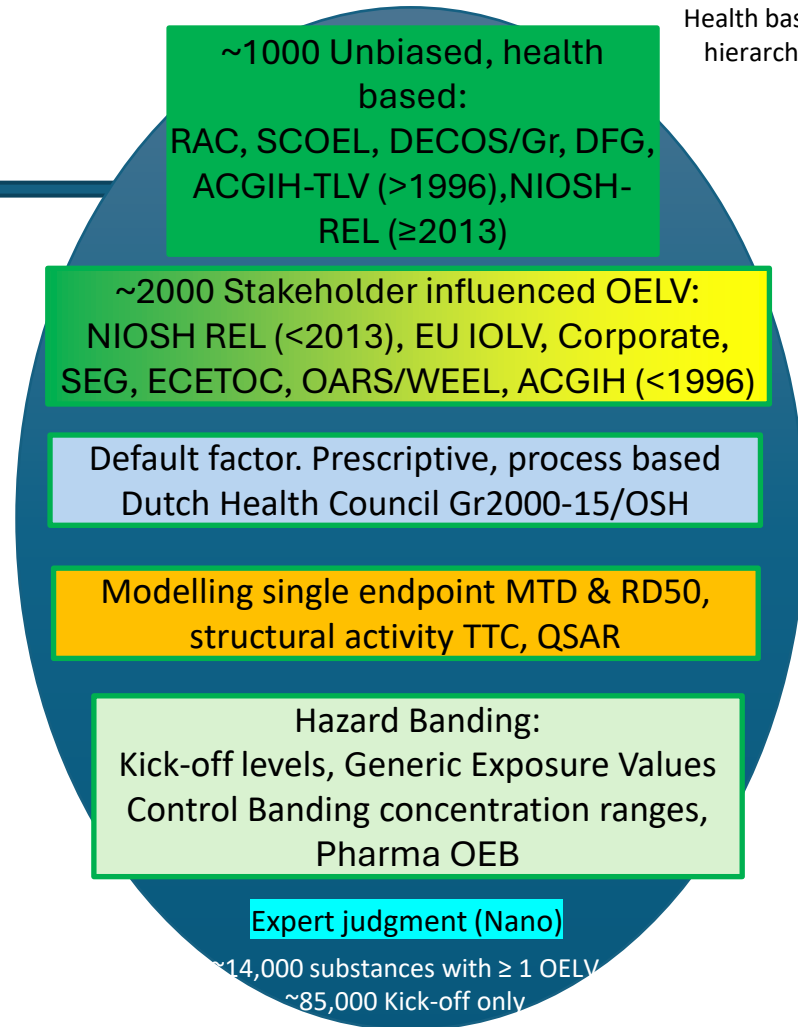
Health protection & liability  
Civil law

Product safety & liability,  
Environmental law

Legal limits with possible technical and/or economical feasibility:

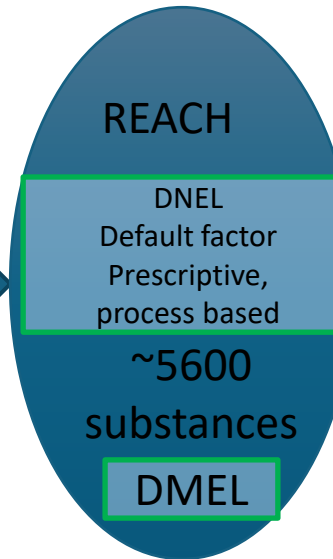
- EU BLV,
- DE TRGS900
- NL legal OELV
- ES LEP
- Fr VLEP
- .....
- UK WEL
- USA OSHA PEL
- .....

