ART ADVANCED REACH TOOL

Modelleren én meten

TNO | Knowledge for business

Wouter Fransman, Erik Tielemans

Programma workshop

1) Algemene introductie
   -Erik-

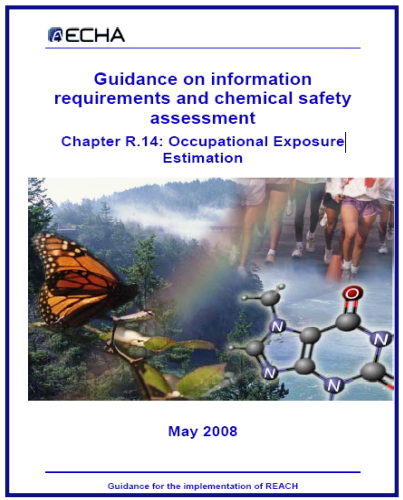
2) ART voorbeelden
   -Wouter-

3) Toekomstige ontwikkelingen / rol NVvA (?)
   -Erik-

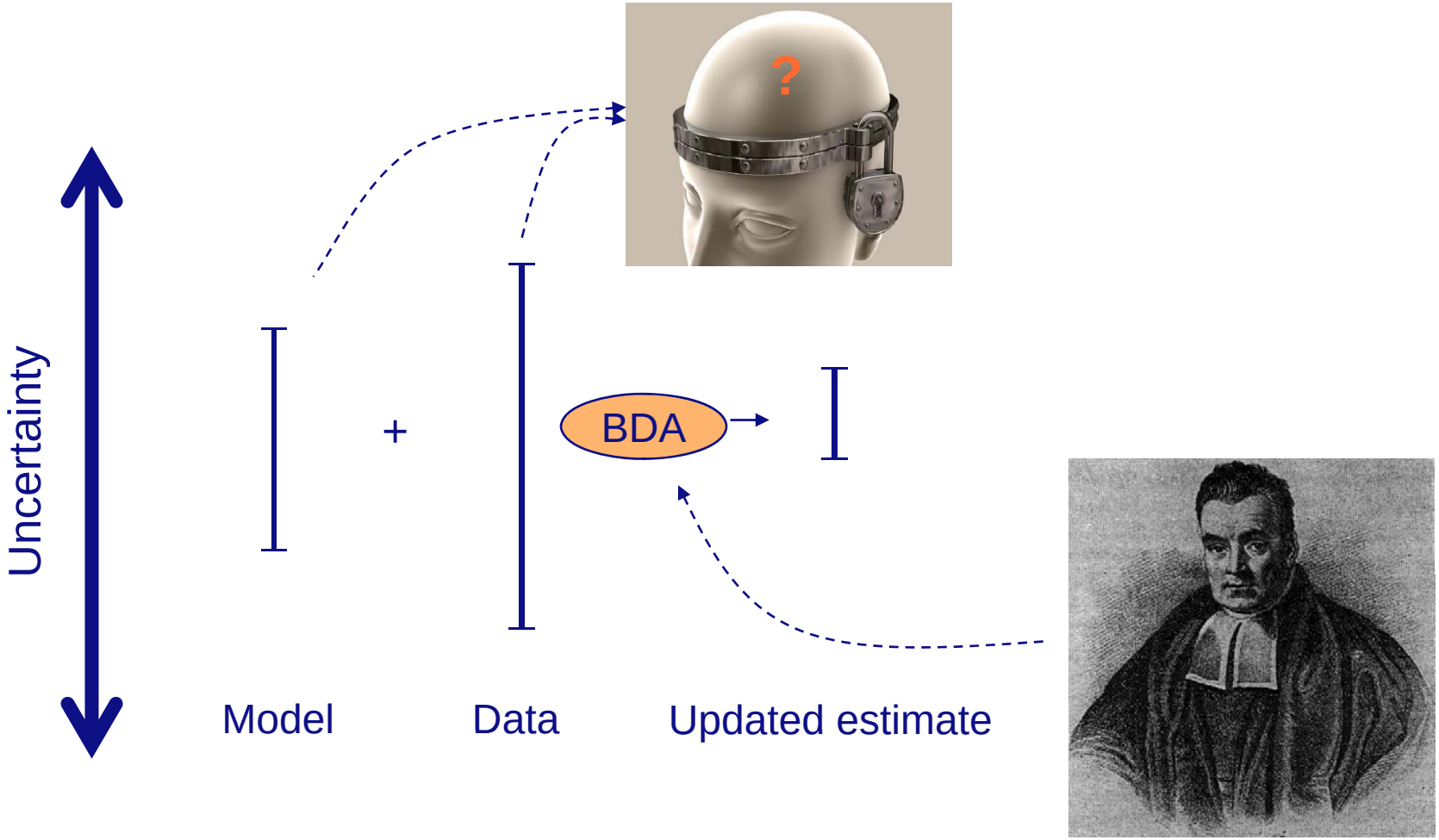
Nieuwe ontwikkelingen

- REACH geeft modelontwikkeling een nieuwe impuls
  - *Tier 1: Ecetoc TRA, BAuA tool, Stoffenmanager*
  - *Tier 2: Advanced REACH Tool*

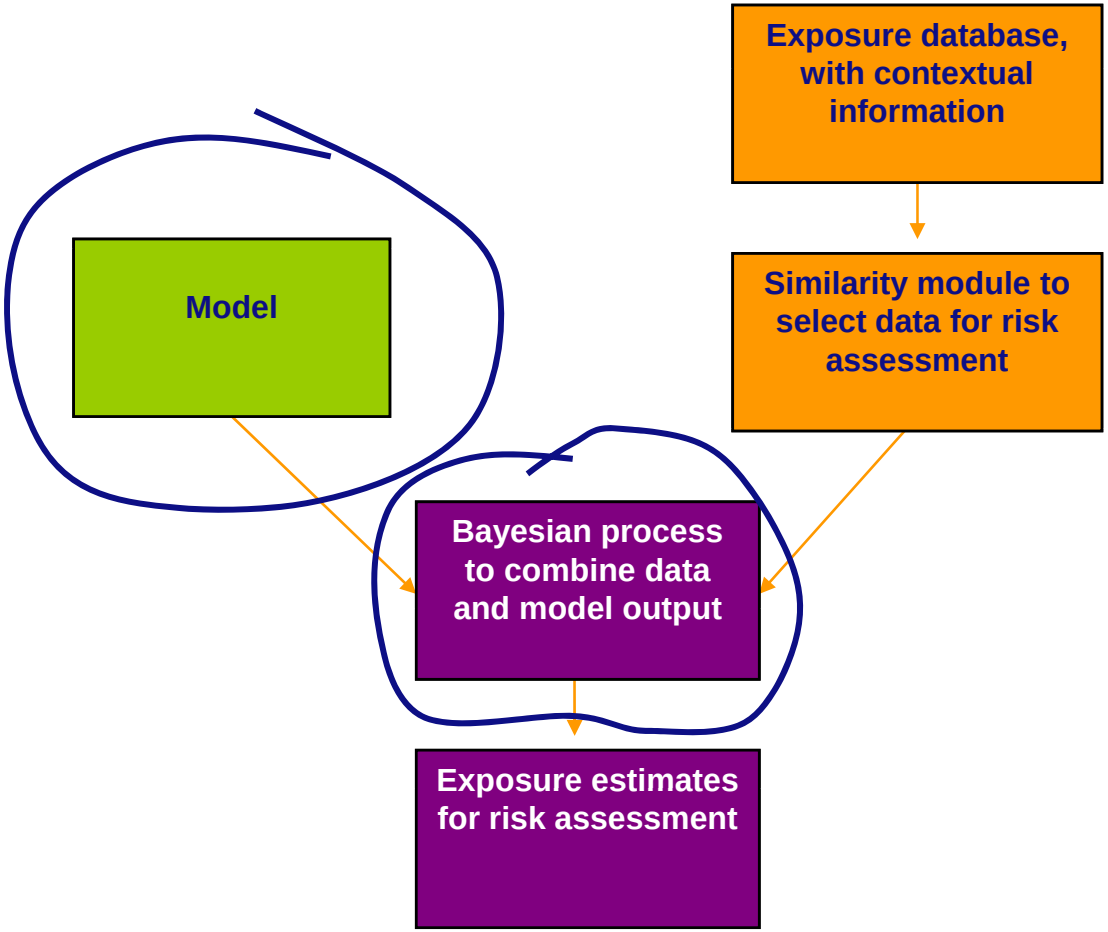
- Nieuwe meetstrategie in ontwikkeling
  - *BOHS – NVvA initiatief*



