INNOVAIR
VTI INTRODUCTION

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The Swedish National Road and Transport Research Institute (VTI)

VTI is an independent and internationally prominent research institute commissioned by the Swedish Government. Our principal task is to conduct research and development related to **infrastructure**, **traffic** and **transport systems**.

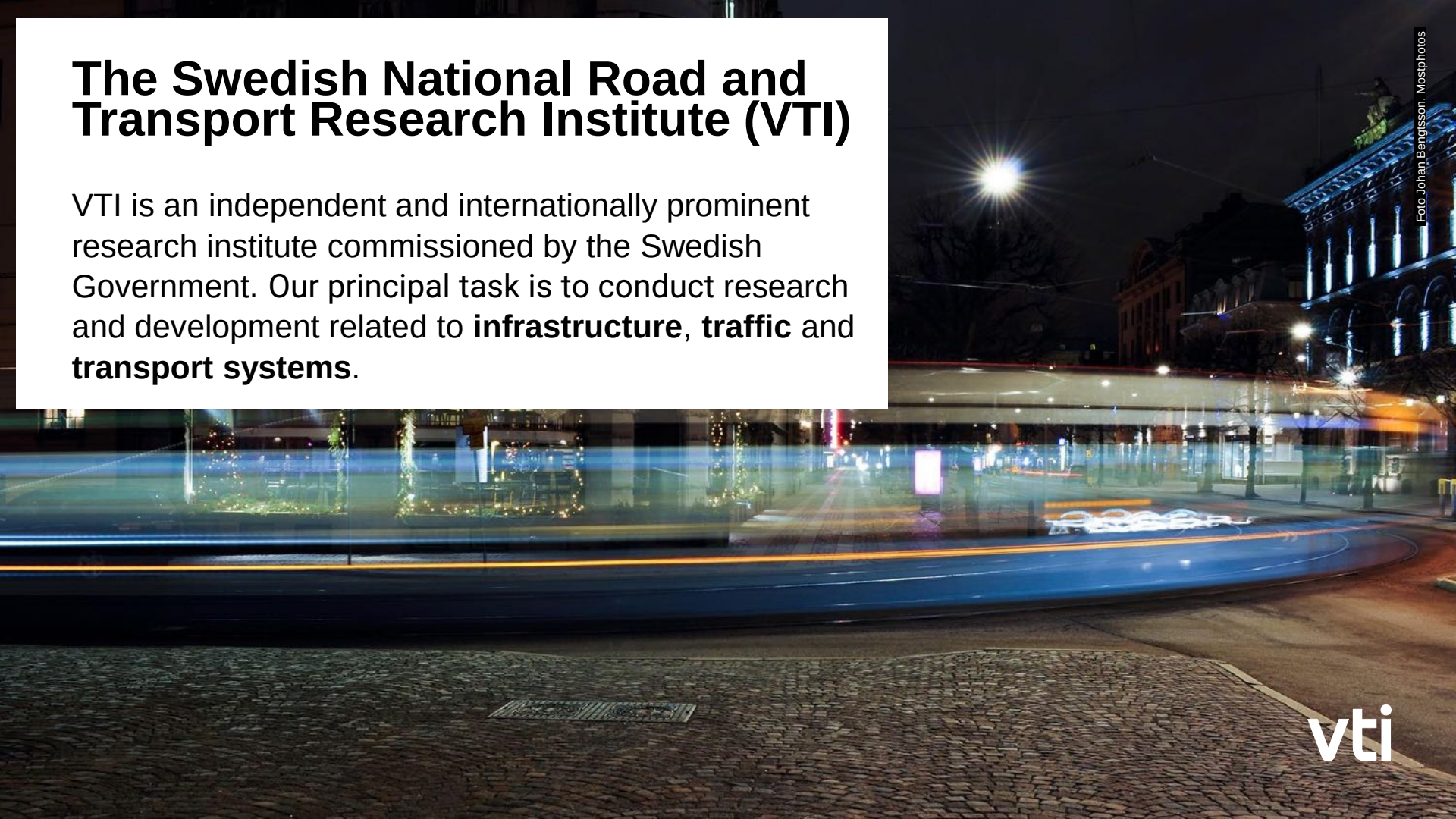

Foto Johan Bengtsson, Mostphotos

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We have approximately 230 employees in several locations around Sweden: Linköping, Gothenburg, Stockholm, and Lund

