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Update on CargoVibes WP1

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Overview of presentation

Aims and objectives of the CargoVibes project

Assessment of response: Annoyance

Assessment of response: Sleep disturbance

Good practice guide

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Introduction

- Projected increase in market share of goods traffic on rail from 8% in 2001 to 15% in 2020
- Implies an increase in noise and vibration exposure for residents in the vicinity of freight lines
- Noise and vibration are key obstacles for this proposed increase
- There is a need for clear methods to assess the human response to noise and vibration

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Aim of CargoVibes

Development and validation of measures to ensure acceptable levels of vibration for residents living in the vicinity of freight railway lines.

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- Aims to establish acceptable levels of vibration from rail transportation
  - Socio-vibration surveys (Netherlands and Poland)
  - Meta-analysis of existing data
  - Laboratory based sleep studies
  - Development of a good practice guide

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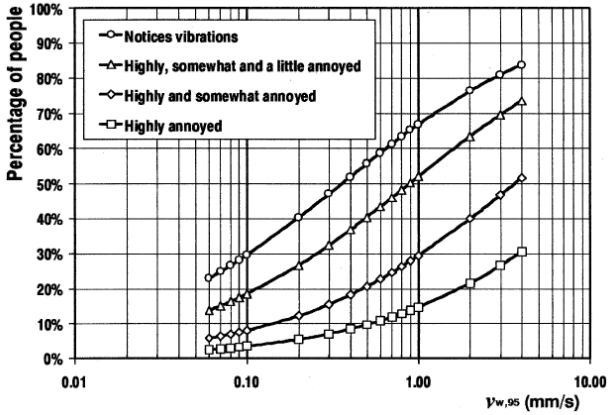
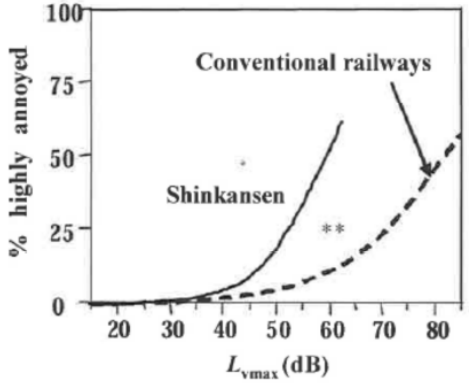
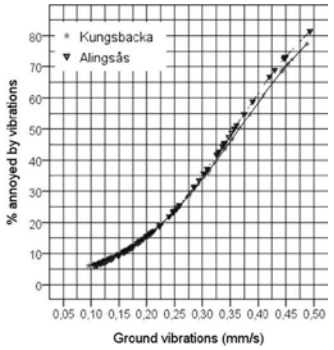
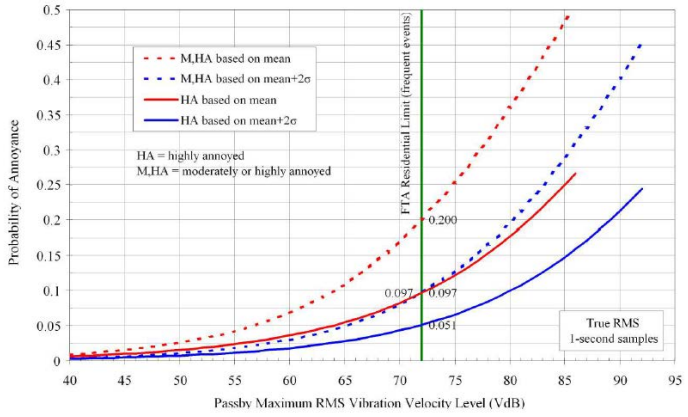
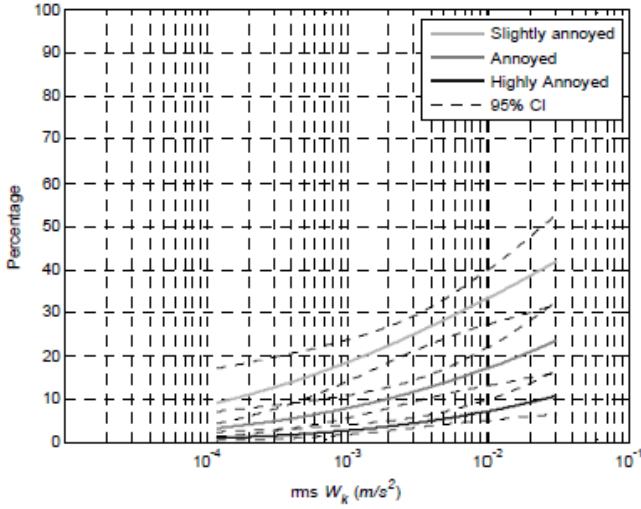
Meta-analysis on available field studies (N=4490)











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Original vibration metrics used in each study

Study	Metric	Unit	Time	Weighting	Direction
Germany	*KB; VCKBL25*	-	0.125s	DIN 4150	Vertical
Norway	V_{w95}	*mm/s*	1s	NS 8176 /ISO W_m	Vertical dominant
Japan	L_{Vmax}	*dB re* 10^{-5} m/s^2	0.63s	JIS C1510	Vertical
USA/Canada	*Passby maximum velocity* ($\mu+2\sigma$)	*dB re 1µin/s*	1s	-	Vertical
UK	*Passby RMS; 24 hr VDV*	m/s^2; $m/s^{1.75}$		ISO W_k, W_d; BS 6472 W_b, W_d	Vertical/horizontal
Sweden	*Maximum velocity*	*mm/s*	1s	SS 460 48 61/ W_m	Vertical
Netherlands	V_{max}	-	0.125s	DIN 4150 /SBR-B	Vertical/horizontal
Poland	$V_{d,max}$	-	0.125s	ISO W_k, W_d	Vertical/horizontal