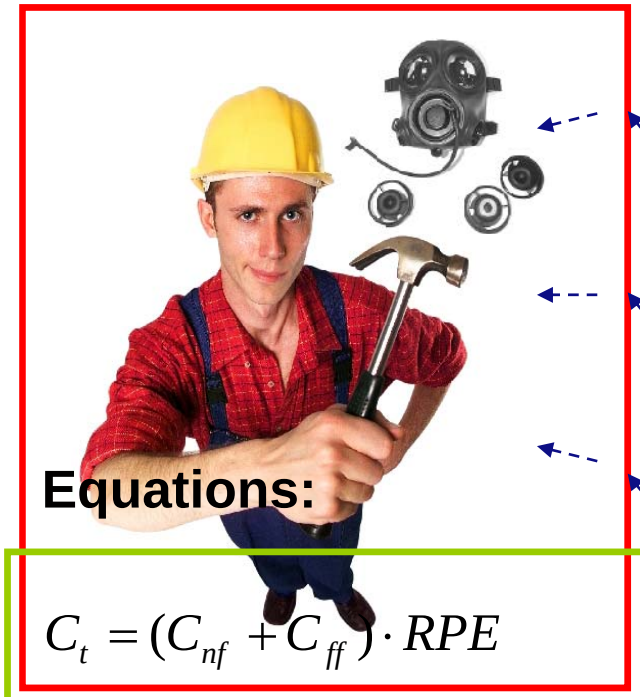
Making full use of information



ART approach



Mechanistic model ART



Equations:

$$C_t = (C_{nf} + C_{ff}) \cdot RPE$$

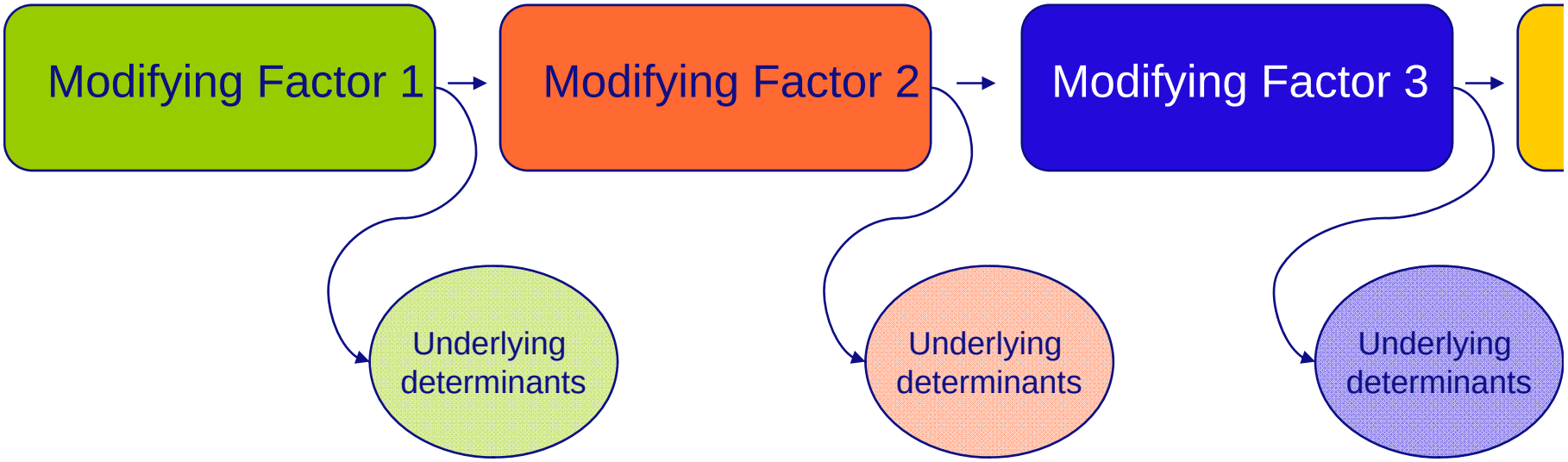
$$C_{nf} = (E_{nf} \cdot H_{nf} \cdot LC_{nf} \cdot P_{nf} + Su_{nf}) \cdot D_{nf}$$

