acoustics in OPO: what parameters to use?

Sara Vellenga-Persoon
Senior Consultant
Acoustics and building physics
M+P | Muller-BBM Group

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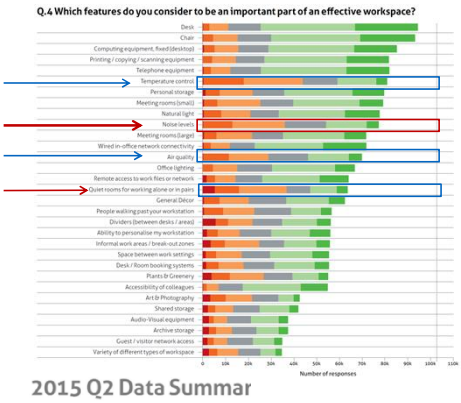
RELEVANCE

OFFICES

80.000 surveyed out of 100.000

Leesman_review



2015 Q2 Data Summar

consider noise levels important:
- 46%: noise levels dissatisfying

other dissatisfying factors:
- Temperature control
- Quiet rooms for working alone or in pairs
- Air quality

Philip Vanhoutte,
Sr VP & MD EMEA of
Plantronics and chair of
Leesman's Advisory Board

'The workplace world cannot ignore that 46,000+ employees have an issue with noise.'

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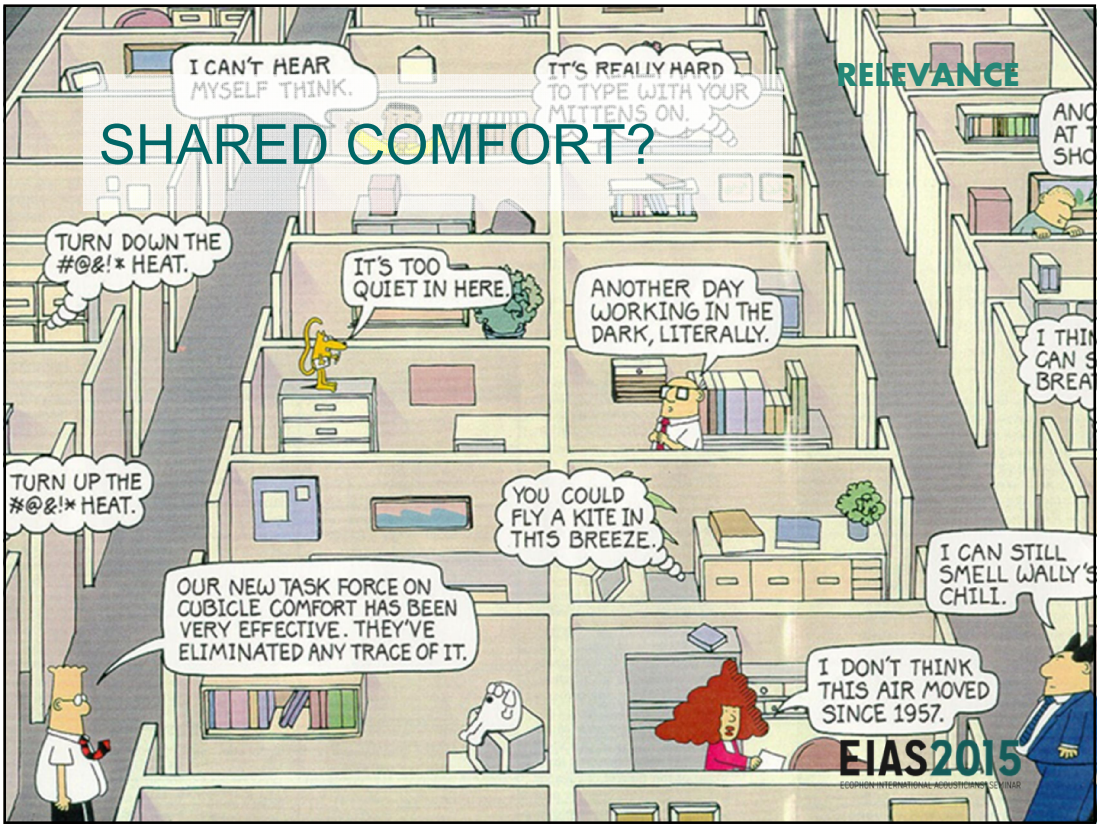
RELEVANCE

SHARED COMFORT?



