 



# A framework to integrate human factor-related elements of chemical exposure in the workplace

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# Content

- Introduction
- Aim
- Framework
- Intervention study (baseline measurement)
  - background
  - method
  - results
- Conclusions



# Introduction

- Much attention for technical control measures in chemical exposures
- Observational and real-time exposure data have shown behaviour to be an important aspect of (peak) exposures (Meijster et al, 2008)
- Very little known about relationship between behavioural factors and chemical exposure
- Evidence of behavioural factors will help us to plan intervention or behaviour change strategies

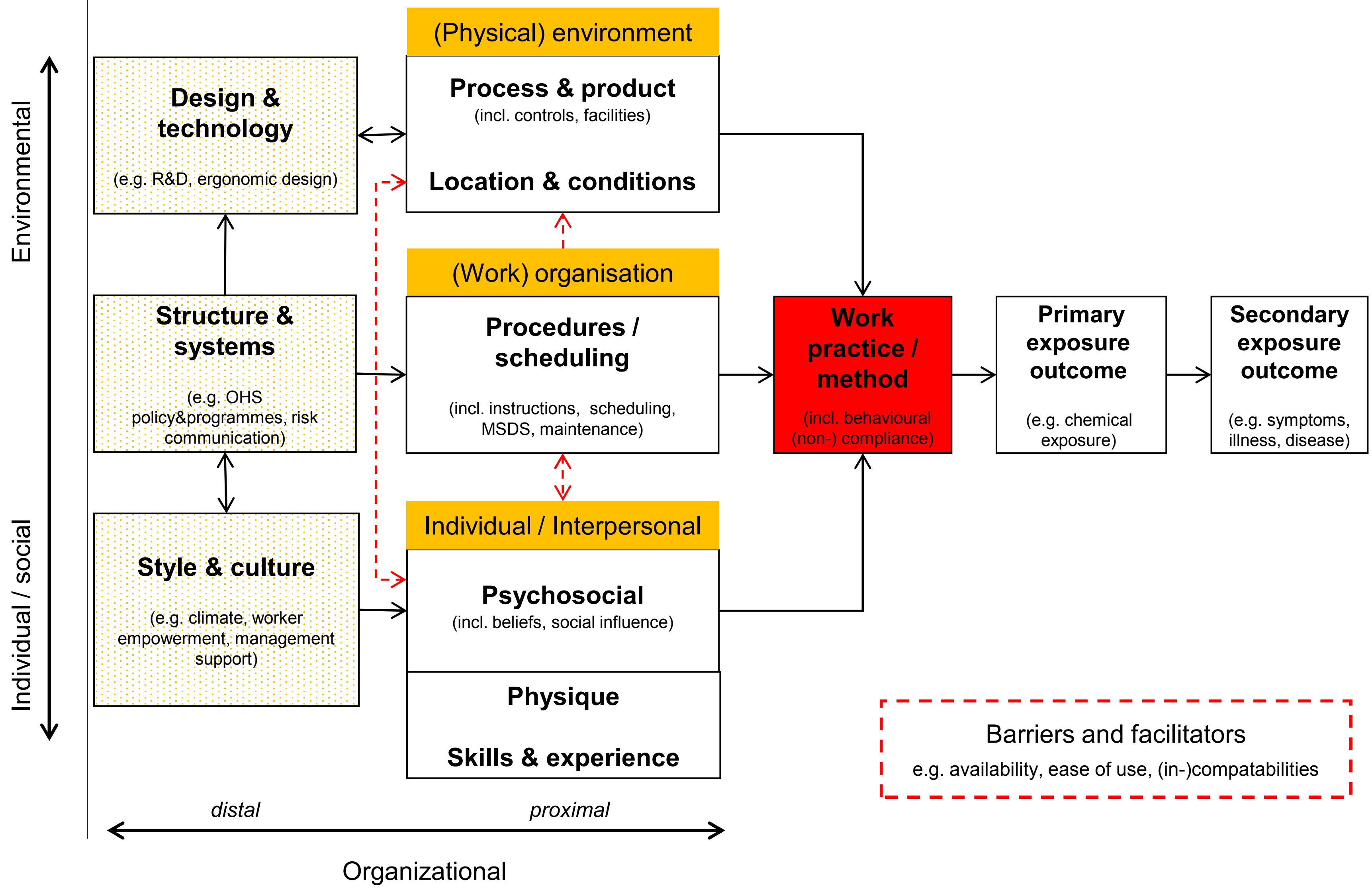


# Aim

- Determine the relationship between behavioural factors, behaviour and (inhalation) chemical exposure
- Propose an intervention strategy based on the outcome of data analysis & other evidence

