Control Banding nanotool

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Origin of Control Banding

Pharmaceutical industry, toxicological uncertainties (1970 - 1980)

UK COSHH Essentials (Annals, 1998)

6 Control Banding workshops (Annals, 2003; Zalk & Nelson, 2008)

Control Banding

hazard + exposure/scenario's ⟶ risk + solutions

Control Banding, chemicals

hazard bands:	EU risk phrases
exposure bands:	volume, dustiness, volatility
control levels:	engineering principles

‘it might be hazardous at the bottom’

size, reactivity, barrier crossing

health hazards: carbon nanotubes introduced into the abdominal cavity of mice show asbestos-like pathogenicity in a pilot study (Poland et al., 2008)

public perception: Crichton M (2002). Prey, Harper Collins

Manufactured nanomaterials

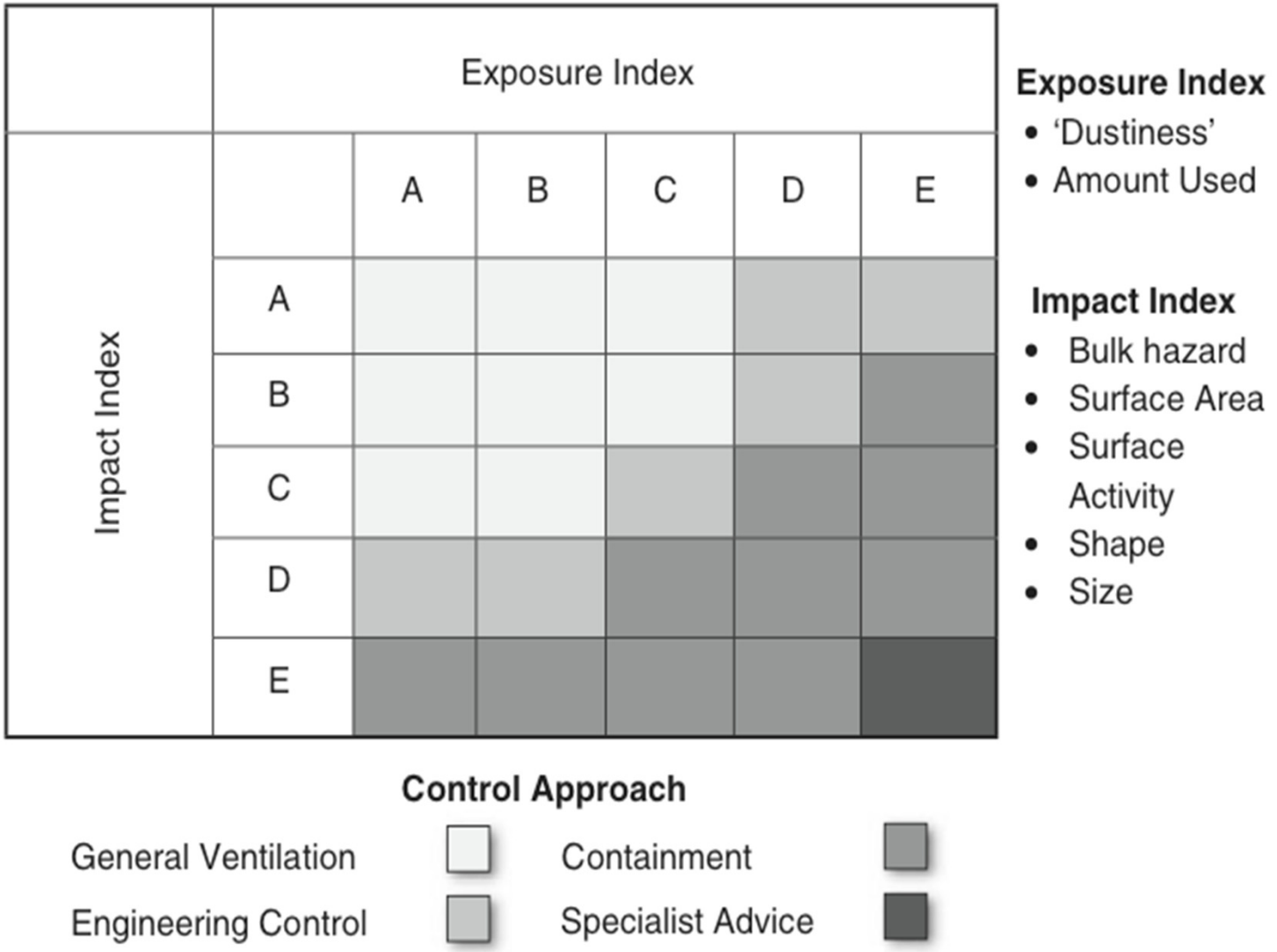
uncertainties

- exposure scenarios
- levels of exposure
- population at risk
- deposition – clearance
- structure – effect