STATE OF ART

ACOUSTIC COMFORT

- **Office types**
  (De Croon et al. 2005, Kaarlela-Tuomaala et al. 2009)
- **Office noise levels**
  (Chigot 2005, Jackson 1999, Kjellberg et al. 1996, Tang 1997)
- **Speech intelligibility**
  (ISO 3382-3: 2012, Hongisto, Keranen, Rindel)

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OFFICE TYPES

- De Croon et al. 2005, systematic literature review

  open workplaces:

  - strong evidence: it reduces privacy and job satisfaction
  - limited evidence: intensifies workload and worsens interpersonal relationships

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OFFICE TYPES

- Finnish Institute of Occupational Health, Kaarlela-Tuomaala et al. 2009, longitudinal study

  private office rooms <-> open plan offices

  the results suggest that the open plan office is not recommended for professional workers

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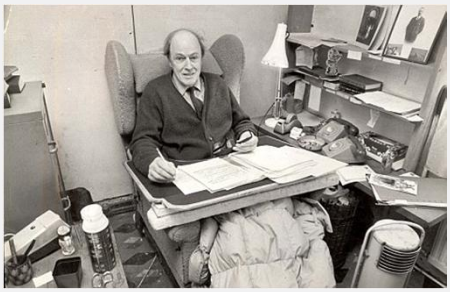
OFFICE TYPES

- Chigot 2005, Jackson 1999: overview of 11 abstracts
  subjective experience <-> objective assessment



Roald Dahl at work in his cluttered shed: Researchers found that cluttered desks actually help people to focus on the task at hand

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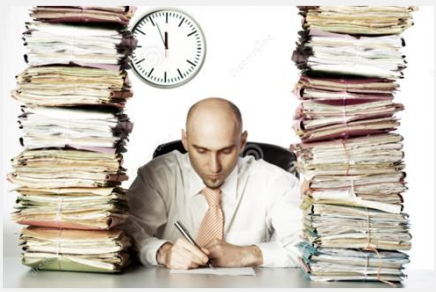
OFFICE NOISE LEVELS

- Jackson 1999 (Chigot 2005):
  noise level ↑ gives increase of subjective workload



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OFFICE NOISE LEVELS

- Kjellberg et al. 1996 (Chigot 2005):
  noise level ↑ gives decrease of cognitive performance in memory tasks

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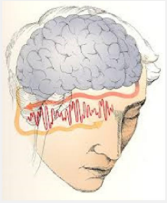
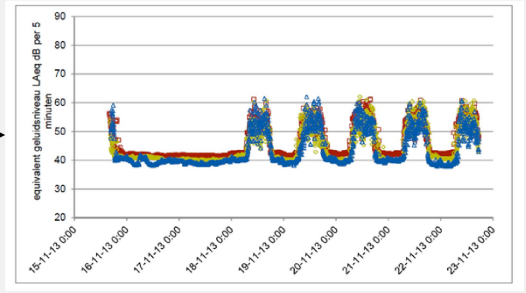
OFFICE NOISE LEVELS

- Tang 1997 (Chigot 2005):
  *L*eq,5min correlates the best with human auditory sensation





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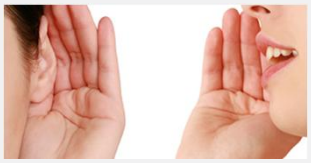
SPEECH INTELLIGIBILITY

- Impact on concentration and privacy
  (ISO 3382-3: 2012, Hongisto, Keranen, Rindel)



STI	Speech privacy	Benaming
< 0.5	Working without distraction is possible	r_D (distraction distance)
< 0.2	Working with concentration is possible	r_P (privacy distance)

ISO 3382-3:
"Acoustics – Measurement of room acoustic parameters – Part 3: Open plan spaces", 2012

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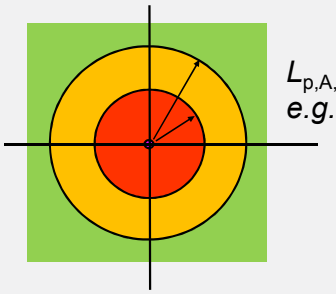
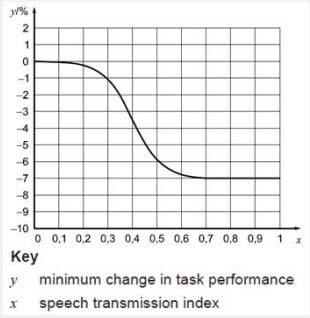
SPEECH INTELLIGIBILITY

- Impact on concentration and privacy



$L_{p,A,S}$ 1m = 57 dB(A),
e.g. $L_{p,A,B}$ = 40 dB(A)



D_{2s} = 5 dB (no screens)
gives $r_D \approx 6$ m
gives $r_P \approx 45$ m

D_{2s} = 11 dB (with high screens)
gives $r_D \approx 2$ m
gives $r_P \approx 6$ m