$$C_{ff} = (E_{ff} \cdot H_{ff} \cdot LC_{ff} \cdot Seg_{ff} + Su_{ff}) \cdot D_{ff} \cdot Sep_{ff}$$

9 Modifying Factors (MF):

- Intrinsic emission potential (*E*)
- Activity emission potential (*H*)
- Local controls (*LC*)
- Separation (*Sep*)
- Segregation (*Seg*)
- Surface contamination (*Su*)
- Dilution (*D*)
- Personal behavior (*P*)
- RPE

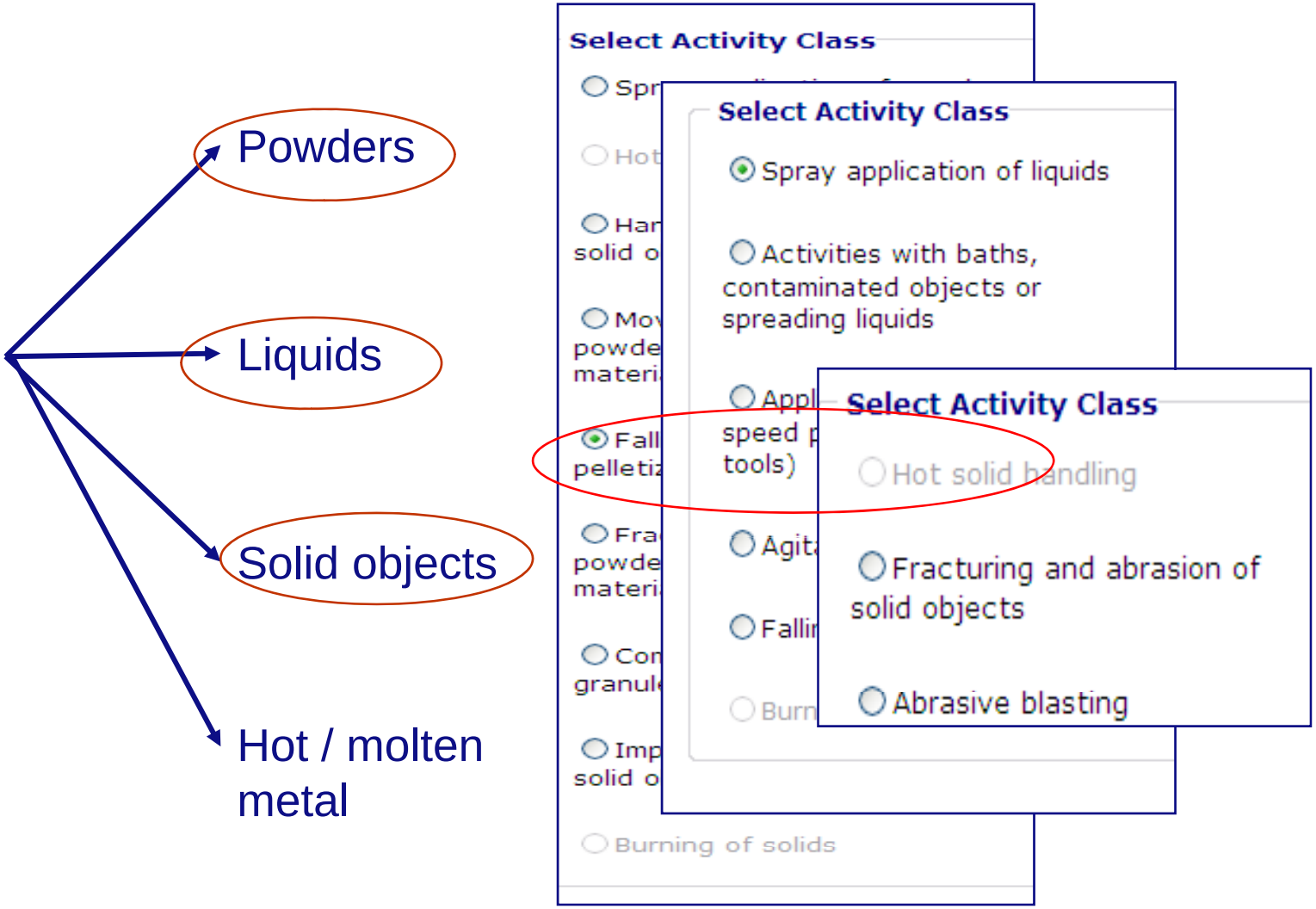
Hierarchical structuring



Substance Emission Potential (dustiness)

Category	Relative weight
Firm granule	0.01
Granule	0.03
Coarse dust	0.1
Fine dust	0.3
Extremely fine dust	1.0

Activity Emission Potential