Xavier Miserachs El Born 1962

Control Banding manufactured nanomaterials

A. D. Maynard



Risk level matrix

Probability

Severity

	extremely unlikely (0-25)	less likely (26-50)	likely (51-75)	probable (76-100)
very high (76-100)	RL 3	RL 3	RL 4	RL 4
high (51-75)	RL 2	RL 2	RL 3	RL 4
medium (26-50)	RL 1	RL 1	RL 2	RL 3
low (0-25)	RL 1	RL 1	RL 1	RL 2

RL 1: general ventilation
RL 2: fume hoods or local exhaust ventilation
RL 3: containment
RL 4: seek specialist advice

Severity score (0 – 100)

- physical properties 0 - 10
- toxicological properties 0 - 7.5
- toxicological properties parent materials 0 - 5

Probability score (0 – 100)

- amount used 6.25 - 25
- dustiness 7.5 - 30
- exposed population 5 - 15
- frequency and duration of operation 0 - 15

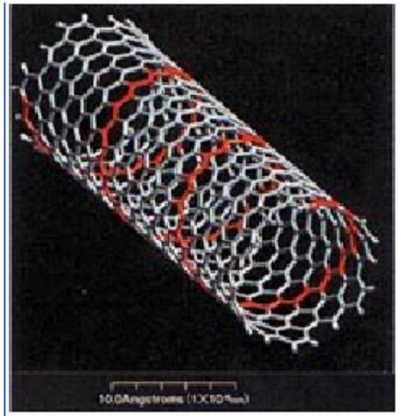
unknown ≡ 75% of highest score

Severity score (1), physical properties

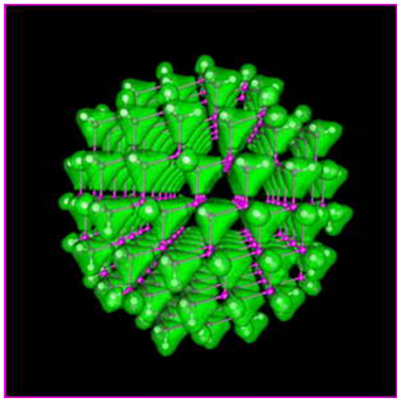
○ surface chemistry	high	10
	medium	5
	low	0
	unknown	7.5
○ particle size	tubular, fibrous	10
	anisotropic	5
	compact or spherical	0
	unknown	7.5
○ particle diameter	1 – 10 nm	10
	11 - 40 nm	5
	< 41 – 100 nm	0
	unknown	7.5
○ solubility	insoluble	10
	soluble	5
	unknown	7.5

Particle shape, nanomaterial

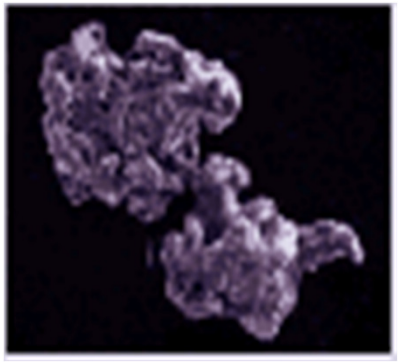
Tubular, fibrous, nanotubes



Quantum dots



Irregular shape



Severity score (2), toxicological properties

- carcogenicity
- reproductive toxicity
- mutagenicity
- dermal toxicity

yes	7.5
no	0
unknown	5.625

- toxicity parent material

< 10 μgm^{-3}	10
10 – 100 μgm^{-3}	5
101 μgm^{-3} – 1 mgm^{-3}	2.5
> 1 mgm^{-3}	0
unknown	7.5

- carcogenicity parent material
- reproductive toxicity parent material
- mutagenicity parent material
- dermal toxicity parent material

yes	5
no	0
unknown	3.75

Probability score (1)

○ estimated amount during operation	> 100 mg	25
	11 – 100 mg	12.5
	0 – 10 mg	6.25
	unknown	18.75
○ dustiness/mistiness	high	30
	medium	15
	low	7.5
	unknown	22.5
○ number of employees	> 15	15
	11 – 15	10
	6 – 10	5
	unknown	11.25

Probability score (2)

○ frequency of operation	daily	15
	weekly	10
	monthly	5
	less than monthly	0
	unknown	11.25
○ duration of operation	> 4 hr	15
	1 – 4 hr	10
	30 -60 min	5
	< 30 min	0
	unknown	11.25