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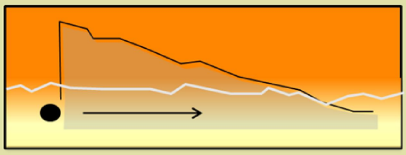
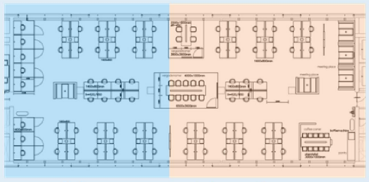
WHAT PARAMETERS

ACOUSTIC DESIGN

Sound propagation:
- Physical environment
- One source
- Background noise levels
- Distance r_P and r_D
- Spatial decay $D_{2,S}$
- Screens and absorption



Noise levels
- People behaviour
- Multiple sources
- Activity noise levels
- Sources nearby & far away
- $L_{eq,5min}$ with sound fragments
- Zones and compartments



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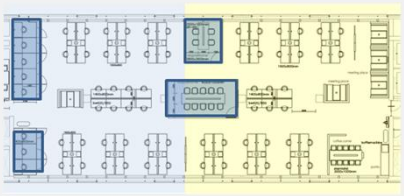
ACOUSTIC DESIGN

ENGINEERING



Engineering the new design
- activity based design
- zones
- closed rooms with high levels of sound insulation
- screens
- absorption

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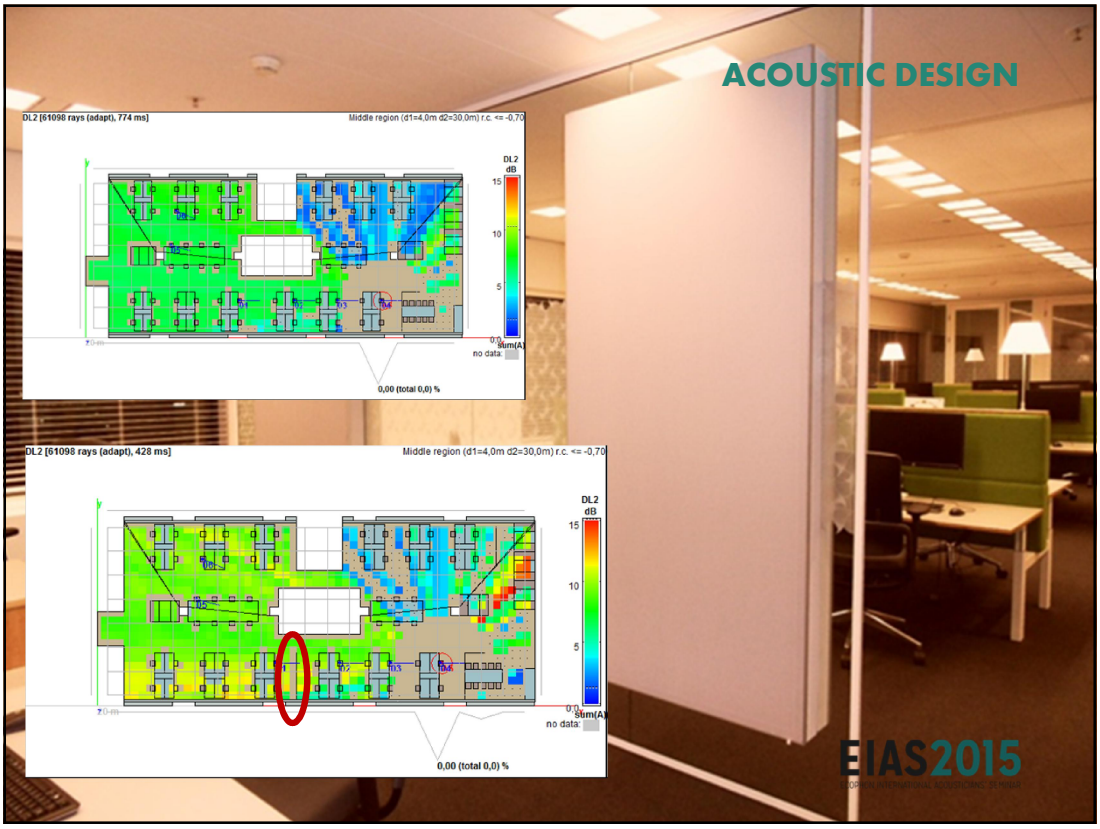


