Sound Exposure Levels in Non-occupational Outdoor Settings in Singapore

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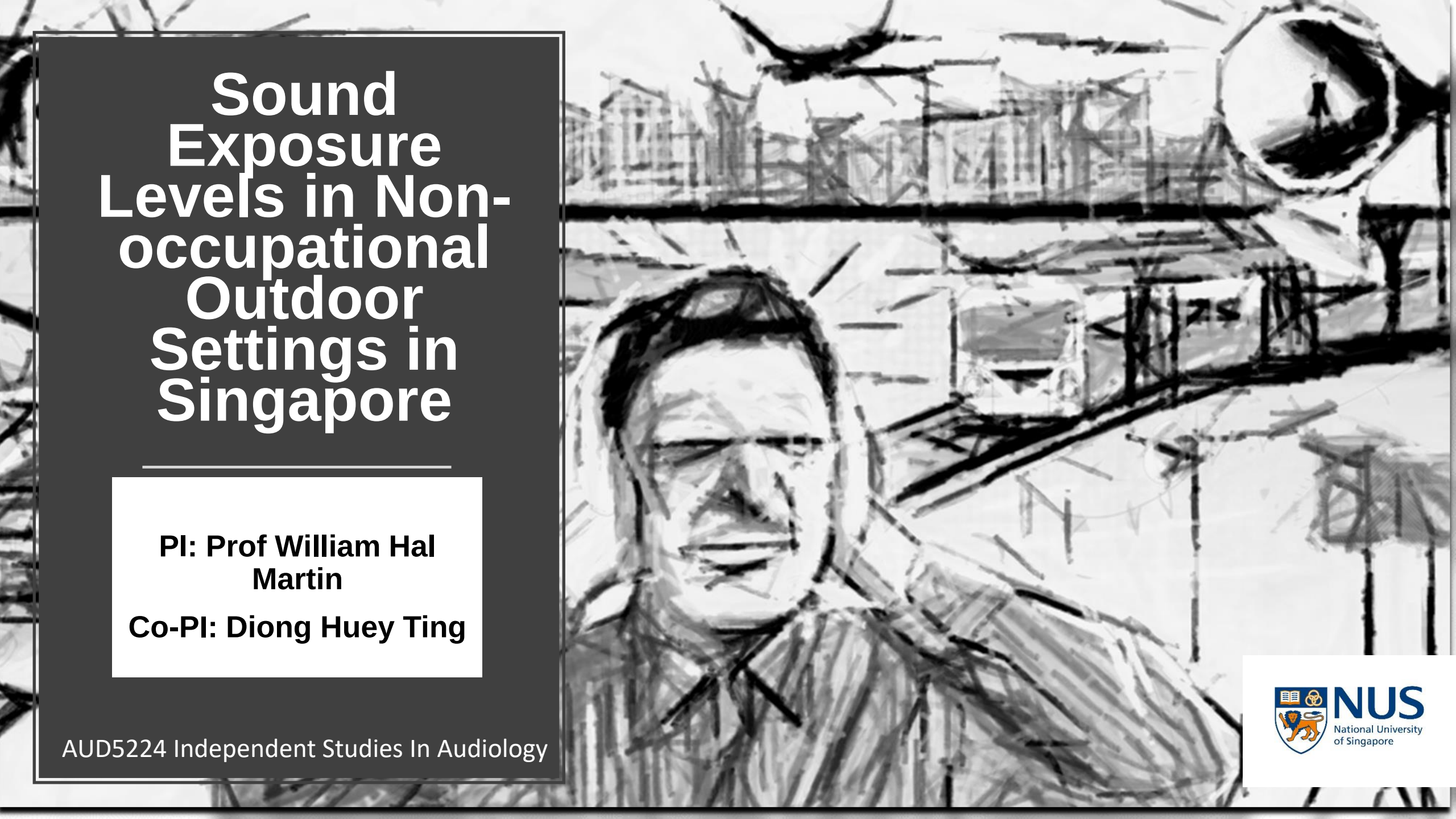
AUD5224 Independent Studies In Audiology