- Transferring more than 1000 kg/minute (e.g. large scale transfer with big bags)
- Transferring 100 – 1000 kg/minute
- Transferring 10 – 100 kg/minute
- Transferring 1 – 10 kg/minute
- Transferring 0.1 – 1 kg/minute
- Transferring 10 – 100 gram/minute
- Transferring less than 10 gram/minute (e.g. very small scale weighing (fine adjustments) and scoping in laboratory)

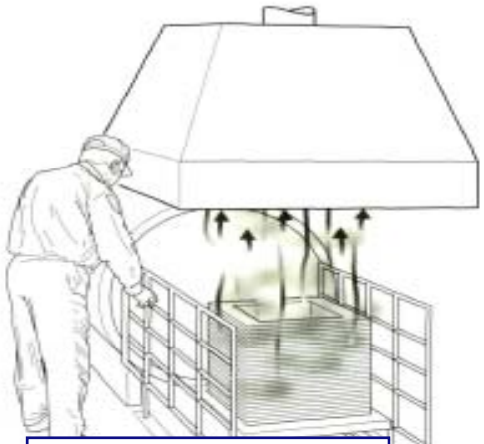
- Routine transfer
- Careful transfer involves workers showing attention to potential danger, error or harm and carrying out the activity in a very exact and thorough (or cautious) manner e.g. careful weighing in laboratory

What is the drop height?