ACOUSTIC DESIGN

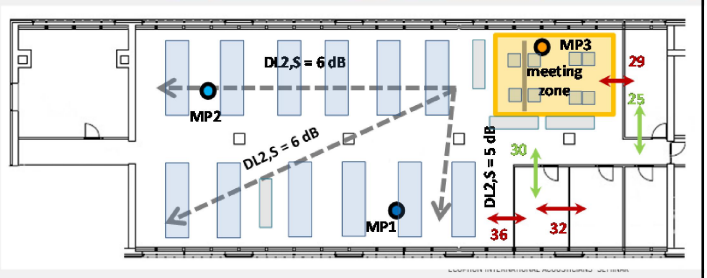
MEASUREMENTS: DESIGN INPUT

Measurements Acoustical parameters:

Building Acoustics & Room Acoustics

- sound insulation DnTA in dB
- reverberation time T in s
- spatial decay D2S
- background noise level LpA,B

Acoustic parameter	results	
sound insulation $D_{nT,A}$ [dB]	29-36	walls (green notation)
	25-30	walls with doors (red notation)
Reverberation time $T_{250\text{-}2k}$ [s]	0,5	open plan office
	0,3	meeting zone
	0,4-0,5	office cells
Spatial decay rate $D_{l2,S}$ [dB]	5-6	open plan office
Background noise level $L_{p,A,B}$ [dB]	37-44	

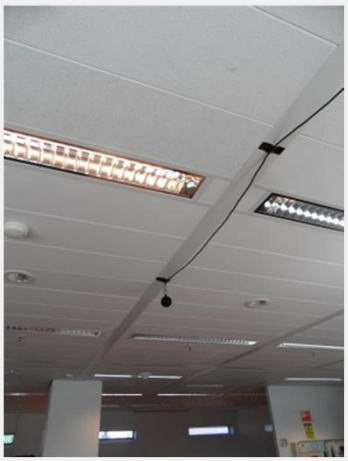


ACOUSTIC DESIGN

MEASUREMENTS: DESIGN INPUT

Measurements Acoustical parameters:
Noise activity levels & interpretation

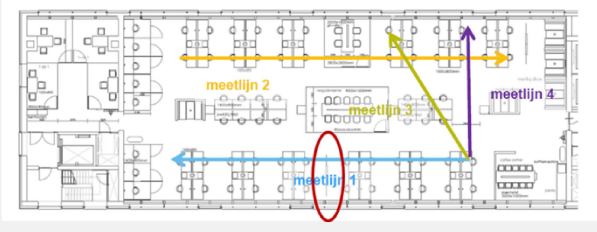
- Leq,5min in dB
- sound fragments

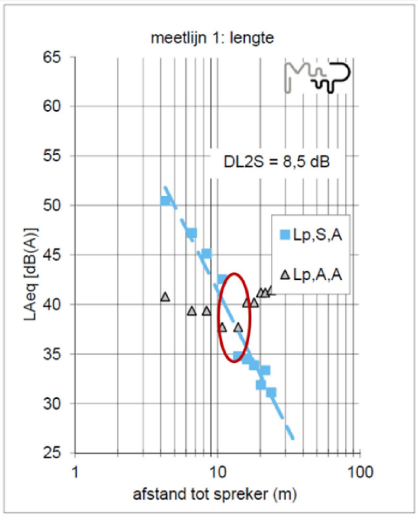


MEASUREMENTS: EVALUATION

Measurements before & after

Room and building acoustics
D2S improved from 6 to 9 dB





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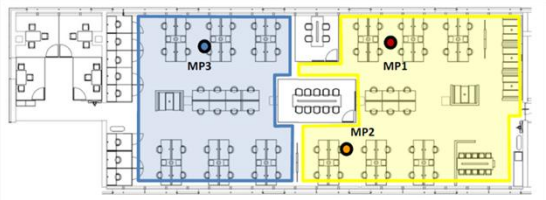
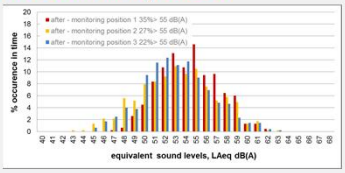
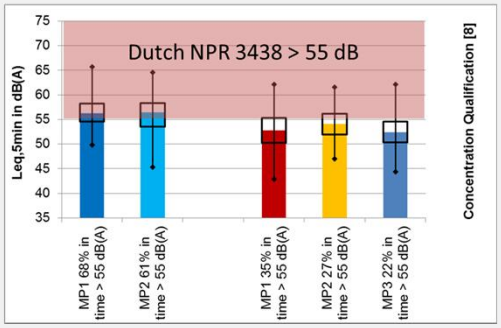
MEASUREMENTS: EVALUATION



Measurements before & after

Noise activity levels





ACOUSTIC DESIGN

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