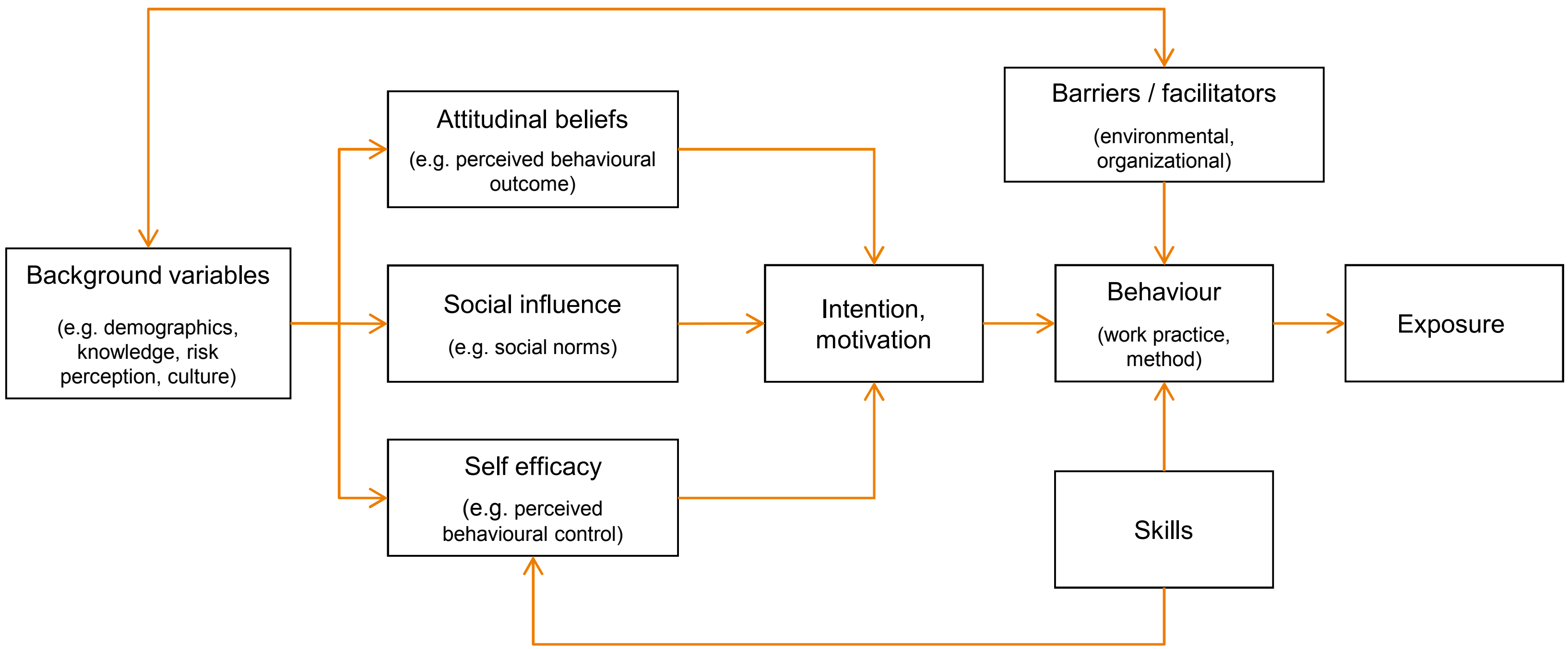



# An integrated framework





# Behavioural models





# Intervention study
## - background

- Dutch study (TNO project + PhD project) → includes intervention mapping, health impact assessment, cost-benefit analysis

- Multidimensional study
  - overall aim to reduce disease burden
  - using broad scope of interventions (human, organisation, technology)
  - → determine the most effective combination of control strategies

- Two industries – building industry (alpha-quartz / crystalline silica) and car repair industry (isocyanates)




# Intervention study (human factor) - method

- Use of framework during pilot study
  - identify important behaviours related to dust exposure
  - identify important barriers/facilitators of behaviour
- Data collection
  - development of worker / management questionnaires, checklists
  - detailed observations of individual workers
  - dust exposure measurements & analysis
- Database development
- 1st preliminary analysis of baseline study
  - regression analysis



# Behaviour in the building industry

## - best & poor practices

| Behaviour | Determinants* | Examples |
|---|---|---|
| Task- and process | Timing & sequence<br>Carefulness<br>Worker orientation | Closing lids on mixers<br>Debagging<br>Orientation to plumes, above shoulder height |
| Control measure | Technical controls<br>Personal controls | Tool exhaust ventilation, wetting systems<br>Respirators |
| Housekeeping | Cleaning methods | Compressed air, vacuum cleaners, wet / dry methods |
| Personal hygiene | | Hand washing, washing clothes |