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Metrics used in the meta-analysis

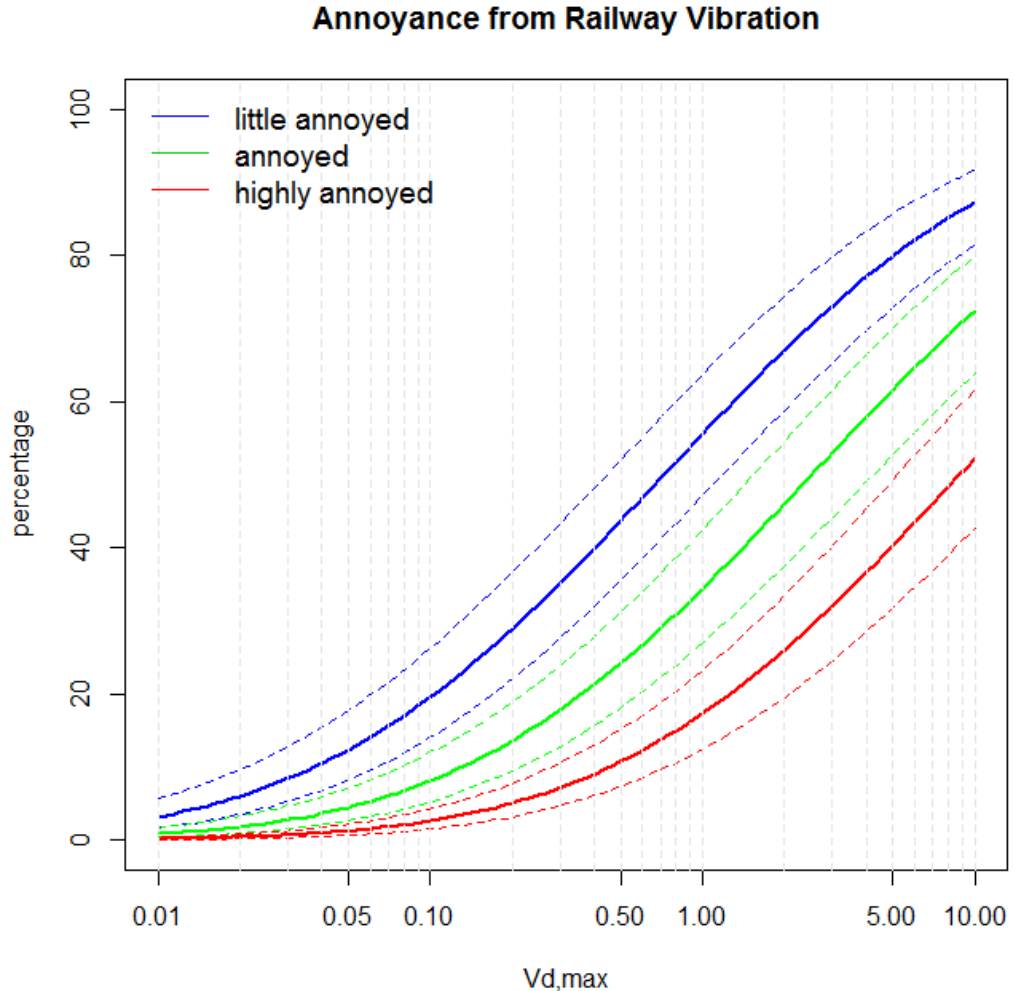
Three metrics are chosen as reference metrics towards which all others are transformed:

- Vd_{max}: maximum vibration velocity level (fast-exponentially filtered maximum velocity over, say, a week), mostly according to DIN 4150 and SBR-B, but frequency weighted for different directions, according to ISO 2631-1

- *RMS*: average vibration velocity level (root-mean-square velocity over 24 hours) acceleration based, frequency weighted for different directions, according to ISO 2631-1

- *VDV*: vibration dose value (root-sum-quad acceleration over 24 hours), acceleration based, frequency weighted for different directions, according to ISO 2631-1

Exposure-response function $V_{d,max}$ – annoyance (N=4490)



Parameter	Estimate	SE	p-value
β_0 (intercept at median)	10.72	4.41	< 0.05
β_1 ($log_{10}V_{d,max,centered}$)	40.53	1.95	< 0.0001
σ^2_0 (between study)	126.73		
σ^2_1 (within study)	1528.14		
Covariance (b_0,b_1)	-1.20		
Explained variance	0.18		

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Sleep labs at University of Gothenburg

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Test design

- 3 experiments with different noise and vibration conditions
- 59 subjects x 6 nights (1 habituation, 1 control, and 4 exposure)
- Sleep quality evaluated objectively using polysomnography and subjectively via questionnaires

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Main results

- Exposure to freight noise and vibration resulted in self reported and objective sleep disturbance
- Number of trains found to influence sleep quality at certain levels of vibration
- Sleep disturbance was found to be related to vibration amplitude
- Exposure to vibration found to influence heart rate

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Good practice guide

- Guidance for assessing human response to railway vibration in steady state conditions
- Present best available data for annoyance, sleep disturbance and other factors
- Comparison of national limit levels with best available data

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Timeline

May 2013 — June 2013 — Mid-Sept 2013 — 30th Sept 2013

International workshop, Salford, UK

ICA, Montreal

IWRN, Sweden

Final draft CargoVibes board

Comments welcome!

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Summary

- Meta-analysis of existing field data has resulted in exposure-response relationships
- Sleep disturbance due to vibration assessed in laboratory tests
- Formal guidance for the evaluation of vibration to be provided in a good practice guide

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