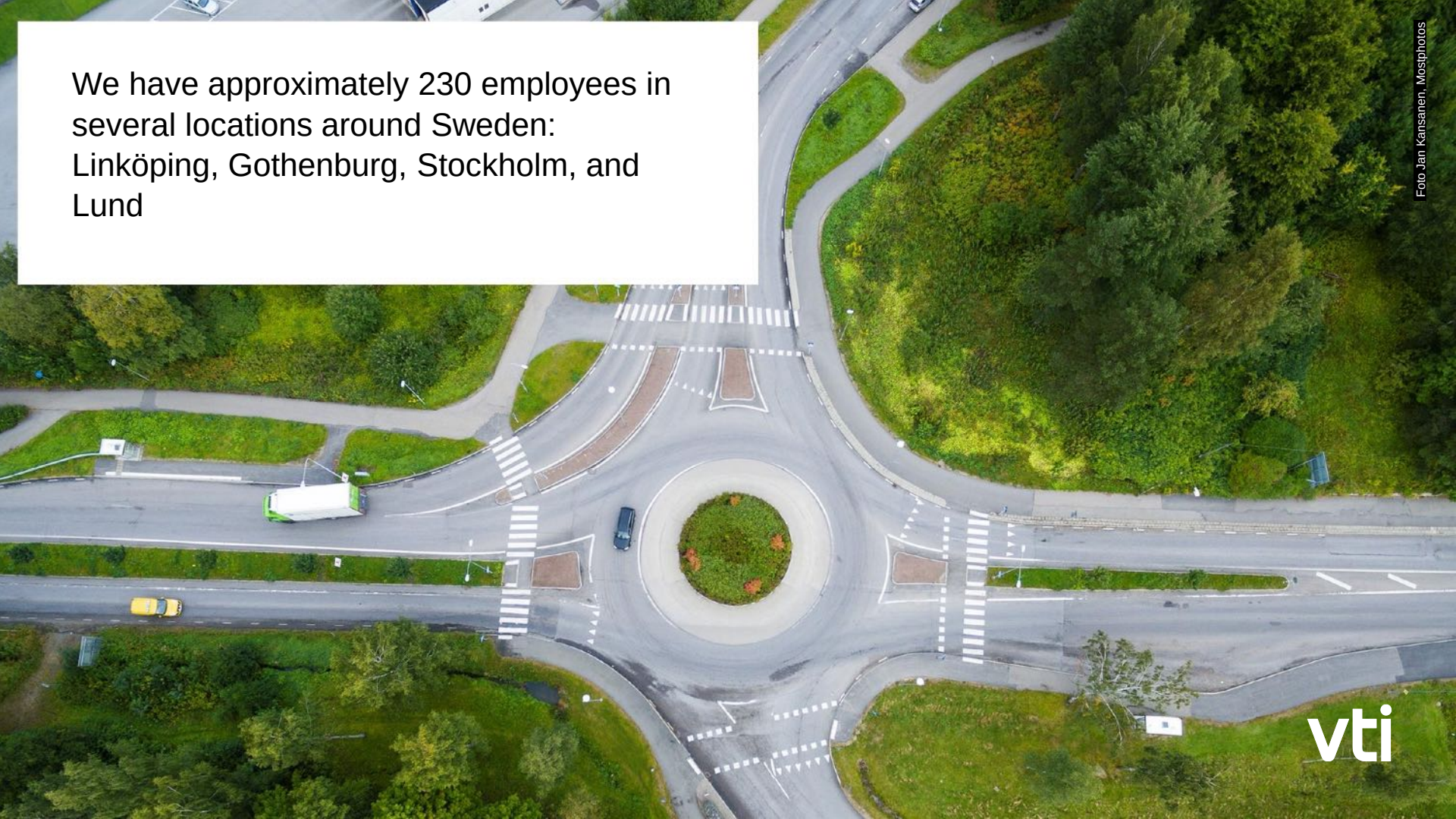

Foto Jan Kansanen, Mostphotos

High level of expertise in many disciplines: More than half of our employees within Research & Development have a doctoral or licentiate degree

OPERATING PRINCIPLE

- VTI is a broad-based and customer-oriented institute for internationally prestigious research
- VTI continuously improves knowledge of the transport sector in order to secure an effective and sustainable provision of transport services in the long term
- VTI works on commission within both private and public sector
- VTI operations cover all modes of transport

