



MOVEMENT THROUGH FIRE SMOKE

PAST RESEARCH AND CURRENT STANDARDS DEVELOPMENT

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OUTLINE

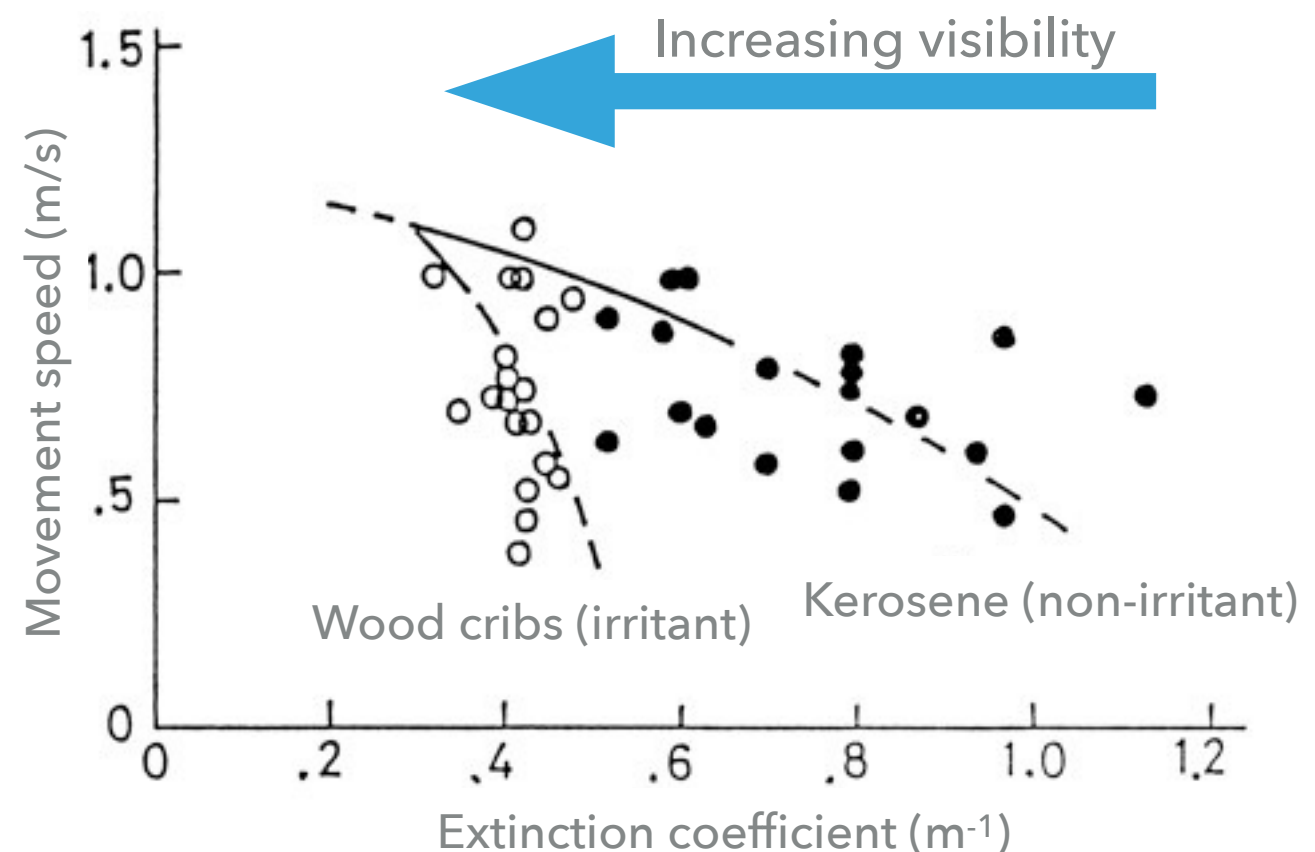
- ▶ Background
- ▶ Past research
- ▶ Standards development
- ▶ Summary

BACKGROUND

- ▶ Performance-based fire safety design
 - ▶ Visibility often a tolerability criteria
 - ▶ 5 or 10 m visibility
 - ▶ Sometimes allow movement through smoke in design
 - ▶ Rail tunnels, road tunnels, complex buildings, etc
 - ▶ Movement speed vs. smoke density represented accurately
 - ▶ No standardised approach exist
 - ▶ Ad-hoc approaches => inconsistent safety levels
 - ▶ A standardised approach is needed

