Urban Air Mobility

Previous and ongoing research activities

Presented at: The Future of Shared Mobility and Public Transport (Workshop)

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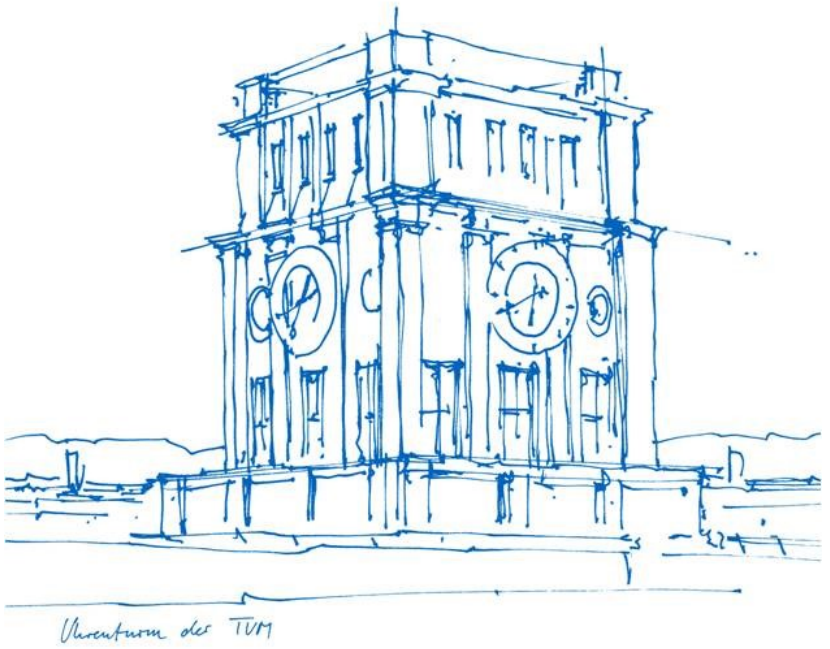


Munich, 14. May 2019

Introduction

What is urban air mobility?

- On-demand sharing mobility
- Operated by fully automated VTOL
- Intra-city passenger trips

Source: Airbus ,2017

Research on choice modeling

- **Motivation**
  - Understanding the **mode choice behavior** in a future urban air mobility context
  - Deriving measures for **transportation service attributes** and the **characteristics** of the potential users

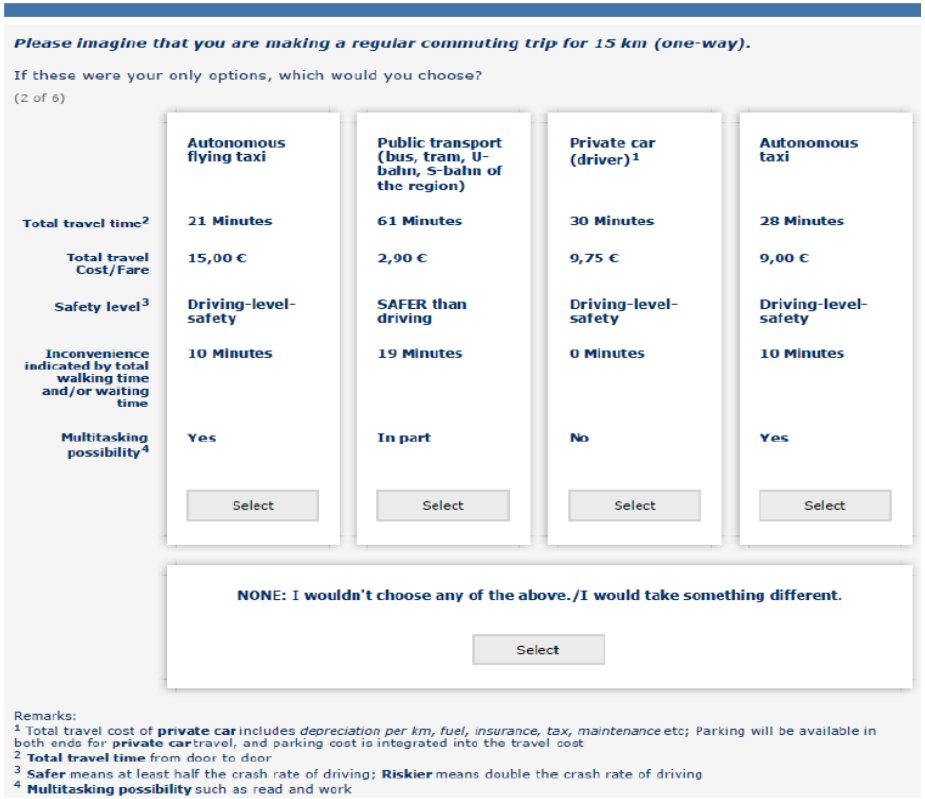
- **Reference**

  Fu, M., Rothfeld, R., & Antoniou, C. (2019). Exploring preferences for transportation modes in an urban air mobility environment: a Munich case study. Transportation Research Record: Journal of the Transportation Research Board, In Press.

Methodology

- SP survey in the **region of Munich**
- Four alternatives:
  - ➢ Private car
  - ➢ Public transportation (PT)
  - ➢ Autonomous taxi (AT)
  - ➢ Autonomous flying taxi (AFT)

- Choice modeling including:
  - ➢ Main MNL
  - ➢ Sub-models based on market segmentation



Please imagine that you are making a regular commuting trip for 15 km (one-way).

If these were your only options, which would you choose?