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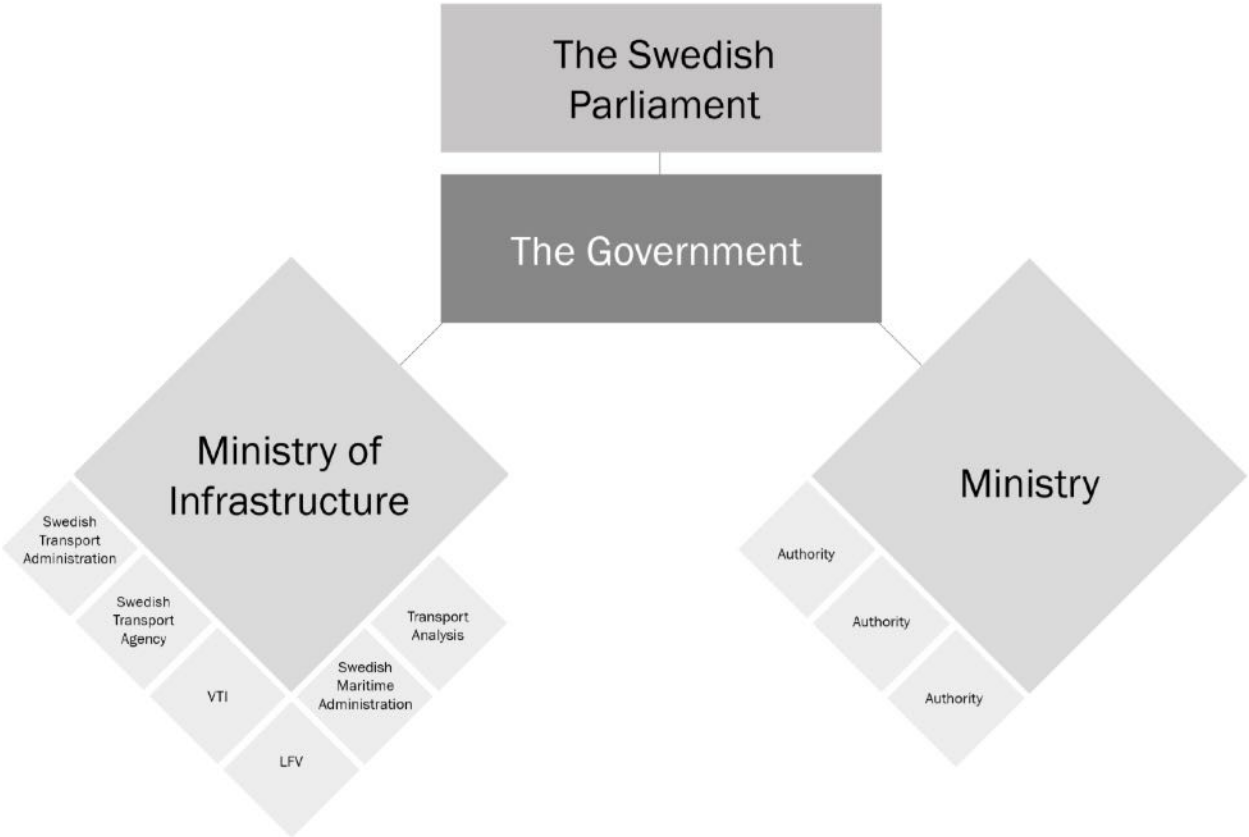