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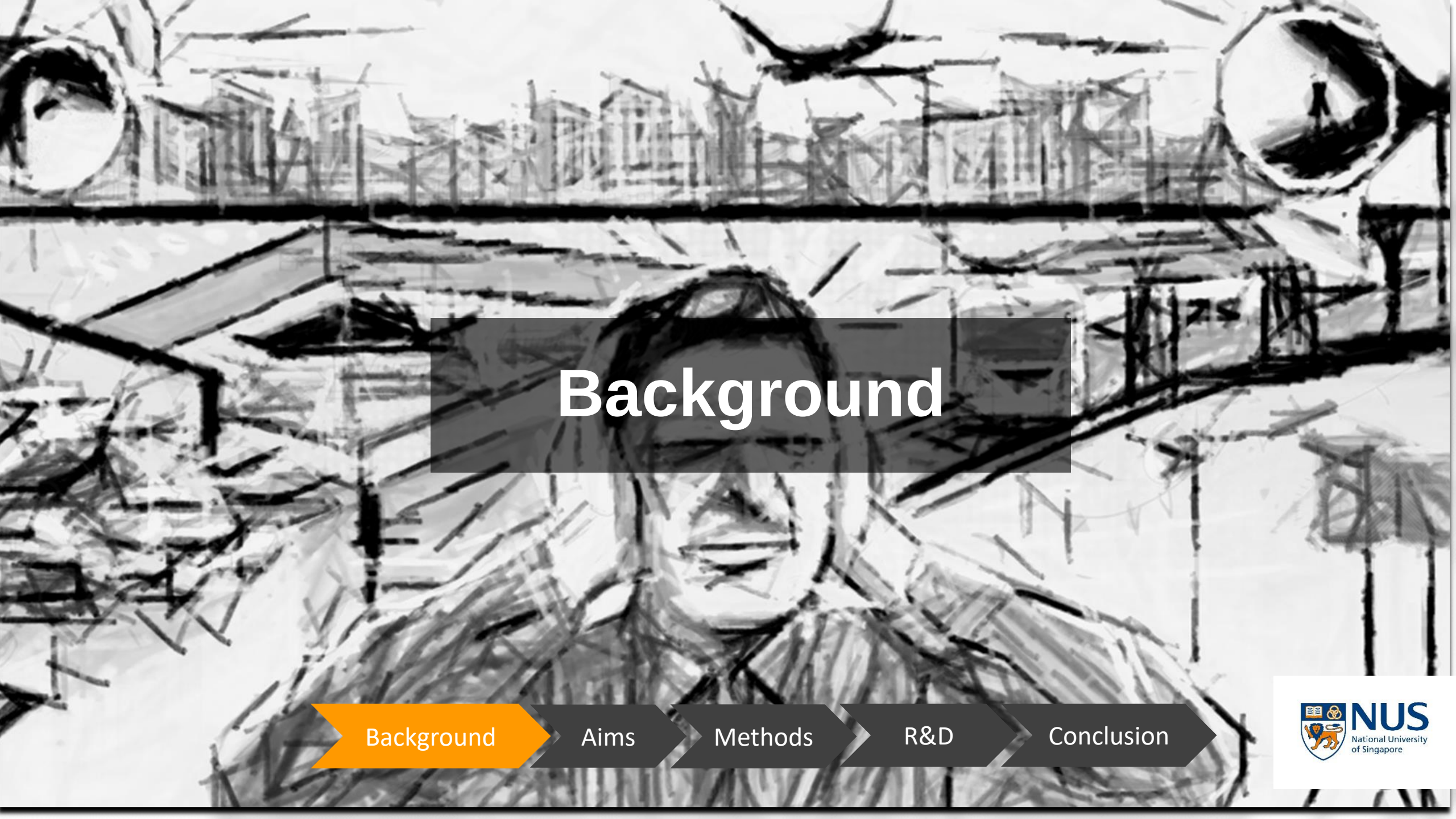

Background

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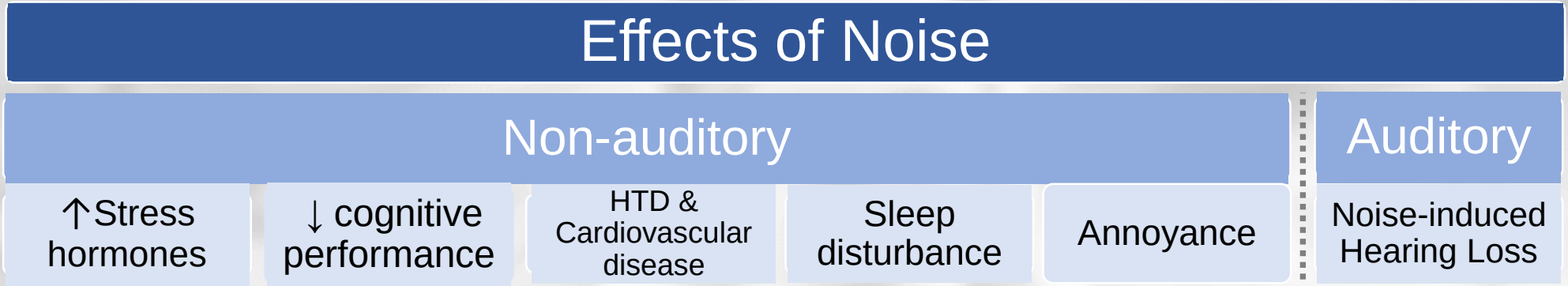
Background