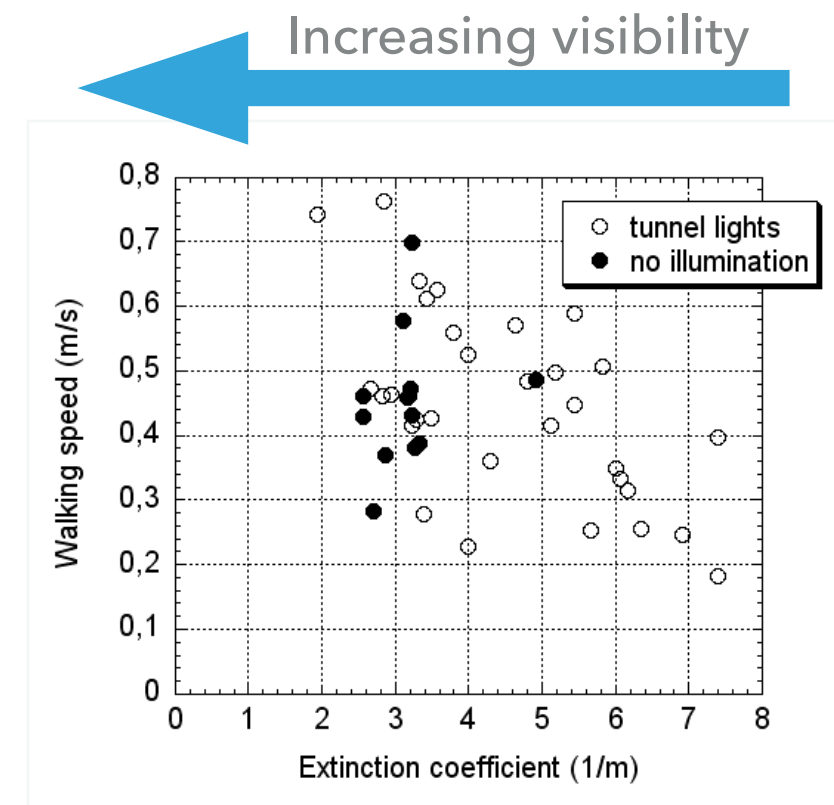
PAST RESEARCH

- ▶ Jin, 1978
 - ▶ Smoke filled corridor
 - ▶ Irritant and non-irritant fire smoke
 - ▶ Conclusions
 - ▶ Smoke slows people down
 - ▶ Irritancy important



PAST RESEARCH

- ▶ Frantzich & Nilsson, 2004
 - ▶ Smoke filled tunnel
 - ▶ Artificial smoke (glycerol) and acetic acid (mildly irritant)
 - ▶ Conclusions
 - ▶ Smoke slows people down
 - ▶ People follow walls and miss exits