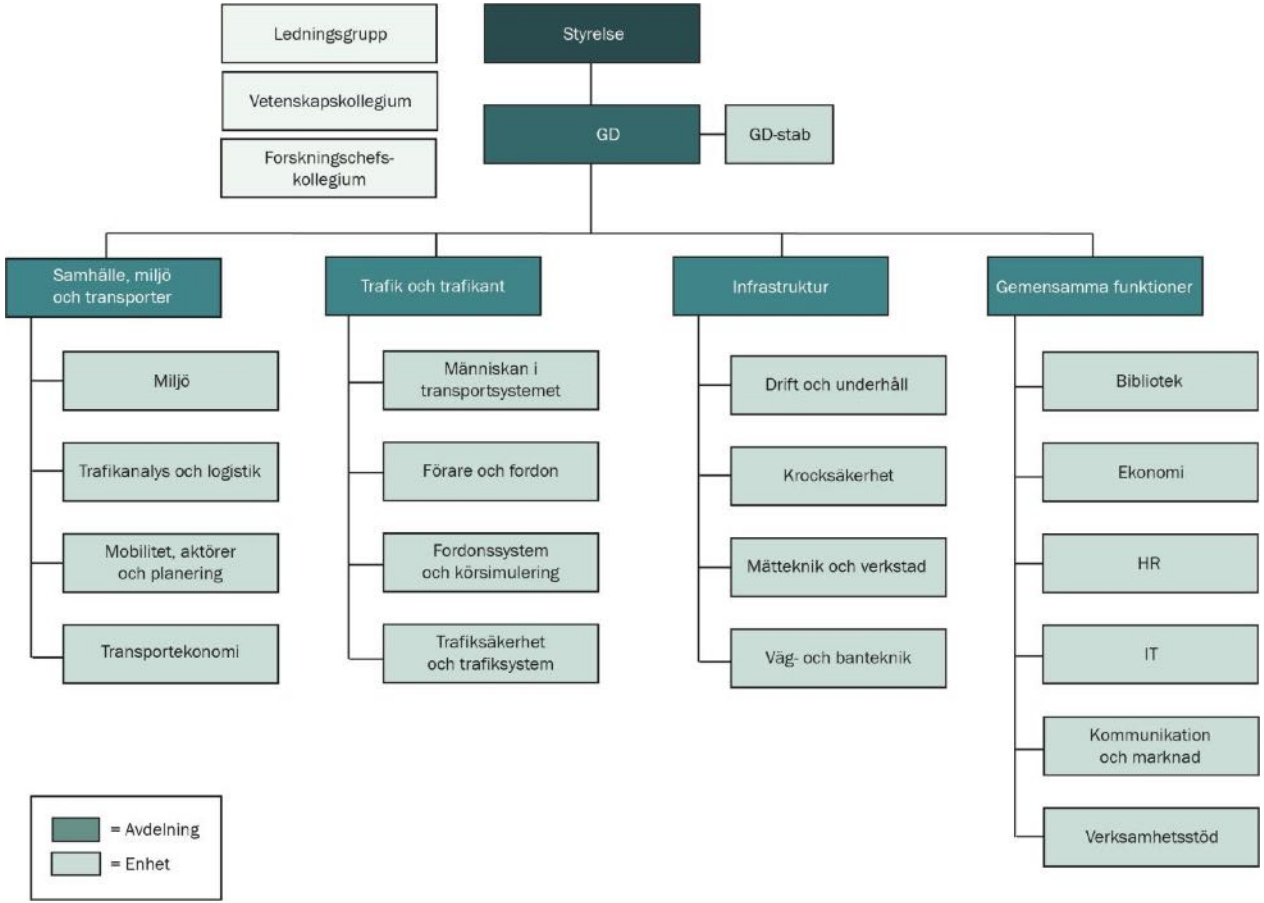
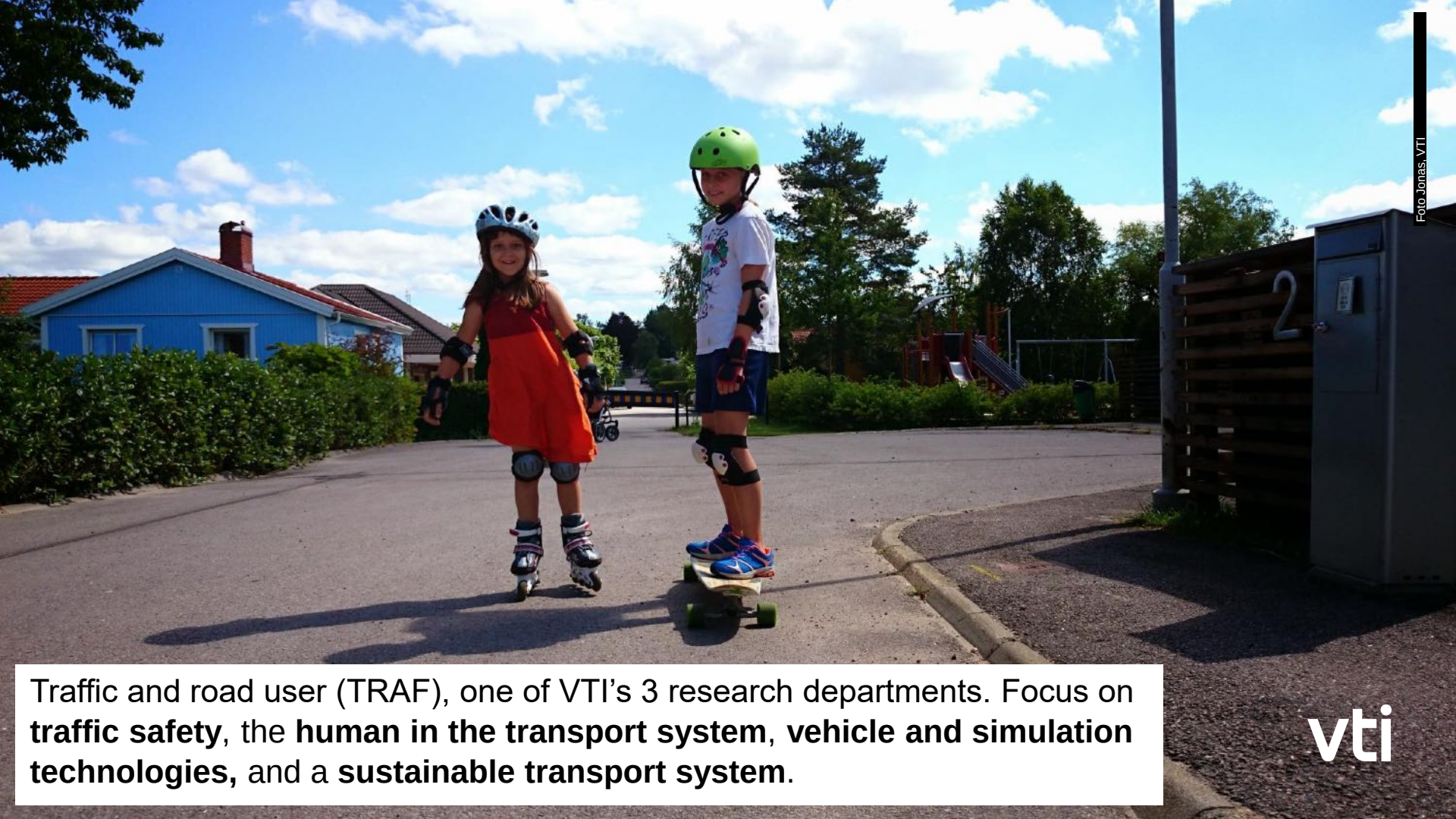
ORGANISATION