100 - 1000



Health based hierarchy

11000  
degroupping  
or read-  
across OELV



Data rich (Tox & Epidemiology) -> Holistic

Selected data -> administrative

<- Data poor algorithms

<- Public Private ->

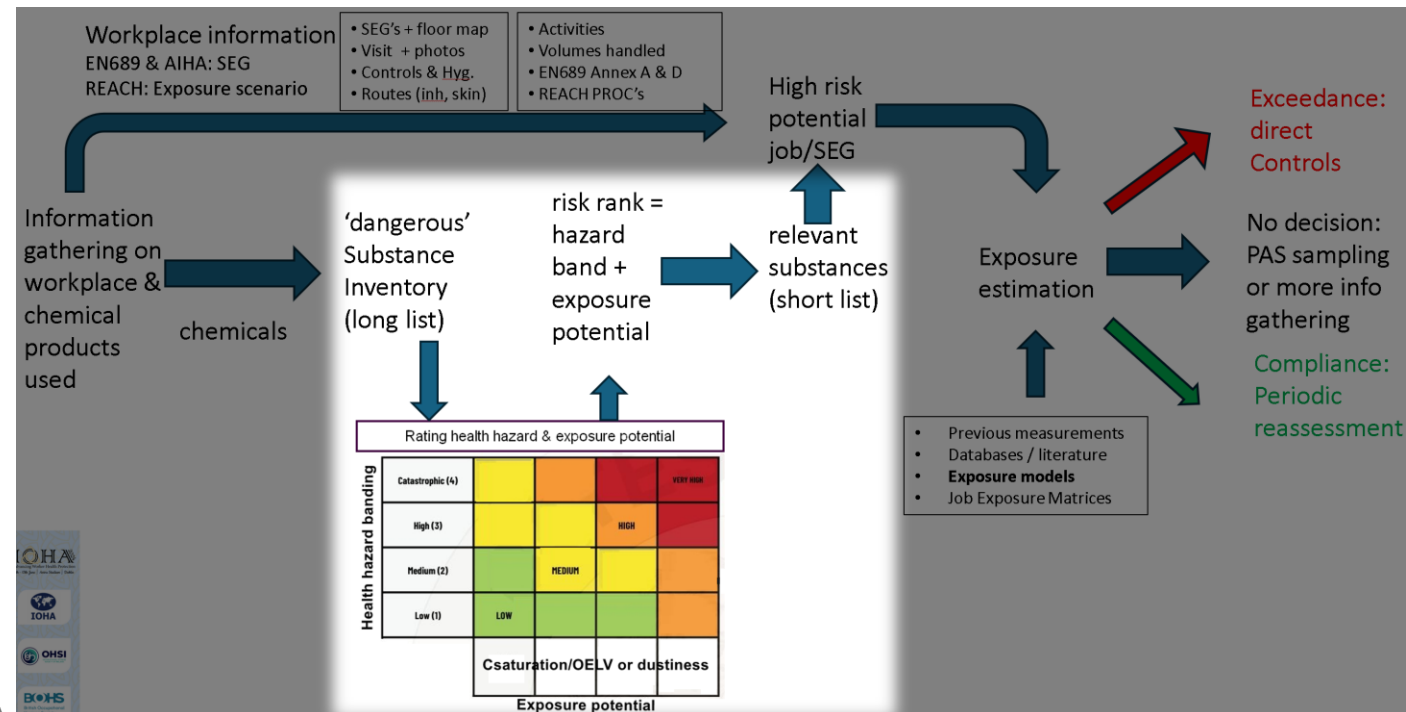
References: Theo Scheffers/DSM/NVvA-WGM/DOHSBase (1981+), Nautam (1996), ECETOC\_TR101 (2006) SER Guidance (2007), JOEH DOI: 10.1080/15459624.2015.1060327, EN689-B(2019), NIOSH OEB (2019)

**ECHA**  
EUROPEAN CHEMICALS AGENCY  
Guidance on information requirements and chemical safety assessment  
Appendix to Chapter R.8: Guidance for preparing a scientific report for health-based exposure limits at the workplace  
Version 1.0 August 2019

**ECHA**  
http://echa.europa.eu  
Version: 2.1  
November 2012  
Guidance on information requirements and chemical safety assessment  
Chapter R.8: Characterisation of dose [concentration]-response for human health

# Ordinal risk potential

- Hazard banding and exposure potential  
OELV, GHS Health hazard codes (H3##), Saturation concentration
- AIHA SDM 2.0 Task based ranking of potential risk  
OELV, (Mixture), Vapor pressure/dustiness, Controls