PAST RESEARCH

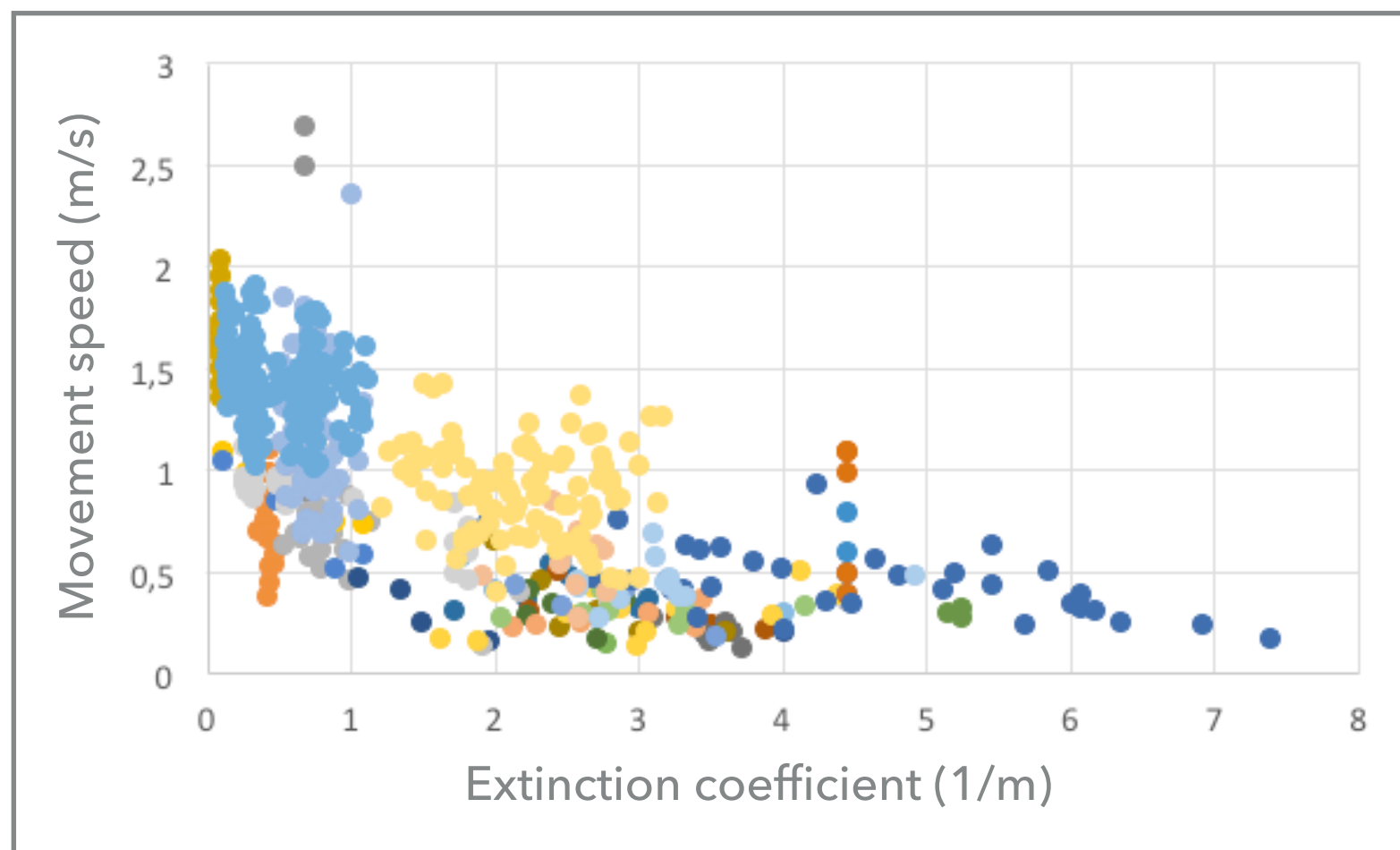
- ▶ Fridolf, Nilsson, Frantzich, Ronchi & Arias (2016)
 - ▶ Compilation of past research studies
 - ▶ Qualitative trends
 - ▶ Movement patterns, pauses, behaviour towards others, behaviours affecting individual decisions, etc
 - ▶ Quantitative data
 - ▶ Movement speed vs. smoke density

PAST RESEARCH

- ▶ Fridolf, Nilsson, Frantzich, Ronchi & Arias (2016)
 - ▶ Movement speed vs. smoke density
 - ▶ Compiled data from past studies
 - ▶ Selection of studies used (similar studies)
 - ▶ mostly tunnel related
 - ▶ same type of smoke (non-irritant or mildly irritant smoke)
 - ▶ same type of lighting

PAST RESEARCH

- ▶ Fridolf, Nilsson, Frantzich, Ronchi & Arias (2016)
 - ▶ Movement speed vs. smoke density