- Growing evidences of short- to long-term auditory and non-auditory health effects related to noise (Basner et al., 2014)



Previous Work - Singapore

- ~4 studies have been conducted so far since 1970s

  [Sy, Ong, Tang and Tan (1985); Chng (2013); Bhanap (2013); [Alam, Eang, Tan, & Tiong (2010)]

- Data from these studies are costly to obtain & limited in numbers

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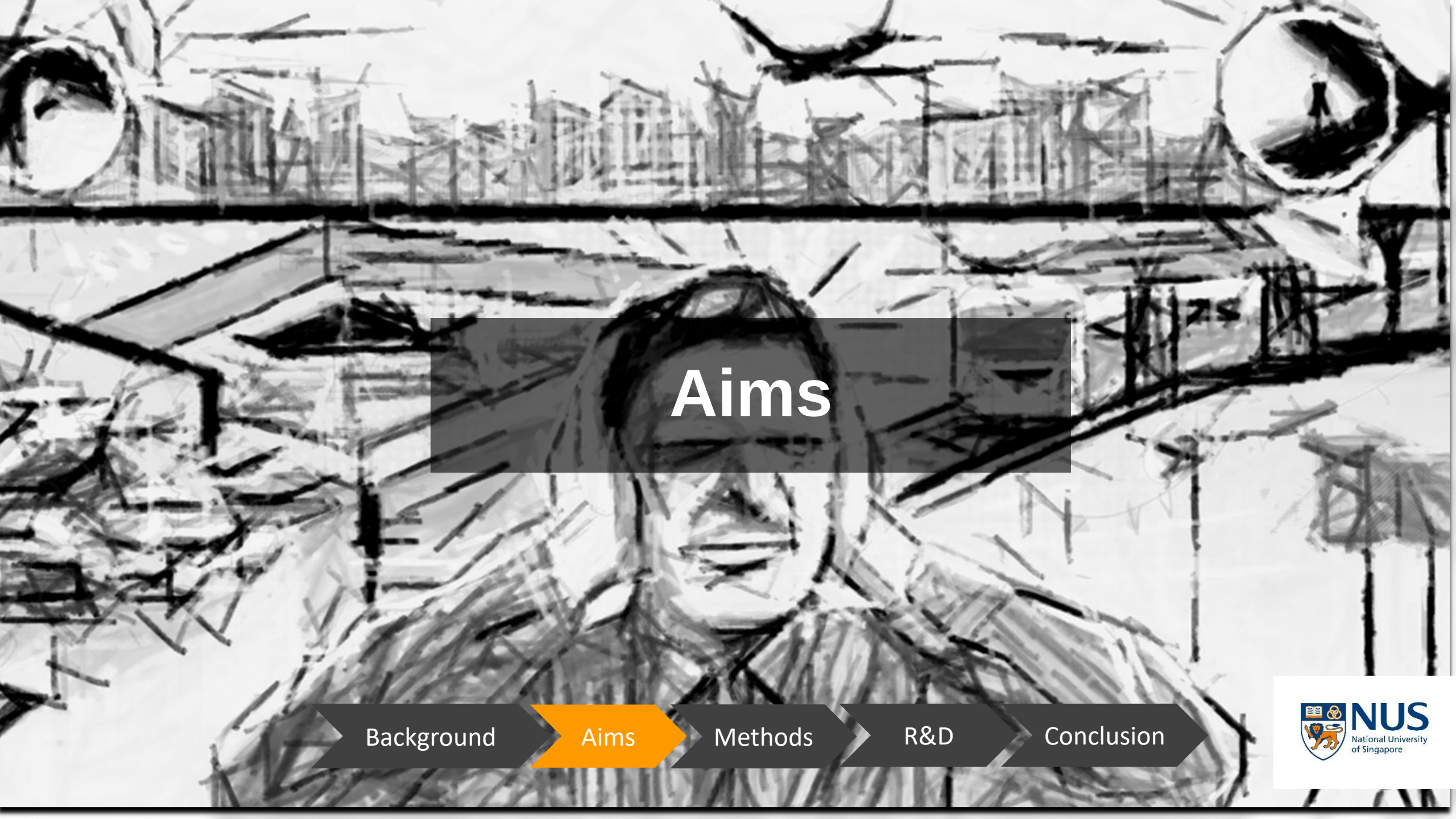
Participatory Sensing

- Participatory sensing – Idea was first introduced in 2006 (Burke et al., 2006)
- Quick and efficient way to collect environmental data
- Highest mobile penetration rate in the world (Kahn, 2014)
- Could be used in Singapore??