THE SWEDISH PARLIAMENT, GOVERNMENT AND AUTHORITIES



ORGANISATION





Traffic and road user (TRAF), one of VTI's 3 research departments. Focus on **traffic safety**, the **human in the transport system**, **vehicle and simulation technologies,** and a **sustainable transport system**.

TRAFIK OCH TRAFIKANT (TRAF)

Trafiksystem och trafiksäkerhet (TST)

Människan i transportsystemet (MTS)

Fordonssystem och körsimulering (FSK)

Förare och fordon (FOF)

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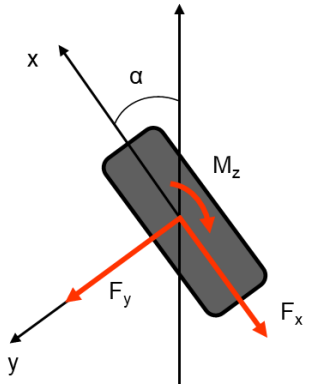
VEHICLE SYSTEMS & TECHNOLOGY

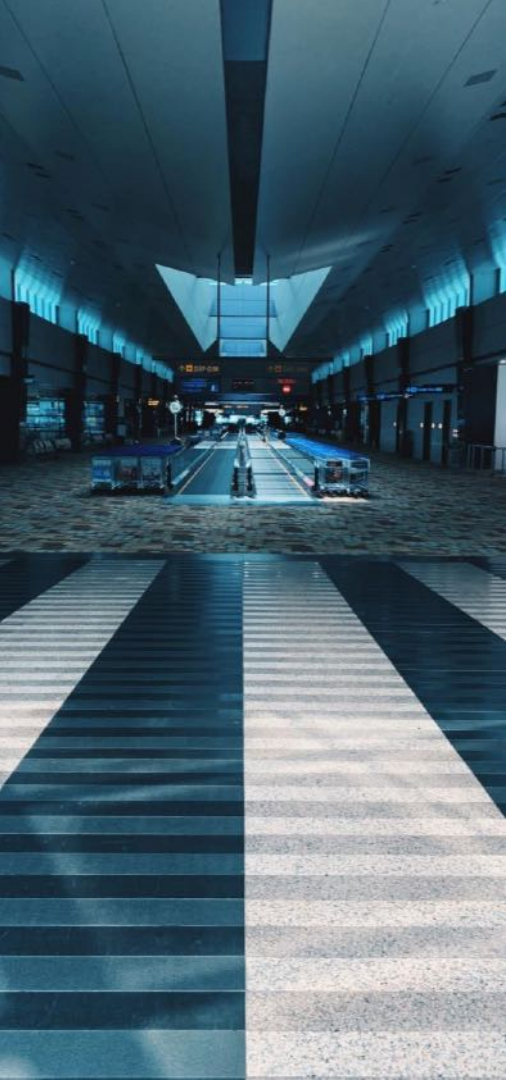
- Vehicle dynamics
- Electrification
- Autonomy, automated driving, and teleoperation
- Active safety
- Tyre and road interaction
- Train, railway, and signals
- Intelligent Transportation Systems (ITS) and Systems-of-Systems



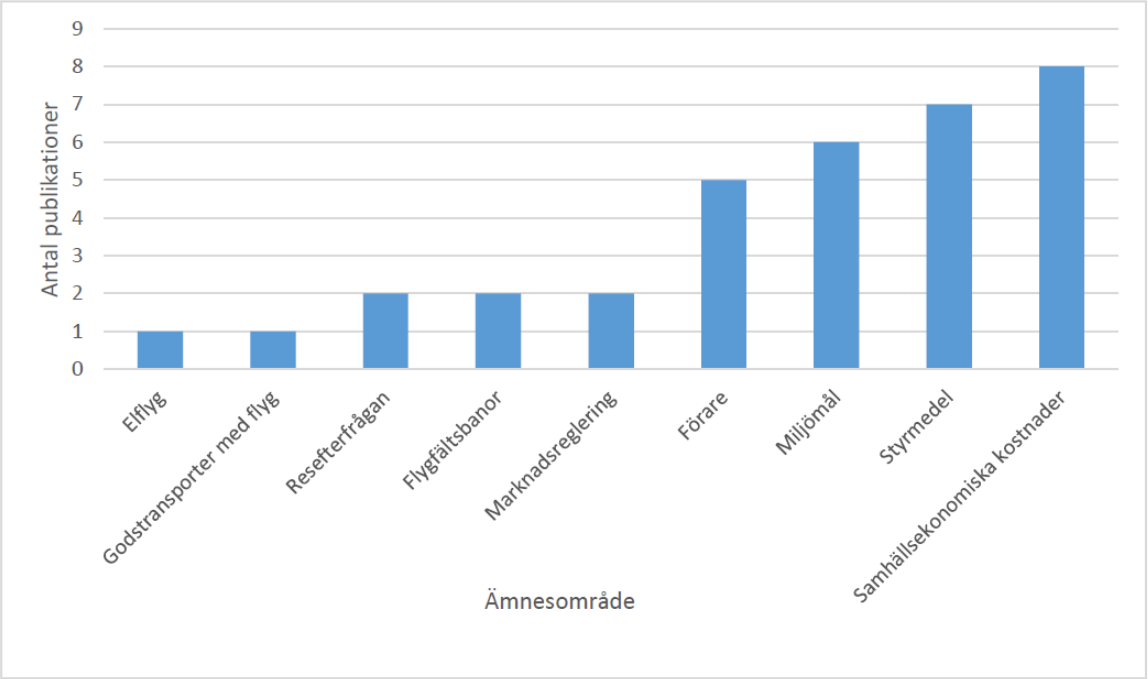
SIMULATION TECHNOLOGY

- Large-scale, moving base driving simulators
- Passenger- and freight train simulators
- Small-scale, dedicated simulators
- Virtual Reality Lab
- In-house developed source code