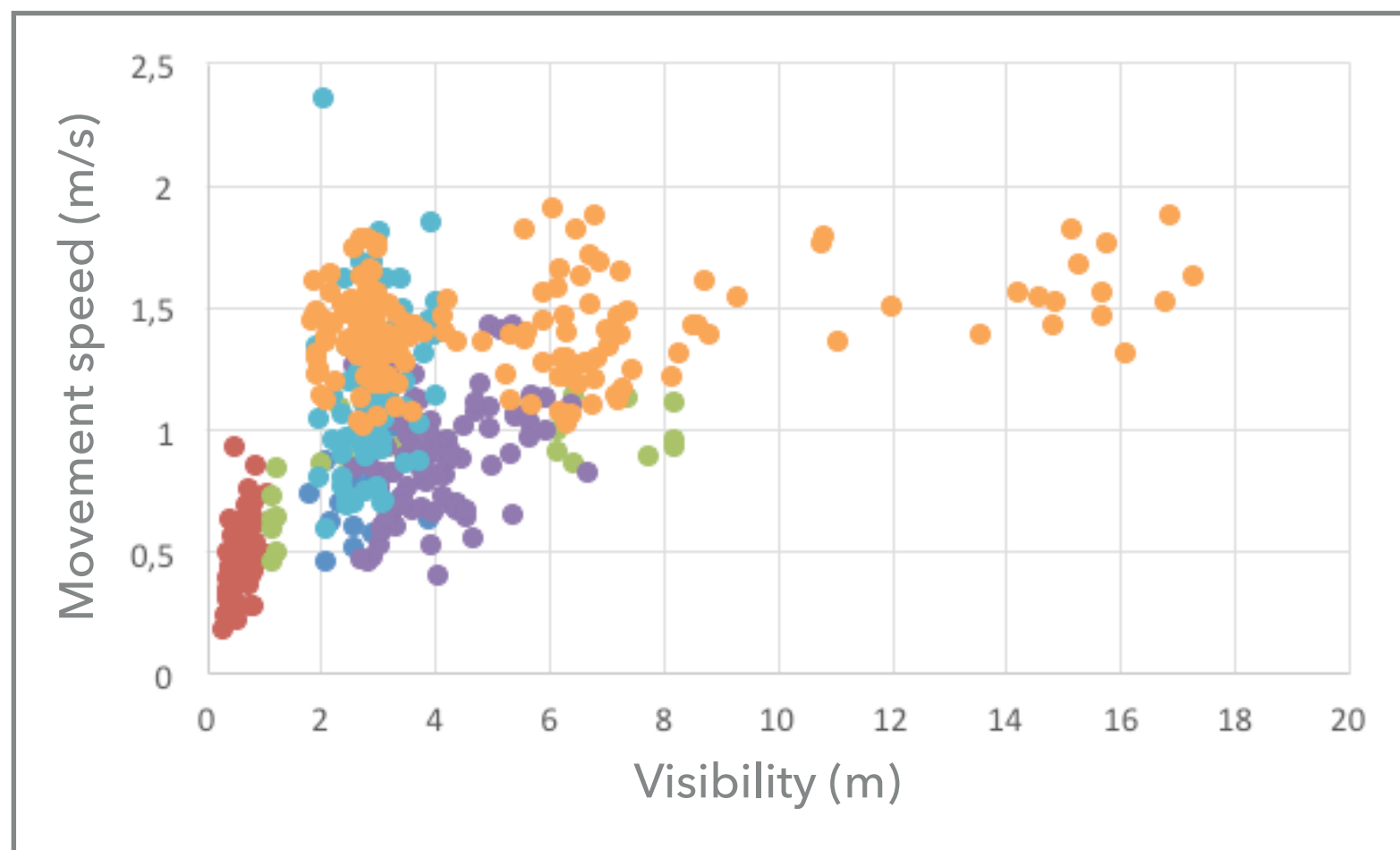


PAST RESEARCH

- ▶ ...but, is movement not governed by visibility?
- ▶ ...but, is it the same visibility if you move towards a wall or a lamp?
- ▶ Makes more sense to convert to **visibility**

PAST RESEARCH

- ▶ Fridolf, Nilsson, Frantzich, Ronchi & Arias (2016)
 - ▶ Movement speed vs. smoke density