Aims

Background | Aims | Methods | R&D | Conclusion

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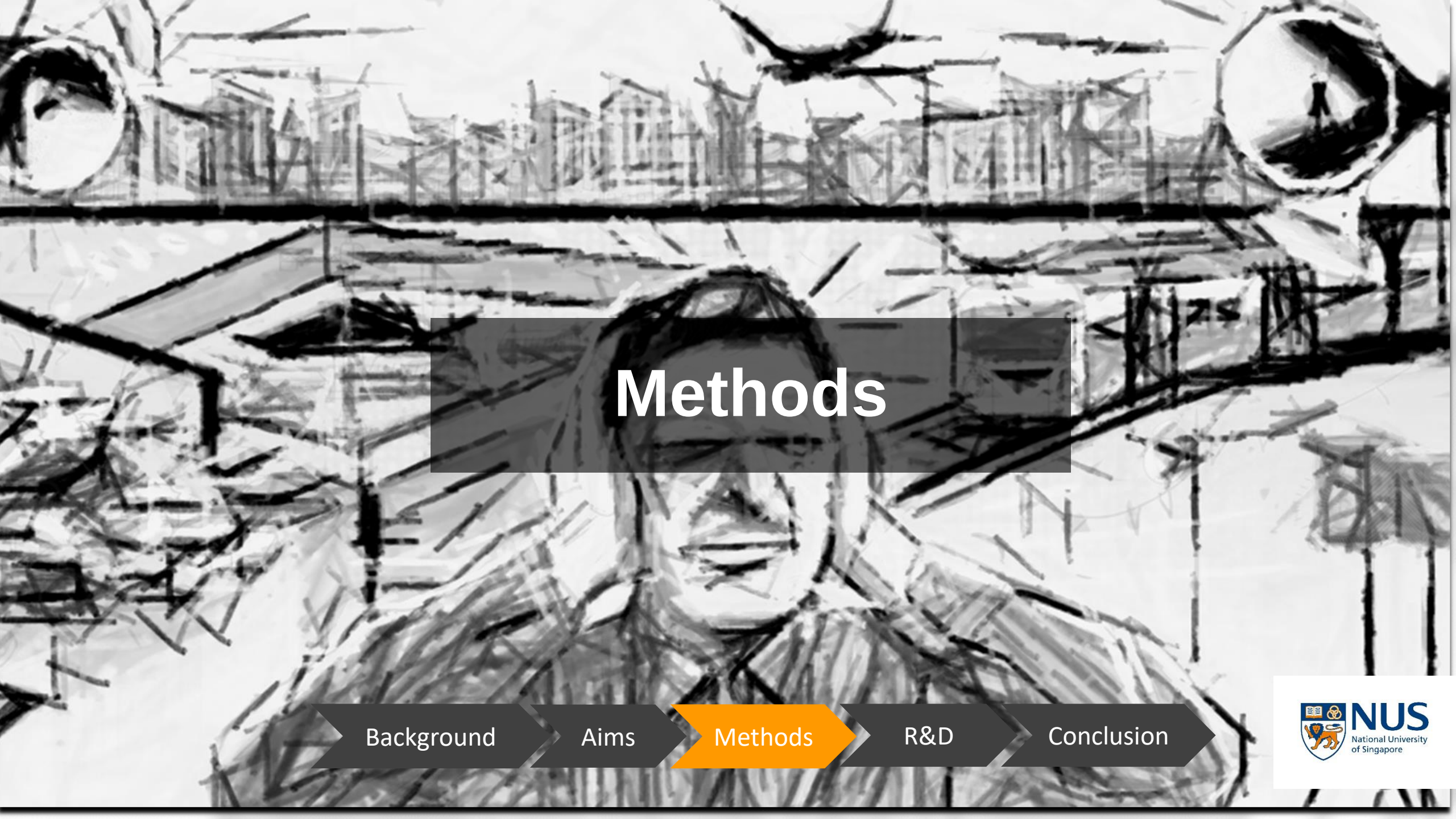
Main Aims

1) To gather information on outdoor sound levels around Singapore with the use of mobile application.

2) To identify general trends in the collected data & compare local outdoor sound levels to relevant **health standards** to evaluate the extent and impact of noise locally.



Methods

Background | Aims | Methods | R&D | Conclusion

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Methods

Part 1

Application evaluation

- Measured in dBA + GPS locations
- Free & Updated
- Precision & accuracy close to Type II SLM

AMBICITI

Part 2

Recruitment

- Aged 21 years old and above
- Good mobility
- Usage of iPhone with iOS v8.0 or later

52 Participants

Part 3

Calibration

- 3M NoisePro Dosimeter

- Average bias value for common models

Part 4

Data Collection

- Communication with participants

Google Hangouts

- Collection of measurements ($L_{AEq,30\ sec}$)