# 1. Hazard Banding + exposure potential

Ann. Occup. Hyg., 2016, 1–13  
doi:10.1093/annhyg/mew050



## On the Strength and Validity of Hazard Banding

Theo Scheffers<sup>1,2\*</sup>, Blandine Doornaert<sup>3</sup>, Nathalie Berne<sup>4</sup>,  
Gerard van Breukelen<sup>5</sup>, Antoine Leplay<sup>4</sup> and Erik van Miert<sup>6</sup>

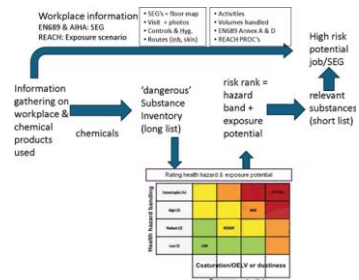
#	Identity/ properties	Xylenes
1	EC#	215-535-7
2	CAS#	1330-20-7
3	MW	106
4	Vapor pressure (Vp) in Pa	1063
5	Saturation concentration in mg/m <sup>3</sup>	46000
6	GHS classification	Acute Tox. 4 Skin Irrit. 2 STOT RE 2
7	GHS H-codes	H332 H312 H315 H336 H373
7->8	Hazard band <sup>1</sup>	
9	OELV mg/m <sup>3</sup> /8hr	
10=5/9	Csat/OELV	
8 x 10	Risk Rank	

Hazard Group	4	3	2	1
H-statements gases/vapors DGUV IFA Spaltenmodell	H300, H310, H330, H340, H350, H350i, EUH032	H301, H311, H317, H318, H331, H334, H341, H351, H360 (F/D/FD/Fd/Df), H370, H372, EUH029, EUH031, EUH070	H302, H312, H314, H332, H361 (f/d/fd), H362, H371, H373, EUH071	H304, H315, H319, H335, H336, EUH066, other H- statements n.o.s., REACH Annex IV

Rating health hazard & exposure potential				
Health hazard banding	Catastrophic 4			VERY HIGH
	High 3		HIGH	
	Medium 2	MEDIUM		
	Low 1	LOW		
		Csaturation/OELV or dustiness		
		1	2	3
		Exposure potential		
		1	2	3