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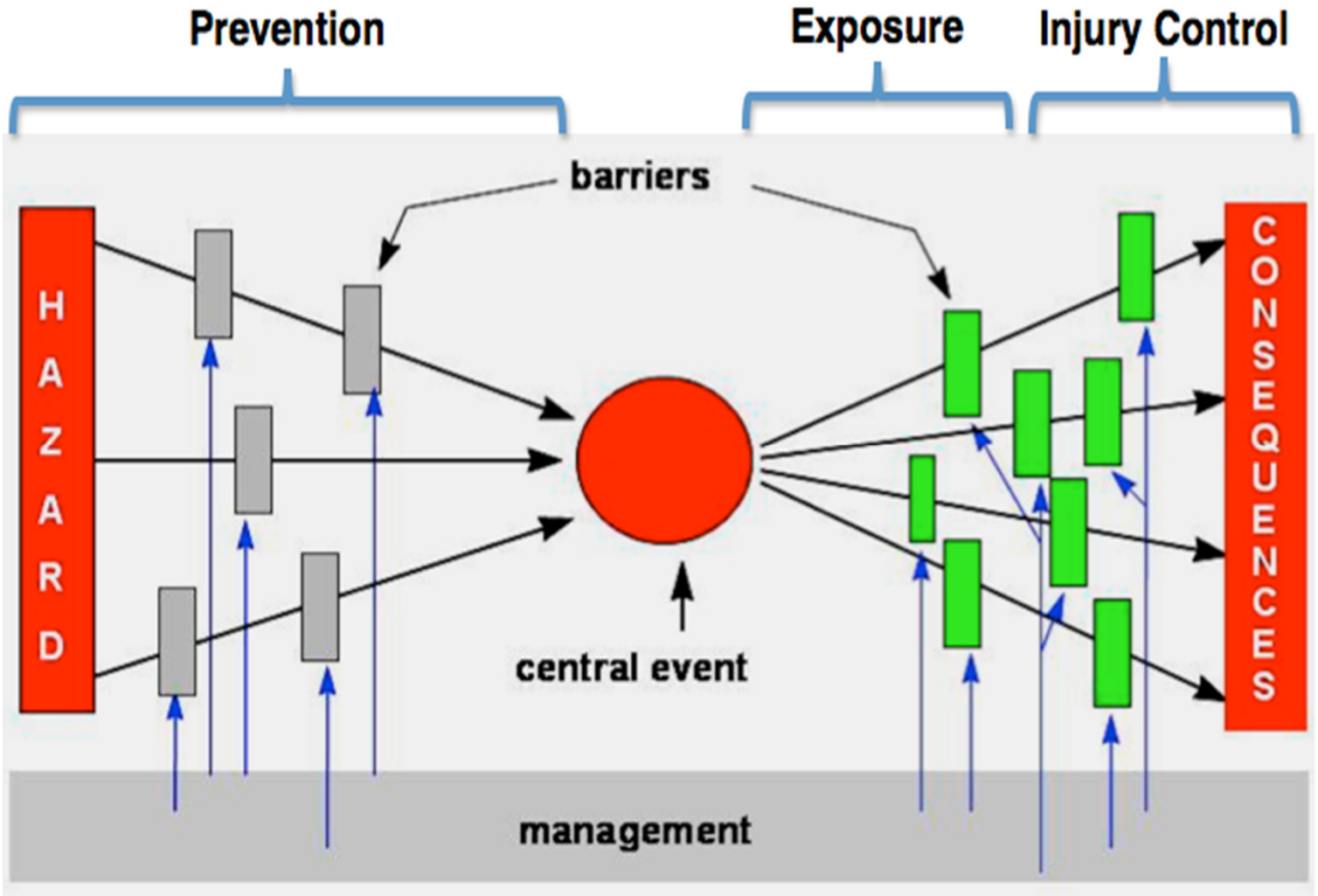
Bowtie


Prevention
Exposure
Injury Control
barriers
HAZARD
CONSEQUENCES
central event
management

Managing hazards and risk

utility of control technologies

establish OEL's

prevention through design

establishment of exposure register

conduct of medical surveillance

Schulte et al., 2010, keynote IOHA Conference, Rome

Discussion

risk management ≡ managing scenarios

limitations

- factors and scores of probability and severity
- no design changes

advantages

- transparent, logical, and simple method
- support for decision making under uncertainties

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CONTROL BANDING

A simplified, qualitative strategy

for the assessment of

occupational risks and selection of solutions

Dave Zalk