Gmail

Part 5

Data Analysis

- Categorising data points
- Interpolation

QUANTUM GIS

- Statistical data analysis

RStudio

SPSS

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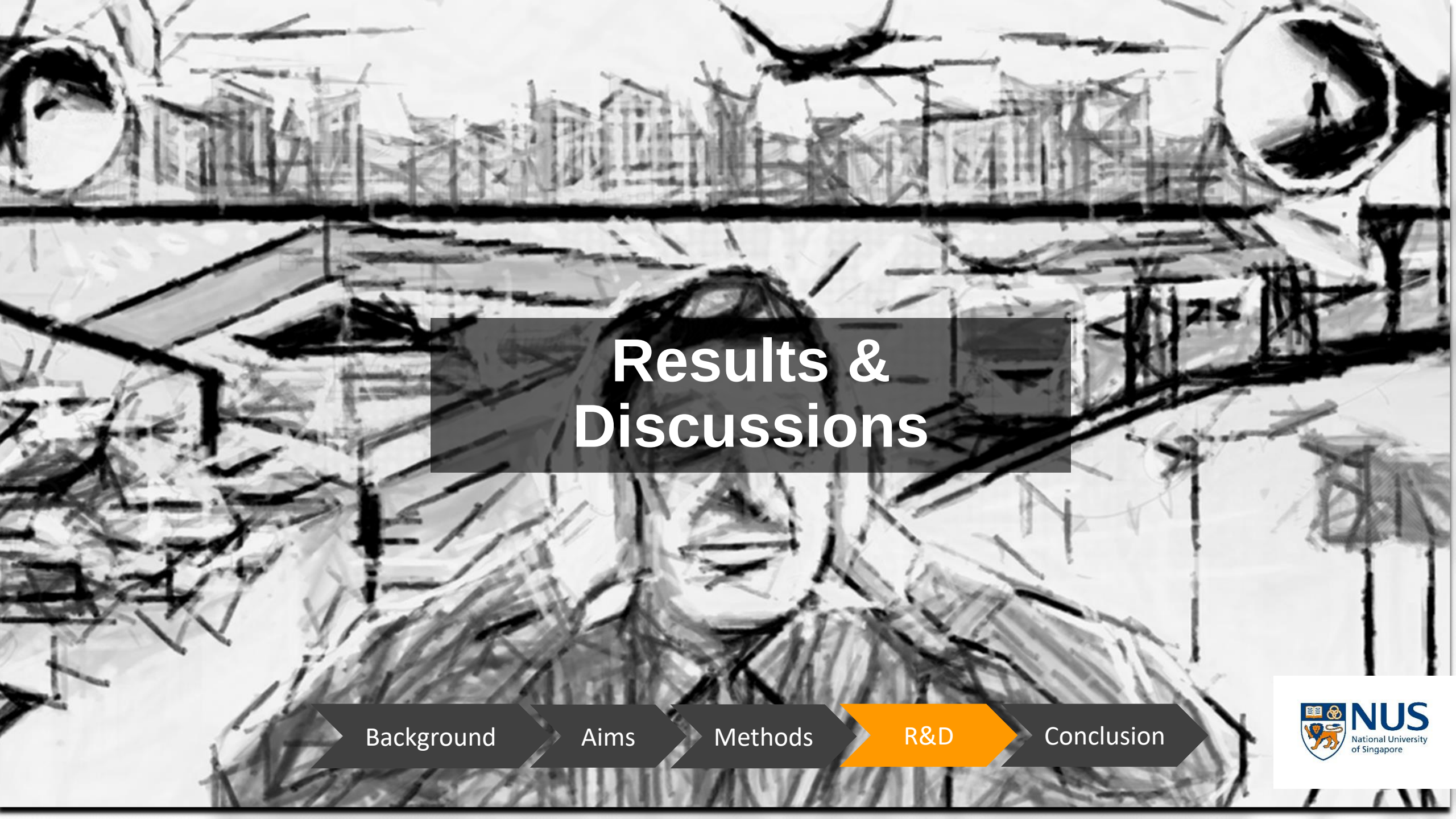