# Risk potential spray painting volatile organic solvent



- 1. Properties of VOS
- 2. Workplace factors

A. outdoor (?)

B. mech. vent.

C. full enclosure

D. LEV

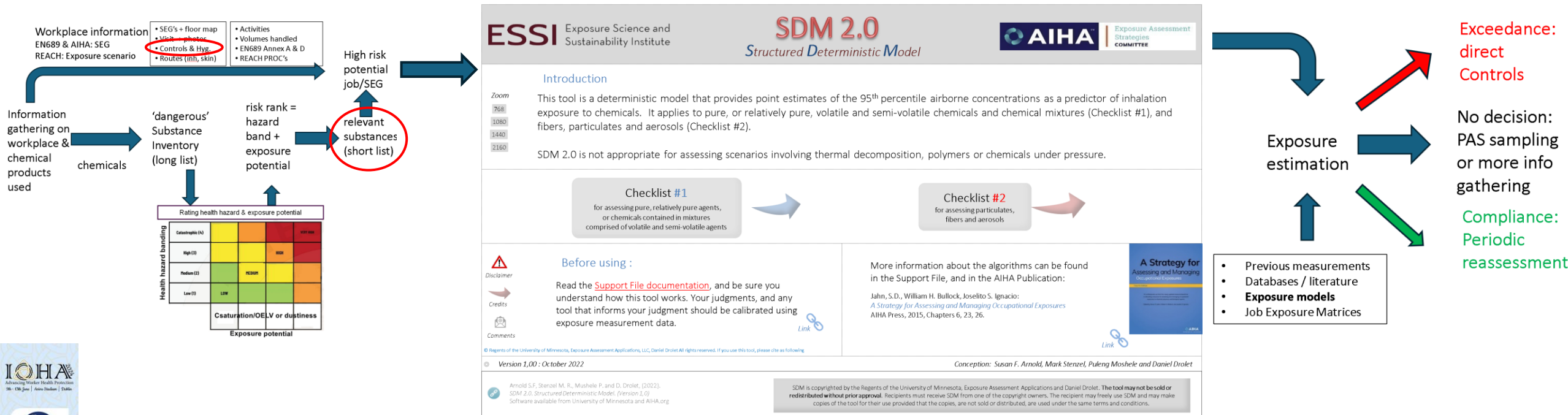


# AIHA

# SDM 2.0


# Quantitative Ordinal Task-Based Exposure Assessment Tool

# OELV, (Mixture), Vapor pressure/dustiness, Controls




# Ranking with OELV, (Mixture),Vp/dustiness, Controls

## Health Risk Ranking



Exposure Assessment  
Strategies  
COMMITTEE



ESSI

Exposure Science and  
Sustainability Institute

Support File

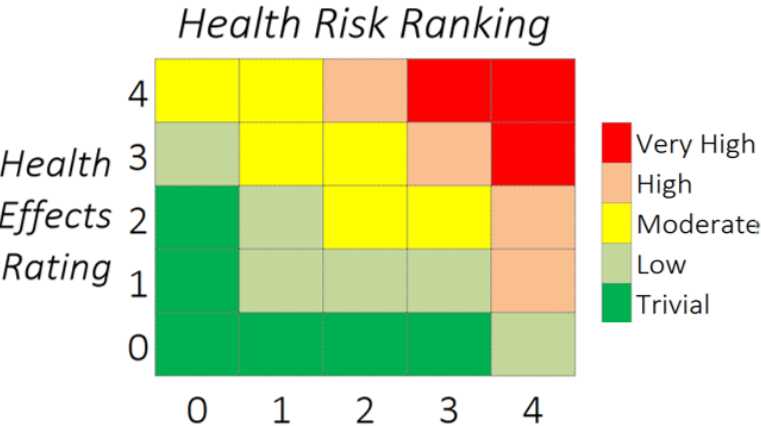
SDM 2.0

Table 1 - AIHA Exposure Control Categories (ECC)

Exposure Control Category (ECC)	Exposure Range	Action
0	< 1% of OEL	<ul style="list-style-type: none"><li>Negligible exposure</li></ul>
1	1 - 10% of OEL	<ul style="list-style-type: none"><li>General Hazcom training</li></ul>
2	10 – 50% of OEL	<ul style="list-style-type: none"><li>+</li><li>Chemical-specific Hazcom training</li><li>Specific training in work practices</li></ul>
3	50 to 100% of OEL	<ul style="list-style-type: none"><li>+</li><li>Exposure surveillance</li><li>Medical Exposure surveillance</li><li>Work place evaluation</li></ul>
4	> 100% of OEL	<ul style="list-style-type: none"><li>+</li><li>Respiratory protection</li><li>Engineering controls</li></ul>

Table 2 – AIHA Health Risk Rating Scheme

Health Effects Rating (HER)	Health Effect
4	Significant reproductive effects, irreversible neurotoxicity, irreversible toxicity to significant body system (e.g., obstructive lung disease - bronchiolitis obliterans), known human carcinogenicity or mortality from a single exposure (e.g. carbon monoxide, phosgene, hydrogen cyanide)
3	Dysfunction effects (e.g. lung, kidney, liver, blood), risk of cancer due to suspected human carcinogens, or severe adverse short-term health effects, dermal or inhalation sensitization
2	Continuing dermal or inhalation irritation or reversible toxicity that can impair ability to function or the individual's judgment
1	Reversible irritation or discomfort (whiff of ammonia)
0	At most, nuisance effects (e.g. watery eyes or obnoxious odor)





Advancing Worker Health Protection  
100 • 10th Ave • 10th Floor • Dublin



IOHA



OHSI



BOHS  
British Occupational Hygiene Society



# SDM 2.0 Ordinal task based EA Tool

**ESSI** Exposure Science and Sustainability Institute

**SDM 2.0**  
Structured Deterministic Model

**AIHA** Exposure Assessment Strategies COMMITTEE

### Introduction

This tool is a deterministic model that provides point estimates of the 95<sup>th</sup> percentile airborne concentrations as a predictor of inhalation exposure to chemicals. It applies to pure, or relatively pure, volatile and semi-volatile chemicals and chemical mixtures (Checklist #1), and fibers, particulates and aerosols (Checklist #2).