- Drop height > 0.5 m
- Drop height < 0.5 m or transfer using a pipe

local controls

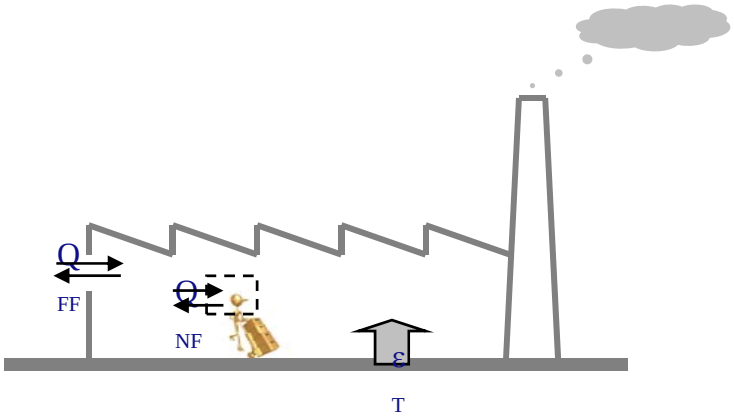
- No localized controls
- Suppression techniques
  - Wetting at the point of release
  - Knockdown suppression (post generation suppression)
- Containment (non-extracted)
- Local ventilation systems
  - Receiving hoods
    - Canopy hoods (hot processes)
    - Other receiving hoods
  - Capturing hoods
    - Fixed
    - Movable
    - On-tool (integrated) extraction
  - Enclosing hoods
    - Glove box
    - Fume cupboard
    - LEV systems with partial enclosure (no front cover)



Efficacy = 0.5

Efficacy = 0.0001

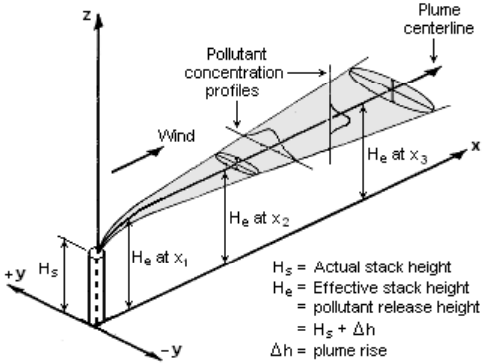
Dispersion

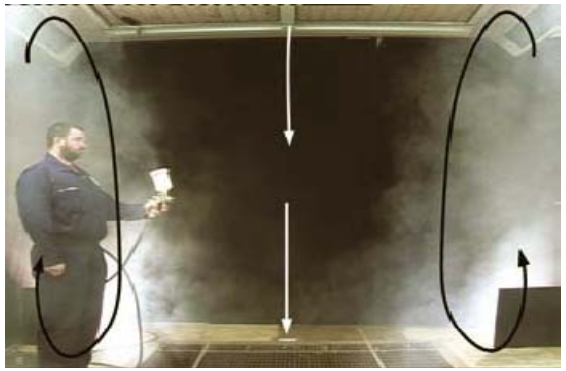


Indoor

Outdoor

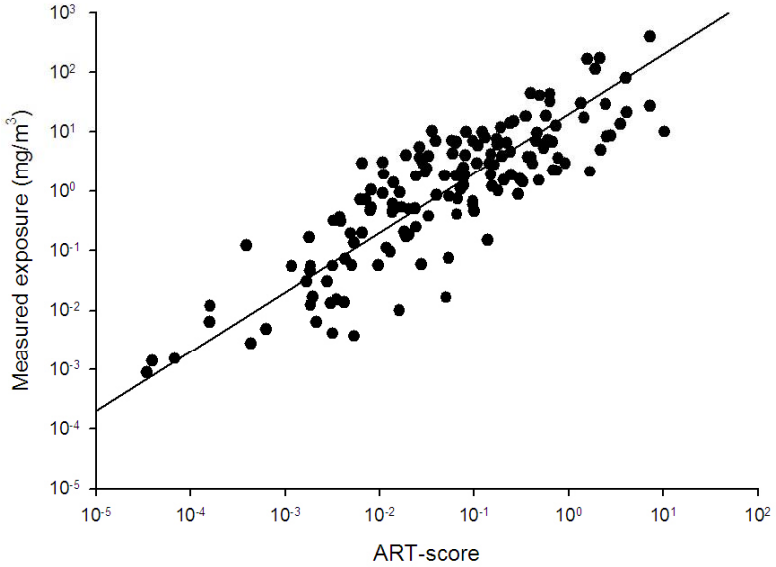
Spray booth





Calibration with measurements

- Using multiple sources
  - *Also including measurements in the low range*
- Only good quality data: N~2,500
- Quantification in units (mg/m^3)
- Provides model uncertainty
- Separate predictions for:
  - *Dust*
  - *Vapour*
  - *Mist*
  - *Fumes*