VTI research in aeronautics and air transport systems



RELATED VTI PUBLICATIONS PER SUBJECT



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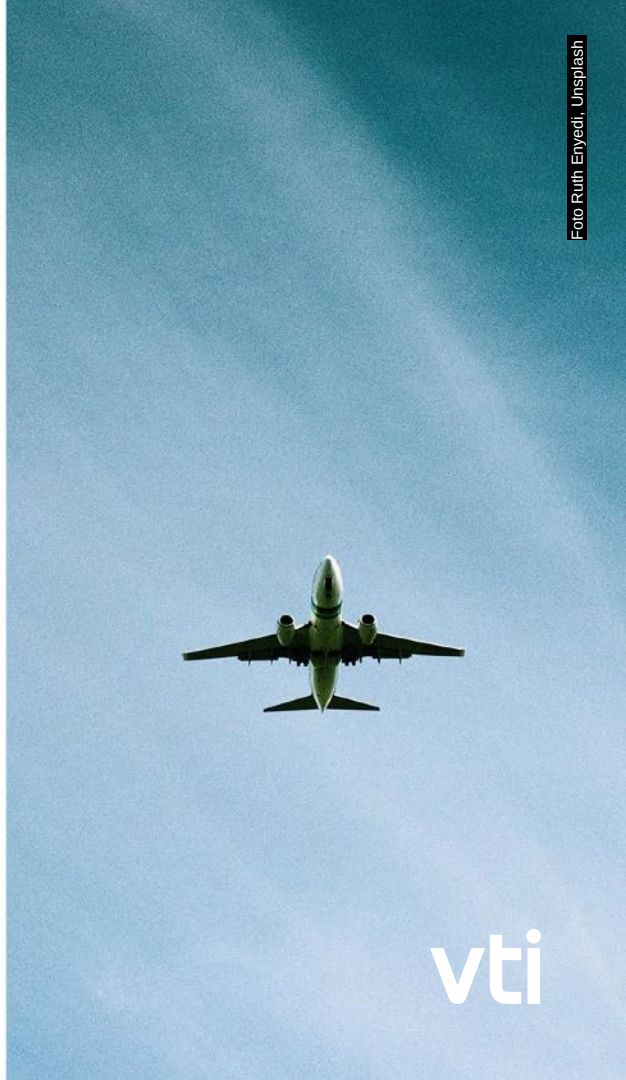
RECENT AND ONGOING RESEARCH AT VTI

- **Climate effects of domestic and international flights from Swedish airports – differentiated marginal costs (Magnus Johansson) (RU)**
  - Bottom-up calculation of CO2 emissions and high-altitude effects based on detailed flight information (~230,000 flights) 2016 and EMEP/EEA air pollutant emissions database
  - Main results comprises marginal costs to use in socio economic analysis – example:
  - Average cost (SEK) for emissions of CO2 and CO2eq high altitude effects per kilometer of flight, movement, chair, passenger and passenger-kilometer; domestic commercial flights 2016

Category	Engine type	/fkm	/flight	/seat	/pax	/pkm
CO_2	All	11,3	5 279	51	79	0,15
	Turbofan	14,7	7 926	56	83	0,15
	Turboprop	5,8	2 213	39	67	0,17
High altitude	All	4,6	2 157	21	32	0,06
	Turbofan	7,4	4 017	28	42	0,07



RECENT AND ONGOING RESEARCH AT VTI

- **Emissions from air traffic in Swedish territory and their external costs (Lena Nerhagen, Yvonne Andersson-Sköld) (RU)**
  - Calculation for air pollution from a selection of flights (pollution at different altitudes) coupled with dispersion- and exposure modelling. Main results:
  - The cost of exhaust particles during the LTO cycle is significantly higher than NOx emissions, but not always included in start- and landing charges
  - Health effects of emissions on high altitude much lower than previously calculated – lower exposure due to winds blowing emission towards the Baltic sea
- **Commercial electric flight – a dream or reality? A literature survey to the possibilities of electric flight (Johan Salomonsson, Johanna Jussila Hammes)**
  - A literature survey from 2019
- **RELISH – is electric aviation beneficial for society? (Johanna Jussila Hammes, Magnus Johansson) – ongoing (TRV)**
  - Calculations on CO2 savings, reduced high altitude effects, travel time gains/losses, changes in producer and consumer surplus, noise and other emissions from scenarios of introducing electric planes of different capacities during the period 2030 to 2050