Results & Discussions

Background | Aims | Methods | R&D | Conclusion

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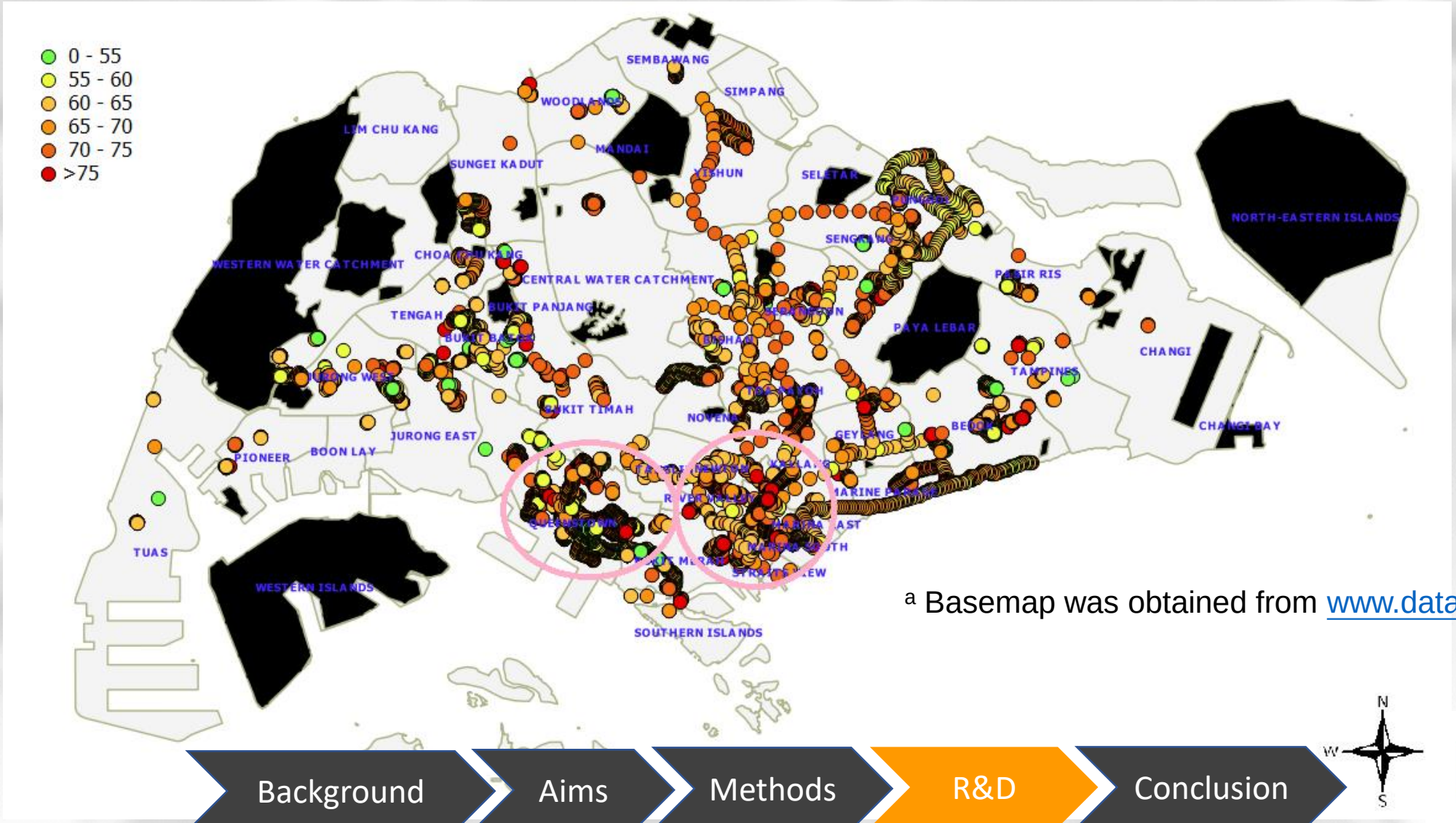
Results