* Include the effectiveness of use or correct use, frequency of use, maintenance



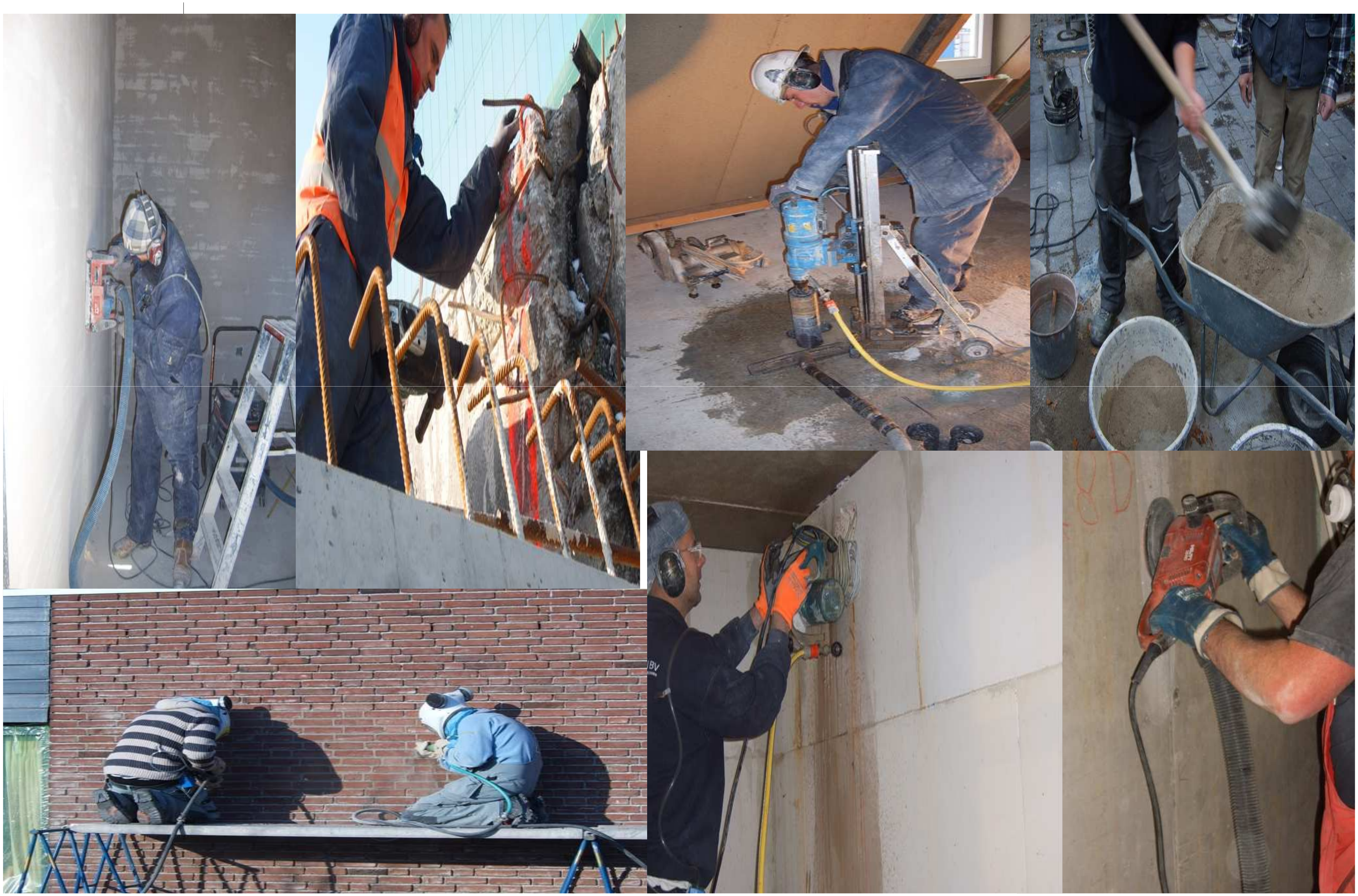
# Barriers & facilitators

| Scale | Issues to consider | Examples |
|---|---|---|
| Environment (vs individual & organisation) | Availability / accessibility<br>Compatibility issues<br><br>Maintenance | Connections for water systems<br>Ease of use of tool extraction<br>Time pressure<br>Replacing filters on ventilation systems |
| Training | Availability, frequency, quality | Periodical training, including best practices, interactive |
| Instructions, information | Availability, frequency, quality | Safe work practices, MSDS |
| Culture | | Management involvement, support |