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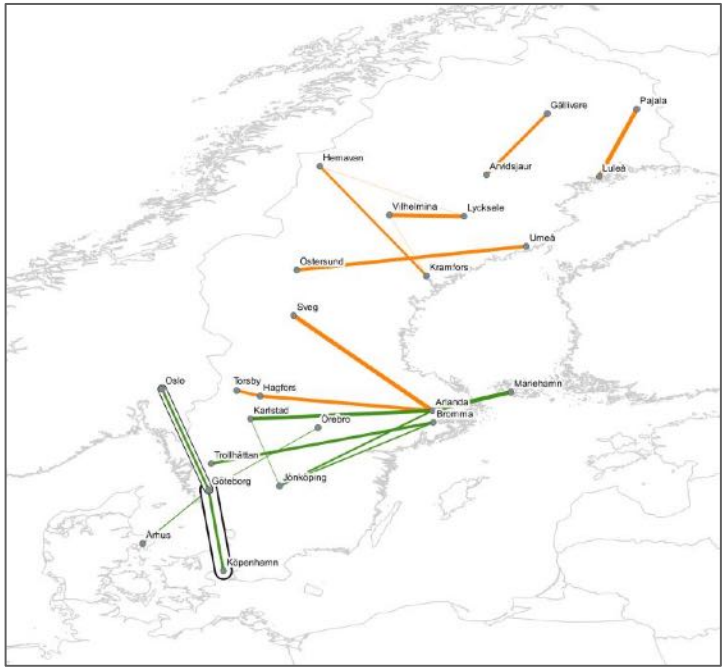
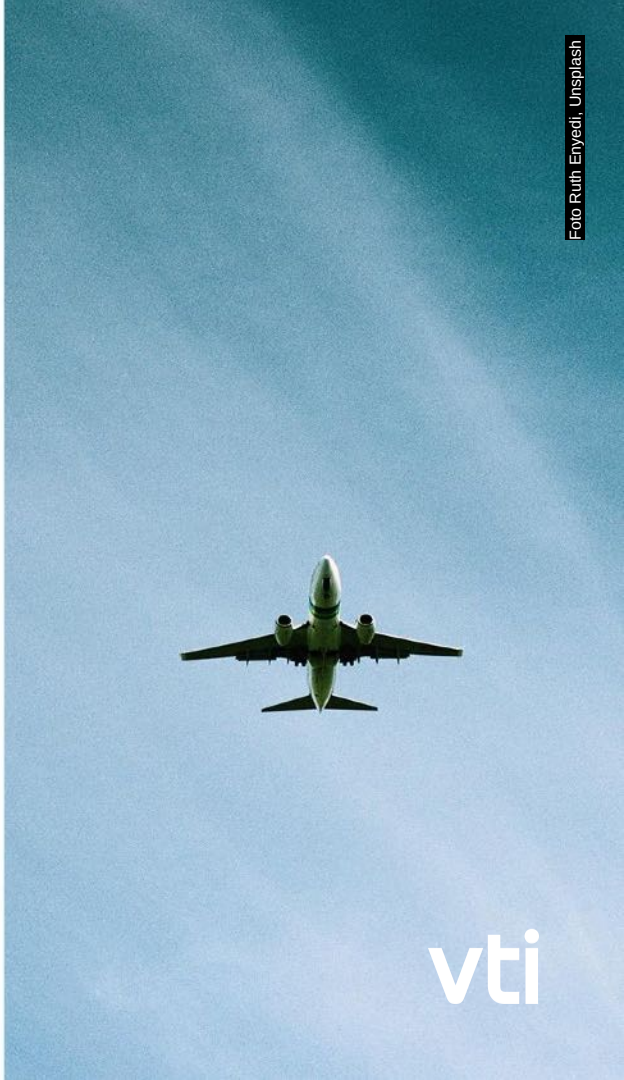
RELISH – PRELIMINARY RESULTS



Possible lines for 19-seater, 400 km range – orange lines indicate procured traffic, circled lines gives the full volume of passengers and that electric planes only covers a share of the demand

Potential to save ~ 2% of domestic CO2 + CO2ekv from high altitude effects – using a CO2 value of 1.5 SEK/kg this gives a benefit to society of around 22.2 million SEK per year

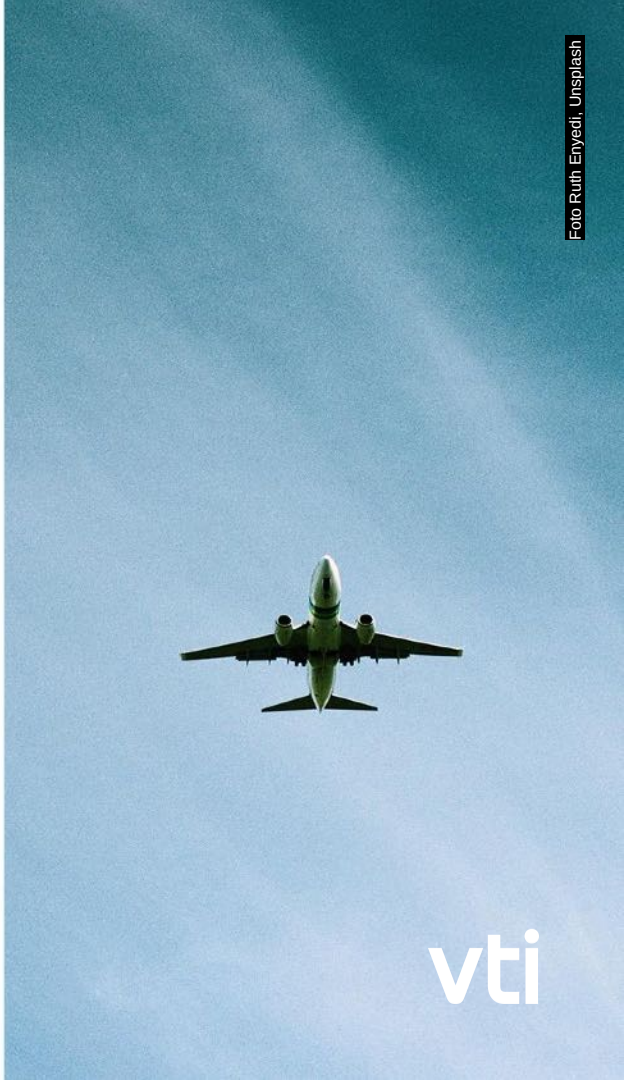
Loss in travel time is estimated to around 13.7 million SEK per year