OUTLINE

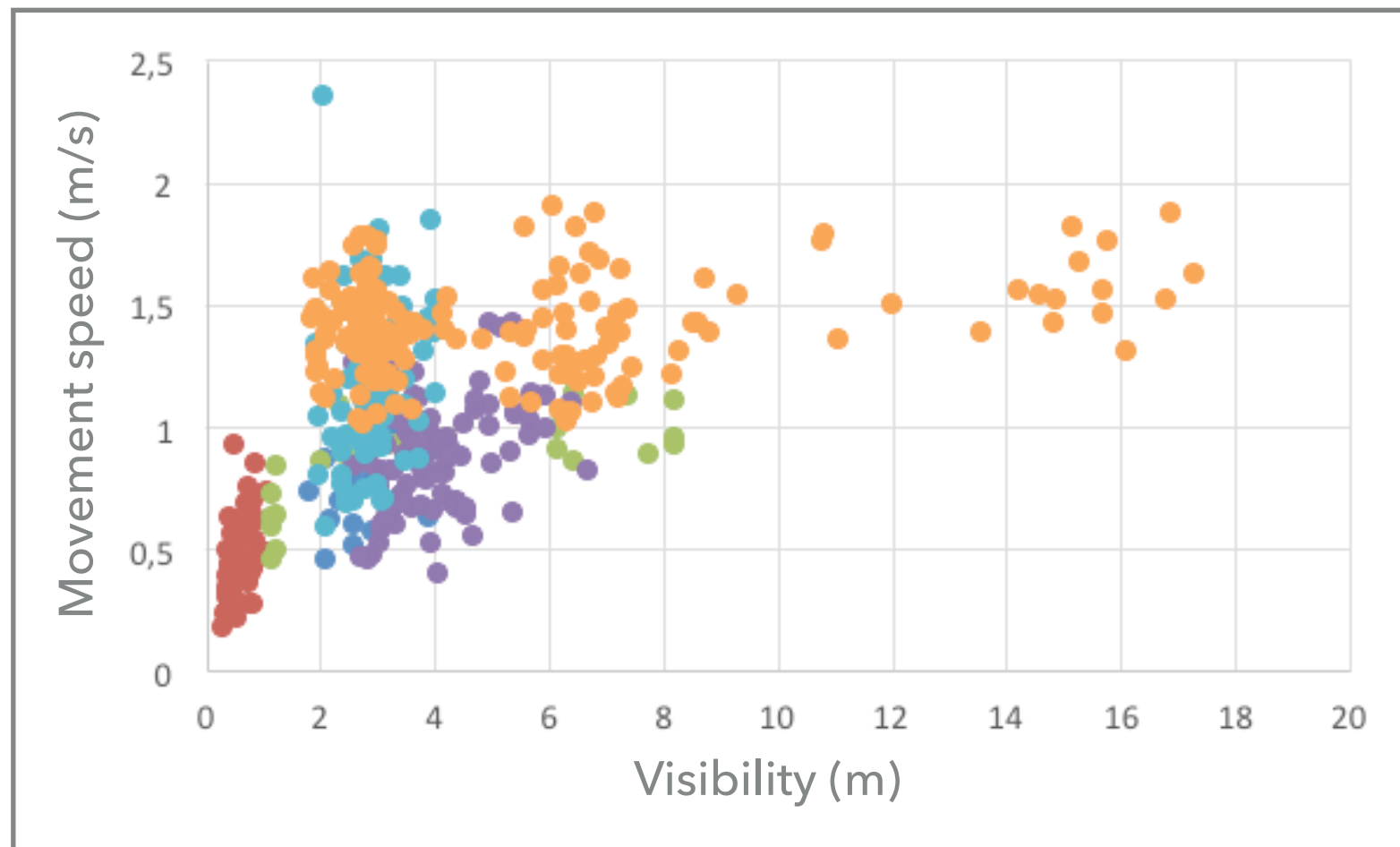
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STANDARDS DEVELOPMENT

- ▶ On-going work in ISO TC92 SC4
 - ▶ ISO/TS 21602
 - ▶ Title: "Estimating the reduction in movement speed based on visibility and irritant species concentration"
 - ▶ Objective:

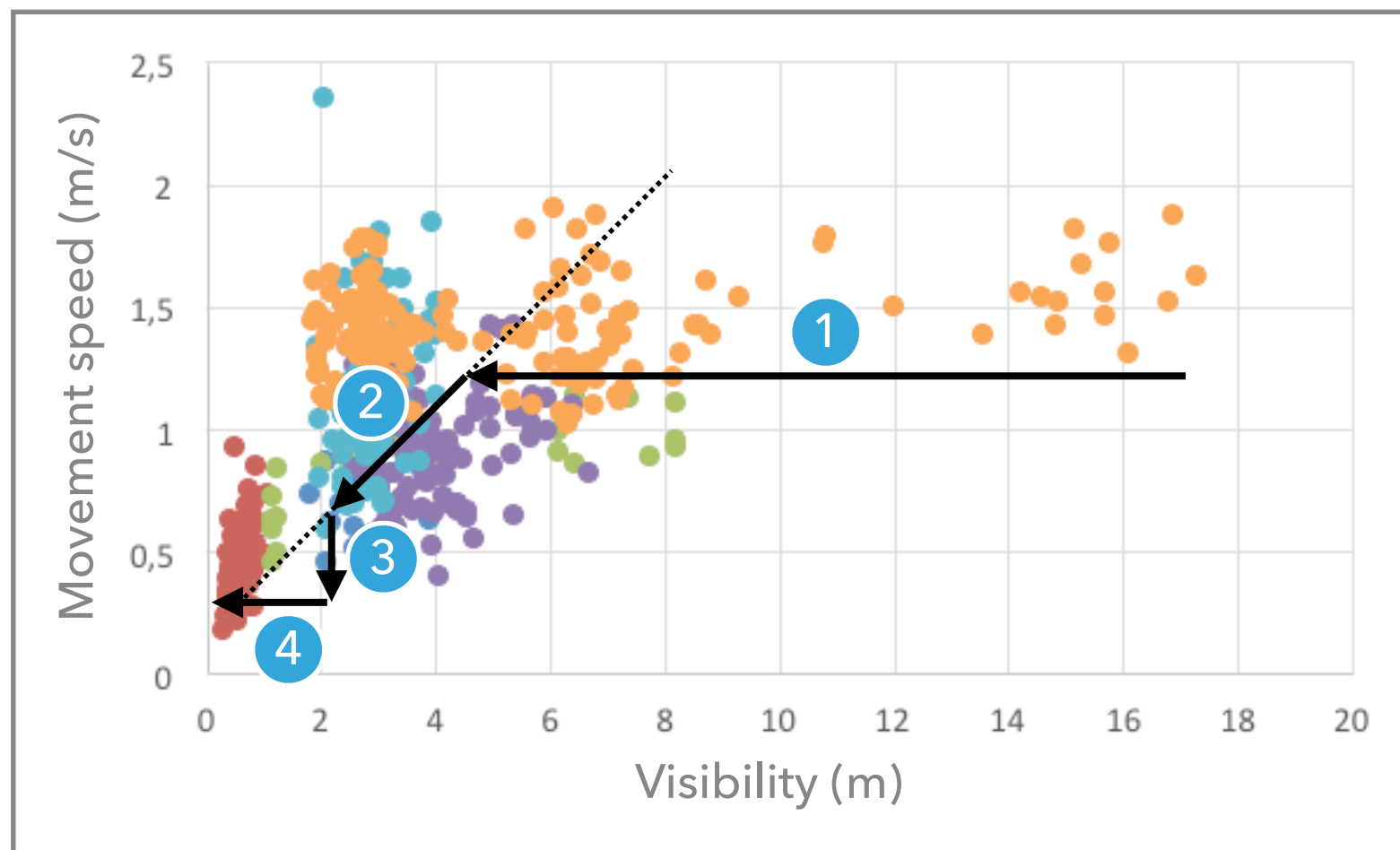
STANDARDS DEVELOPMENT

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STANDARDS DEVELOPMENT

- ▶ On-going work in ISO TC92 SC4
 - ▶ ISO/TS 21602



- 1 Unimpeded movement speed
- 2 Movement speed vs. visibility
- 3 Movement speed and irritancy
- 4 Lowest movement speed

STANDARDS DEVELOPMENT

- ▶ On-going work in ISO TC92 SC4
 - ▶ ISO/TS 21602
 - ▶ Movement speed vs. visibility
 - ▶ Method I - Deterministic approach (individual)
 - ▶ Method II - Deterministic approach (group)
 - ▶ Method III - Probabilistic approach
 - ▶ Movement speed and irritancy
 - ▶ $FEC < 0.1 \Rightarrow 0.2 \text{ m/s}$
 - ▶ FEC from ISO 13571:2012

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