# Results (1)

| | N | Range (min-max) | Mean (SD) | % |
|---|---|---|---|---|
| Participants | 102 | | | |
| Full-shift dust measurements | 125 | | | |
| Companies | 9 | | | |
| Demographics | | | | |
| - Gender (male) | | | | 100 |
| - Smoking (yes) | | | | 52 |
| - Country (education NL) | | | | 96 |
| - Education (secondary school +) | | | | 76 |
| - Professional training job (yes) | | | | 43 |
| - Job experience (yrs) | | 1-44 | 16(11) | |
| Job categories | | | | |
| - Carpenter | | | | 22 |
| - Concrete driller | | | | 27 |
| - Demolisher | | | | 26 |
| - Tuck pointer, carver / grinder | | | | 25 |
| Exposure data | | | | |
| Respirable dust > 5mg/m$^3$ exposure limit | | | | 12 |
| α-quartz > 0,075 mg/m$^3$ exposure limit | | | | 60 |





# General response

| | % |
|---|---|
| If best practices available to effectively control dust, why use it? | |
| - Better for health | 5 |
| - Less nuisance from dust | 66 |
| | |
| Reason NOT to use best practices to reduce dust exposure? | |
| - Not sufficient / effective | 21 |
| - Technically difficult | 36 |
| - Takes too much time | 15 |
| | |
| Who has the most influence on you to use best practices to control dust? | |
| - Co-workers | 5 |
| - Myself | 73 |
| - Supervisor, manager | 11 |
| - Family | 3 |



# Scales used in preliminary analysis

| Scale | Sub-scale | Content |
|---|---|---|
| Behaviour | Behaviour (control use)<br>Behaviour (best practices) | Frequency of use of dust controls (self-reported)<br>Effective use of controls & best practices (self-reported) |
| Intention | - | Intention to use controls & best practices |
| Attitudinal beliefs | Perceived effectiveness | Beliefs about effectiveness of controls / best practices |
| Social influence | Co-worker behaviour | Co-workers behaviour with regard to controls and best practices (self-reported) |
| Knowledge | - | Substance, exposure process, health effects, controls/practices |
| Background variables | Risk sensitivity<br>Risk ignorance | Perceived susceptibility & severity of health outcomes<br>Risk taking beliefs, risk propensity |

# Preliminary results (1)

| Scale (Cronbach alpha) | Coefficients (ß) | |
|---|---|---|
| Dependent variable | α-quartz exposure | respirable dust exposure |
| Respirable dust exposure | 0,21 | - |
| Behaviour (control use) (0,88) | 0,30* | 0,01 |
| Behaviour (best practices) (0,79) | -0,14 | 0,27 |
| Intention (0,92) | 0,17 | -0,13 |
| Beliefs in effectiveness of controls (0,75) | -0,01 | 0,03 |
| Risk sensitivity (0,70) | -0,10 | -0,2 |
| Risk ignorance (0,68) | 0,33** | -0,06 |
| Co-worker behaviour (0,67) | 0,16 | -0,06 |
| Knowledge | -0,04 | -0,41*** |
| $R^2$ | 0,30 | 0,22 |
| Adjusted $R^2$ | 0,22 | 0,15 |
| SE of estimate | 0,18 | 3,61 |
| F | 3,77** | 2,92** |