18,768 measurements over 2.5 months



[a] Basemap was obtained from www.database.gov.sg

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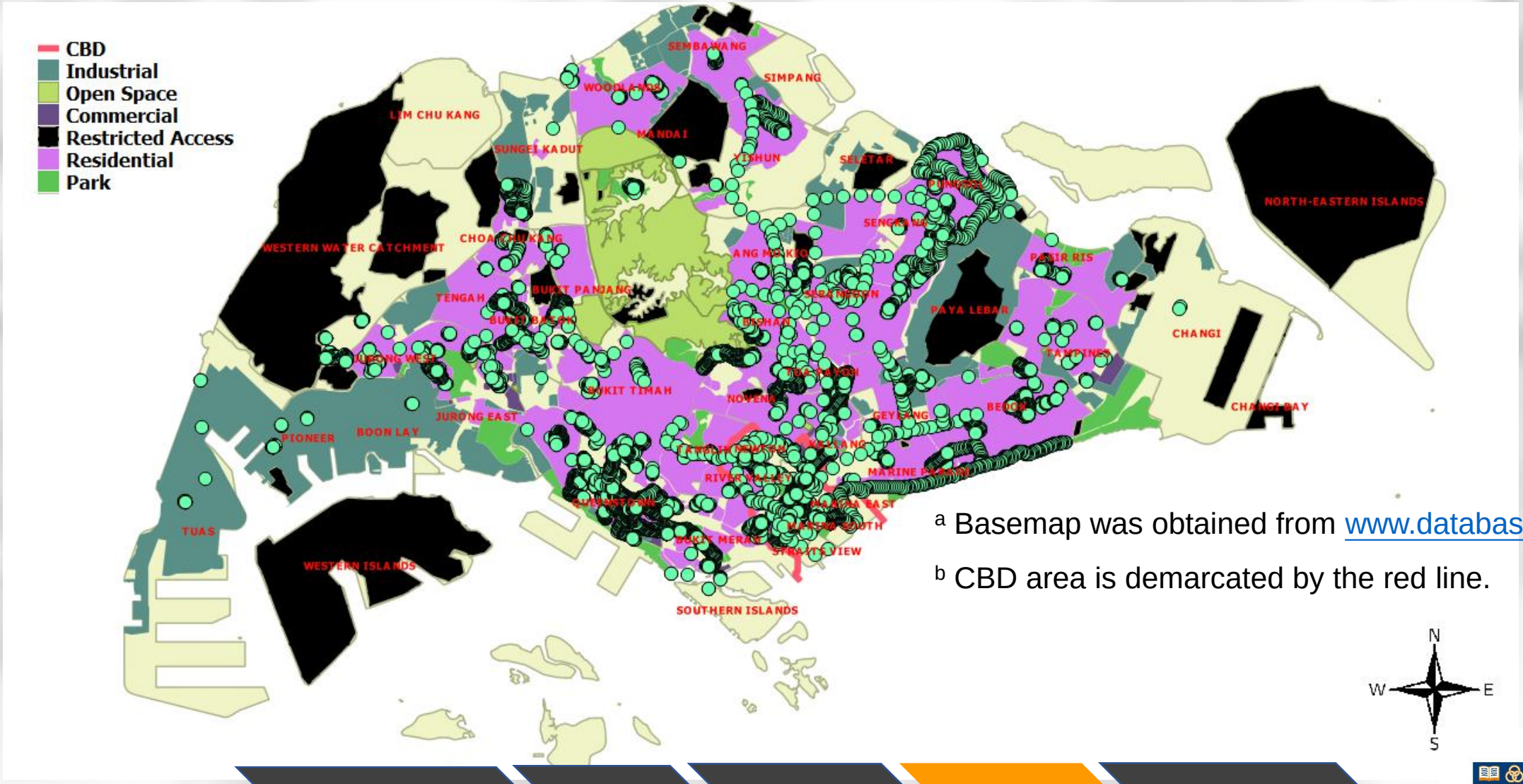
Results – Land use



[a] Basemap was obtained from www.database.gov.sg

[b] CBD area is demarcated by the red line.

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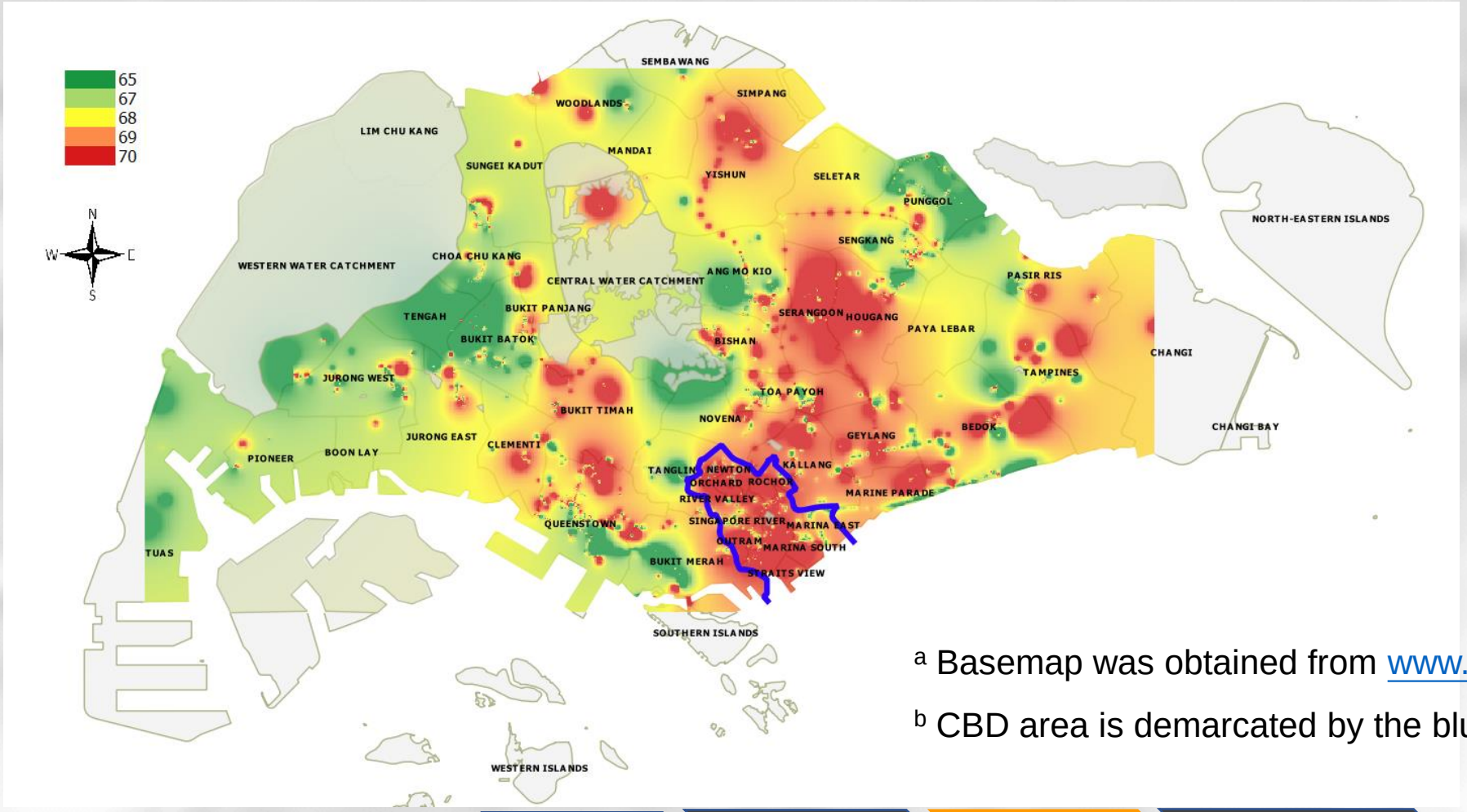
Results – Interpolation by inverse-distance weighted (IDW) method