SDM 2.0 is not appropriate for assessing scenarios involving thermal decomposition, polymers or chemicals under pressure.

Checklist #1  
for assessing pure, relatively pure agents, or chemicals contained in mixtures comprised of volatile and semi-volatile agents

Checklist #2  
for assessing particulates, fibers and aerosols

**Before using :**  
Read the [Support File documentation](#), and be sure you understand how this tool works. Your judgments, and any tool that informs your judgment should be calibrated using exposure measurement data.

More information about the algorithms can be found in the Support File, and in the AIHA Publication:  
  
Jahn, S.D., William H. Bullock, Joselito S. Ignacio:  
*A Strategy for Assessing and Managing Occupational Exposures*  
AIHA Press, 2015, Chapters 6, 23, 26.

**A Strategy for Assessing and Managing Occupational Exposures**

Link

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Version 1.00 : October 2022

Conception: Susan F. Arnold, Mark Stenzel, Puleng Moshele and Daniel Drolet

<https://www.youtube.com/watch?v=miTJHGHHCYg>



**ESSI** Exposure Science and Sustainability Institute

**SDM 2.0**

**AIHA** Exposure Assessment Strategies COMMITTEE

**Few Words from the Authors**  
VP Calculator  
Clausius-Clapeyron Eq.  
Antoine Equation  
Converter  
Units  
Concentrations

**Guide**  
Rule of Ten  
Hazard Ratio (VHR)  
Controlling Compound  
Raoult's Law  
Henry's Law  
Type of Controls  
Mixtures Calculation  
Health Risk Ranking

**Reference Values**  
OSHA  
RELS  
ACGIH\*  
Selection process  
WELs  
AEGLs  
Admin / Help  
Running Macros  
Computer Requirements  
Log SDM CATALYST group  
Introduction to SDM  
Relevant HyperLinks

SDM is copyrighted by the Regents of the University of Minnesota, Exposure Assessment Applications and Daniel Drolet. The tool may not be sold or redistributed without prior approval. Recipients must receive SDM from one of the copyright owners. The recipient may freely use SDM and may make copies of the tool for their use provided that the copies, are not sold or distributed, are used under the same terms and conditions.

Version 1.00 : October 2022

**1 Scenario**

Name *PDC*

User *IOHA Dublin*

Date *9-jun-24*

Temp. *25°C*

Sc # *1*

**2 Chemical composition**

**1 Select substance**

Database  
☒ SDM ☐ User's

Stoddard solvent

Name *Stoddard solvent*

CAS # *8052-41-3*

MW *140*

W % *1*

**2 Select Vapor Pressure**

VP from  
☐ Antoine ☐ DB ☒ User

VP User *9*

**3 Select OEL in ppm**

Stoddard solvent

	TWA	STEL	Ceiling
OSHA	500		
ACGIH	n/a		
REL NIOSH			
WEEL			
USER			


OEL selected *20*

Version 1.00 : October 2022

2. Mapping PDC-150 IOHA 2024 Dublin. vanBalen, Scheffers & Emonds

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# SDM 2.0 Ordinal task-based EA Tool