*p<0,05; **p<0,01; ***p<0,001

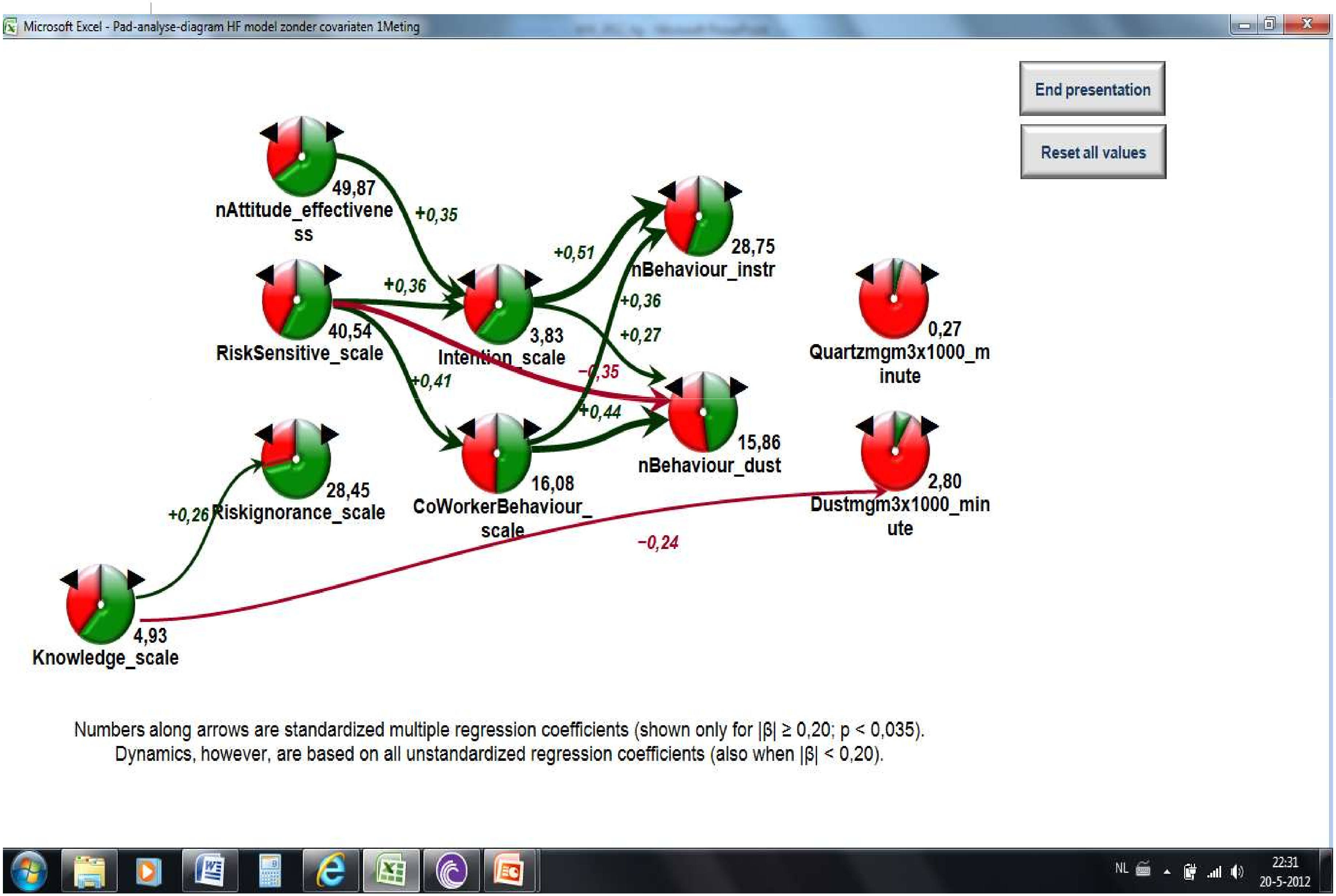



# Preliminary results (2)

| Scale (Cronbach alpha) | Coefficients (ß) | |
|---|---|---|
| Dependent variable | Behaviour (control use#) | Behaviour (best practices#) |
| Behaviour (control use) (0,88) | - | 0,29** |
| Behaviour (best practices) (0,79) | 0,39** | - |
| Intention (0,92) | 0,08 | 0,43*** |
| Beliefs in effectiveness of controls (0,75) | 0,05 | 0,06 |
| Risk sensitivity (0,70) | -0,15 | 0,02 |
| Risk ignorance (0,68) | -0,09 | 0,08 |
| Co-worker behaviour (0,67) | 0,36** | 0,19* |
| Knowledge | 0,13 | -0,01 |
| $R^2$ | 0,43 | 0,57 |
| Adjusted $R^2$ | 0,38 | 0,53 |
| SE of estimate | 5,3 | 7,7 |
| F | 8,9*** | 15,7*** |

*p<0,05; **p<0,01; ***p<0,001
# self-reported

TNO innovation for life





# Conclusions (1)

- Framework proven useful to identify behaviours and barriers / facilitators

- Importance of social influence, co-worker behaviour and role models also found in other studies (de Vries, 2000; Koppleaar et al, 2008; Nicol & Kennedy, 2008)

- More in-depth analyses required with all available data
  - detailed observation data, also include barriers & background variables

## Conclusions (2)

- Possible suggestions for an intervention strategy, e.g.:
  - participative approach between workers and management (solving barriers of behaviour together)
  - one worker per working team proposed as coach / representative to influence behaviour
  - interactive and skills training (PIMEX – real-time exposure video clips)
  - ‘reminder, prompts, warning systems’ (e.g. on tools)

- Challenge is to find an intervention strategy that is effective in short & long term, & maintenance of change




# Thank you for your attention!

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