[a] Basemap was obtained from www.database.gov.sg

[b] CBD area is demarcated by the blue line.

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Guidelines & Regulations

Organisation	Critical health effects	L_{Aeq} (dBA)	Time base (hours)
WHO – Guidelines for community noise	Moderate annoyance	50	16
	Serious annoyance	55	16
	Hearing Impairment	70	24

	Regulation	L_{Aeq} (dBA)	Time base (hours)
National Environment Agency (NEA) Singapore	Construction noise around residential & commercial area	75	12
	Industrial noise around residential and commercial area	65 (residential) 70 (commercial)	12

Results

- ~ 92% of the measurements exceeded the established guideline limit established by World Health Organisation (WHO) for serious annoyance (i.e. 55 dBA for 16 hours).
  - In EU, 40 % of the population exposed to traffic noise at levels exceeding 55 dBA (Berglund, Lindvall, & Schwela, 1999).
- ~ 27% of the measurements exceeded the limits for hearing impairment based on the guideline level of 70 dBA for 24 hours set by WHO (0% excess risk).

Current study	Measured mean (Std. Dev.) / dBA	N (%) of measurements ≥ 55 dBA	N (%) of measurements ≥ 70 dBA
Overall	69.4 (6.8)	17308 (92.2)	5034 (26.8)
North region	66.3 (6.0)	935 (90.8)	124 (12.0)
North-east region	69.9 (7.3)	1960 (93.4)	637 (30.5)
East region	69.8 (7.9)	1427 (88.5)	74.5 (28.0)
West region	67.8 (6.6)	3525 (84.7)	656 (15.8)
Central region	70.0 (6.4)	9294 (94.1)	3086 (31.3)

Results

- ~57% of the monitored points exceed the 65-dBA sound level limit in the current available regulations in Singapore (i.e. industrial noise around residential area)
  - In EU, 20% of the population was exposed to levels exceeding 65 dBA during daytime (Berglund, Lindvall, & Schwela, 1999)

- 5 out of 10 of the noisiest planning zones (i.e. Orchard, Outram, Marina South, Downtown Core, Rochor) are in the CBD area in the Central region of Singapore while the remaining 5 were in the residential zones.
  - Comparable to another study in Tainan, Taiwan (Tsai, Lin and Chen, 2009)

Limitations

Small number of participants	• Affects: - Spatial resolution (coverage area) - Temporal resolution (noise fluctuation throughout the day)
Sound quality	• App does not collects the sound spectrum of the noise → **sharpness, fluctuation strength and roughness**
Saturation of iPhone microphones (>80 dBA)	• Underestimates area with sound levels more than 80 dBA → Limits the assessment of the auditory impact of noise

Conclusion

- The effect of noise pollution affects local residents to a large extent
  - A big proportion of the population (~92%) may potentially suffer from serious annoyance (assuming consistent levels measured at each point) → More actions need to be taken!!

- Results from this study indicate the suitability of mobile application as a potential means to fill the gap in outdoor noise levels around Singapore

Future work

- **Night time noise**
  - Effects of night time noise exposure are more severe than day time (WHO, 2009)

- **Vertical noise propagation**
  - To investigate the effects of noise for residents living at higher storeys

Acknowledgement

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All classmates ☺

THANK YOU!


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Reference

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Q & A


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