Exposure Science and Sustainability Institute

**SDM 2.0**

Gas and Vapors

REPORT

Quantitative Ordinal Task-Based Exposure Assessment Tool



Exposure Assessment Strategies COMMITTEE

input

Scenario parameters

1 pdc

25°C

9-jun-24

Save PDF

Mixture parameters

18.2 ppm  
OEL<sub>mix</sub> = or 84.5 mg/m<sup>3</sup>

Adj VHR<sub>mix</sub> = 0.2502

MW<sub>mix</sub> = 113.64 g/mole

Tot. Adj VP<sub>mix</sub> = 5.004 mm Hg

ECC mixture

HRR

8 5 4 2 2 1 0

6 5 4 3 3 2 1

	Chemical	CAS #	Wt	OEL ppm	VP mm Hg	Adj. VP	Adj. VHR	VHR Ratio %	Very Limited	Poor	GGV inside – displaced air	GGV inside / GGV outside – displaced air	GGV outside	GGV + LEV – capture	GGV + LEV – enclosing hoods	ECC Very Limited	ECC Poor	ECC GGV inside – displaced air	ECC GGV inside / GGV outside – capture	ECC Good – Outside	ECC GGV + LEV – capture	ECC GGV + LEV – enclosing hoods
1	n-Butyl alcohol	71-36-3	40	20	6	3.344	0.167	100	440	44	14.7	4.4	1.47	0.44	0.04	7	5	3	2	1	1	0
2	Stoddard solvent	8052-41-3	60	20	3.75	1.660	0.083	49.6	218	21.8	7.28	2.18	0.73	0.22	0.02	7	4	2	2	1	1	0

4

Send Table to Analysis

Microsoft Excel

Data have been transferred to CALC and REPORT sheets

OK

	Chemical	CAS #	WT (%)	MW	OEL ppm	VP torr
1	n-Butyl alcohol	71-36-3	40	74.1	20	6
2	Stoddard solvent	8052-41-3	60	140	20	3.75

Select Health Effects Rating

? 0 1 2 3 4

Select Obs. Level of Control LoC : 6

GGV + LEV –capture

Health Effects ratings ?

4 = Extremely High

3 = Very High

2 = High

1 = Moderate

0 = Low

GGV : Good General Ventilation

LEV : Local Exhaust Ventilation

HER = 2

Health Risk Ranking

HER	0	1	2	3	4	5	6	7	8	9
4					Very High			Severe		Critical
3				High						
2			Moderate							
1		Low								
0	Trivial									