PhD Jody Schinkel

Bayesian model

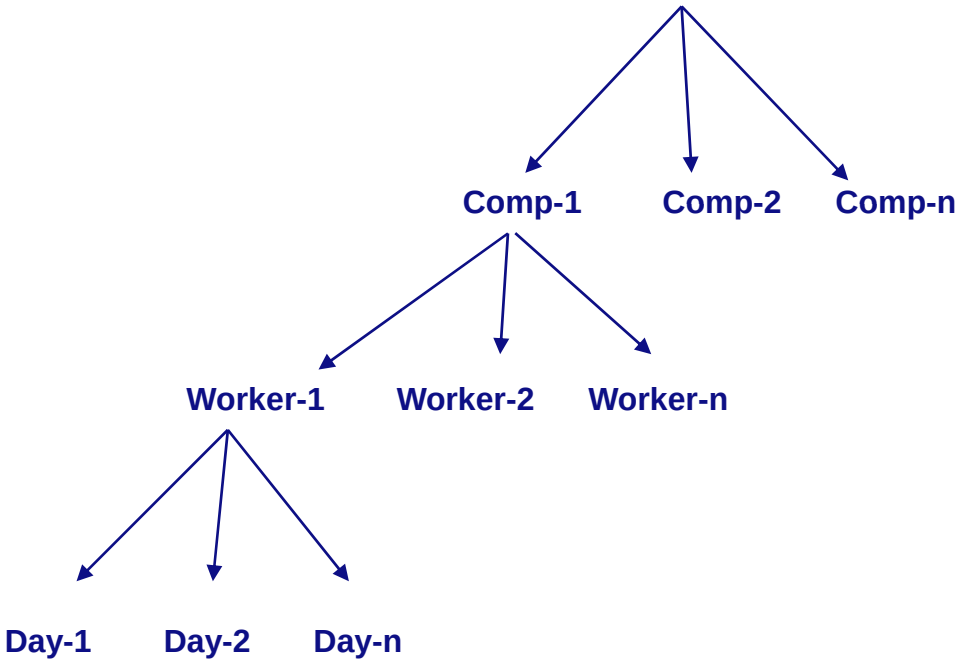
- Bayesian techniques allow for different types of information to be integrated in a theoretically rigorous way via probability theory

- Bayes approach takes account of the relative strength of the different information sources

- Bayesian module is integrated in ART to update model estimate with user's own data

Hierarchical exposure model

- Between company variability
- Between worker variability
- Within worker variability



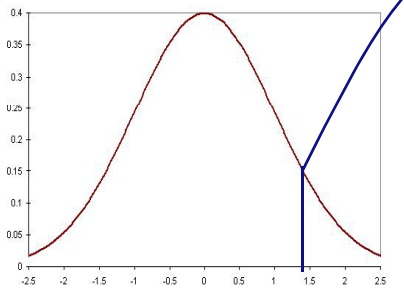
Weight of Evidence

- Large sample size >> Small sample sizes
- Multiple companies >> Single company
- Uniform measurement series >> Heterogeneous measurement series
- Analogous data >> Partially analogous data

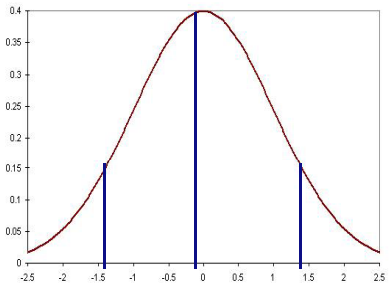
ART - output

- Explicit treatment of variability and uncertainty
  - *Percentile of distribution*
  - *Uncertainty of estimate*

Variability



90th , 75th , 50th percentile



Uncertainty

Inter-quartile, 80 %, 90 %, 95 % CI

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