Travel demand models for long-distance passenger transport

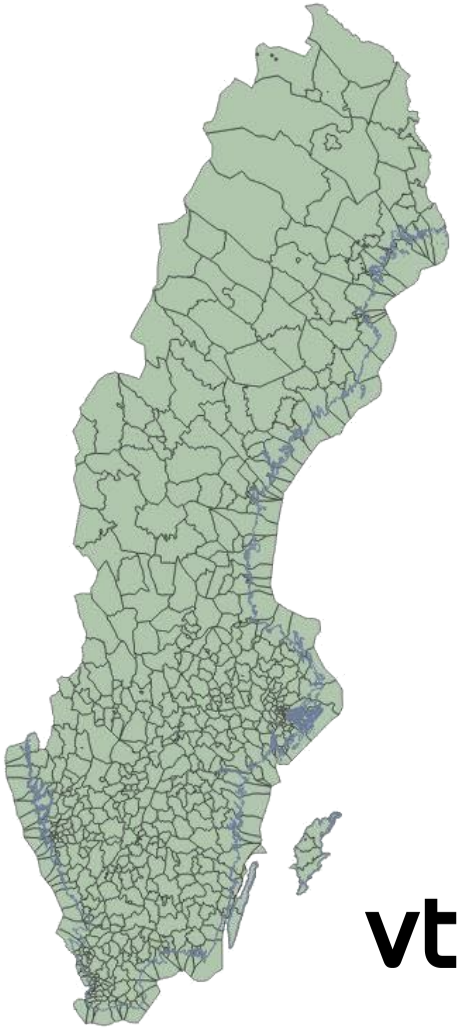
MODE CHOICE PREDICTION MODELS

- At VTI we have several projects with the aim to develop **prediction models** for traveller **mode choice** between Car, Train, **Air**, and Bus for long-distance trips (in some cases also boat). Two ongoing project examples:
  - **DEMOPAN 1+2**: Estimation of mode choice prediction model for long-distance *national* trips based on mobile phone network data.
  - **International trips**: Estimation of trip generation, mode and destination choice prediction models for long-distance *international* trips based on survey data.
- *How are these projects relevant for the air sector?* – Develop models that decision makers and others can use to **forecast future passenger-km / modal shares for air travel**.



DEMOPAN 1+2

- PhD Project (Angelica A), founded by TRV
- Response rates to travel behaviour surveys are declining → bias in results of model estimations
- Mobile phone network data has the potential to give large amounts of passive data. However there are challenges related to 1) no socio-economic information about the traveller, 2) no information about trip purpose and 3) difficult to distinguish bus and car
- The mode of the trip was identified (by LiU) at the mobile phone operators' servers using detailed antenna connection data
- The trip is identified as Air if:
    - It contains two events that are within 10 km distance to an airport
    - The distance between the two events is at least 200 kilometres
    - The straight-line travel speed is at least 200 km/h



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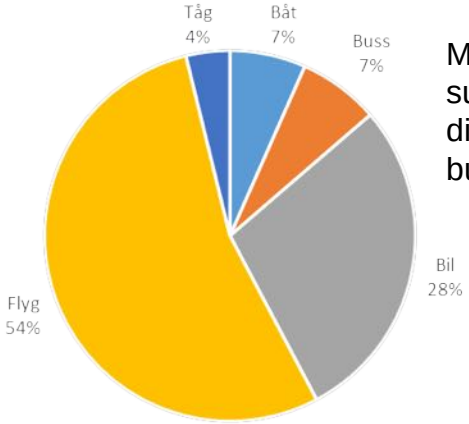
INTERNATIONAL TRIPS

- Research project (Ida K, Chengxi L), founded by TRV
- Estimation of a prediction model for Swede's long-distance travel abroad, i.e., a model for how many trips, to which destination and by which mode
- Data about all **airlines** are available and have been implemented in the model
- We developed a regression model for **Air travel cost** based on distance
- It was important to take into account in the model Swede's preferences for far away destinations (e.g. Thailand). Not including this led to positive valuation of **air travel time**, which is not credible.



Modal shares in the survey for Swede's long-distance private (non-business) travel abroad

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SUMMARY & RESEARCH POSSIBILITIES

- VTI operations cover all modes of transport
- Modelling and simulation connecting several system levels (SoS) to analyse possibilities and consequences for different technologies, at transport system level
- Multiple perspectives, e.g. future travel needs, climate, economy, health, policy, accessibility, etc.
- VTI contributes to addressing NRIA Flyg 2020 *”Challenge G”* ***Need for civil system evaluation capability:*** *“The military ambition to build a system-evaluation capability needs to be reflected in the civil area, for effective prioritisation of research areas of the future.”*

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