ECC<sub>mix</sub> = 1

Health Risk Ranking

2

7 Critical

6 Severe

5 Very high

4 High

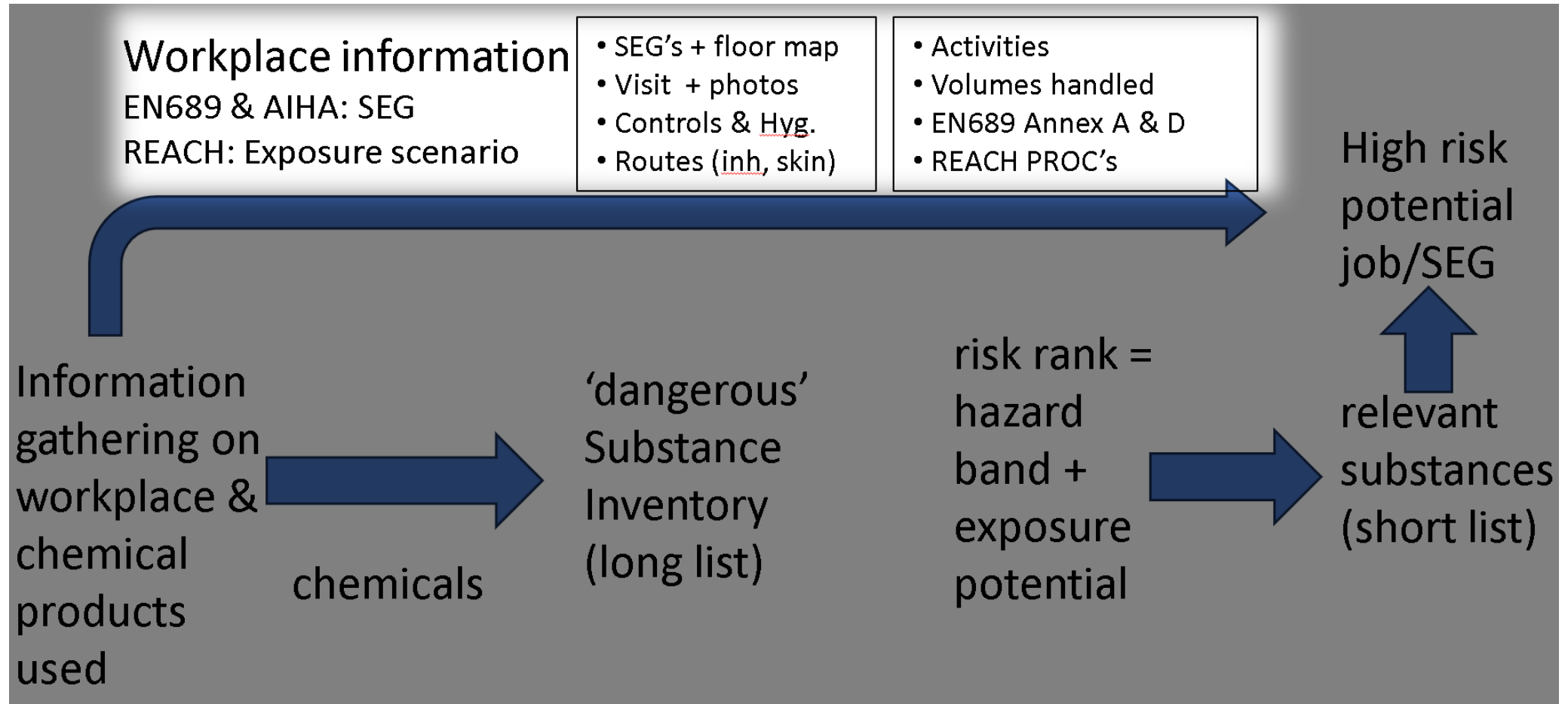
3 Moderate

2 Low

1 Trivial



# Inventory of workplace information Trexmo+ / ART



# Exercise 1 Rating health hazard & exposure potential

## Exercise 1 Find most relevant substance

#	Identity/ properties	Xylenes	C9-arom. (as Mesithylene)	Butanol-1	1-Methoxy- 2-Propanol	White Spirit, Stoddard Solvent
1	EC#	215-535-7	918-668-5	200-751-6	203-539-1	232-489-3
2	CAS#	1330-20-7	128601-23-0 (25551-13-7)	71-36-3	107-98-2	8052-41-3
3	MW	106	120	74	90	142
4	Vapor pressure (Vp) in Pa	1063	279	858	1197	499
5	Saturation concentration in mg/m <sup>3</sup>	46000	14000	26000	44000	29000
6	GHS classification	Acute Tox. 4 Skin Irrit. 2 STOT RE 2	Asp. Tox. 1 STOT SE 3	Acute Tox. 4 Skin Irrit. 2 Eye Dam. 1 STOT SE 3	STOT SE 3	Asp. Tox. 1 Stot SE 3 STOT RE 1
7	GHS H-codes	H332 H312 H315 H336 H373	H336 (Nervous syst), H335 (respir)	H302 H335 H336 H315 H318	H336	H304 H336 H372 (central nervous system)
7->8	Hazard band <sup>1</sup>					
9	OELV mg/m <sup>3</sup> /8hr					
10=5/9	Csat/OELV					
8 & 10	Risk Rank					

# Result Exercise 1

#	Identity -> properties↓	Xylenes	C9-arom. (as Mesithylene)	Butanol-1	1-Methoxy-2-Propanol	White Spirit, Stoddard Solvent
1	EC#	215-535-7	918-668-5	200-751-6	203-539-1	232-489-3
2	CAS#	1330-20-7	128601-23-0 (25551-13-7)	71-36-3	107-98-2	8052-41-3
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7	GHS H-codes	H332 H312 H315 H336 H373	H336 (Nervous syst), H335 (respir)	H302 H335 H336 H315 H318	H336	H304 H336 H372 (central nervous system)
7->8	Hazard band <sup>1</sup>	2	1	3	1	3
9	OELV mg/m <sup>3</sup> /8hr	210	151 DNEL (100 EU/NL legal)	45	375	116
10=5/9	Csat/OELV	219	93 (140)	578	117	250
8 & 10	Risk Rank	3	1	5	2	4