(2 of 6)

	Autonomous flying taxi	Public transport (bus, tram, U-bahn, S-bahn of the region)	Private car (driver)[1]	Autonomous taxi
Total travel time[2]	21 Minutes	61 Minutes	30 Minutes	28 Minutes
Total travel Cost/Fare	15,00 €	2,90 €	9,75 €	9,00 €
Safety level[3]	Driving-level-safety	SAFER than driving	Driving-level-safety	Driving-level-safety
Inconvenience indicated by total walking time and/or waiting time	10 Minutes	19 Minutes	0 Minutes	10 Minutes
Multitasking possibility[4]	Yes	In part	No	Yes
	Select	Select	Select	Select

NONE: I wouldn't choose any of the above./I would take something different.

Select

Remarks:
[1] Total travel cost of **private car** includes *depreciation per km, fuel, insurance, tax, maintenance* etc; Parking will be available in both ends for **private car** travel, and parking cost is integrated into the travel cost
[2] **Total travel time** from door to door
[3] **Safer** means at least half the crash rate of driving; **Riskier** means double the crash rate of driving
[4] **Multitasking possibility** such as read and work

Main findings

- **Travel time, travel cost, and safety:** critical determinants
- **Willingness to pay more,** especially for UAM
- **Younger individuals and older individuals with high household income:** more likely to adopt UAM
- During market entry, potential travelers may favor UAM particularly for performing **non-commuting trips**

Transportation Modes	VOT (Euros/hour)
Private car	27.41
Public transportation	27.30
Autonomous taxi	33.04
Autonomous flying taxi	49.79

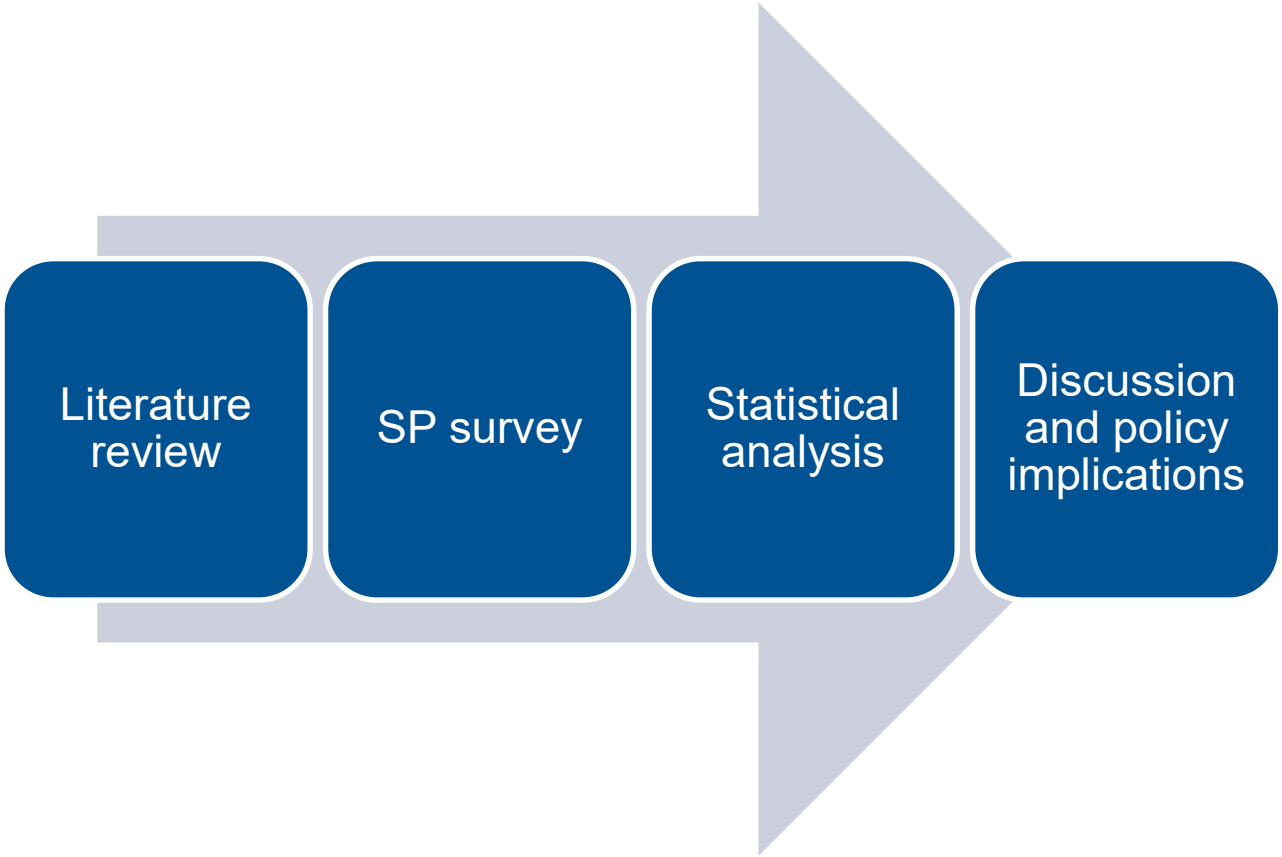
Research on user acceptance

- **Motivation**
  - Market barriers to UAM: including **community acceptance**
  - Understanding the human factors: user perception outside mode choice
  - Identifying the **factors** affecting the adoption and use of UAM

- **Reference**

  C. Al Haddad, M. Chaniotakis, A. Straubinger, K. O. Ploetner, and C. Antoniou, “User Acceptance and Adoption of Urban Air Mobility,” *Transportation Research Part A: Policy and Practice*, under revision, 2019.

Methodology



Scenario presentation

Example 1: A trip from **Munich Airport** to **Dachau:**

	UAM	TAXI
Trip Duration	• 15 min **access time** • 5 min **boarding time** • 13 min **in-vehicle travel time** • 5 min **egress time**	• 5 min **waiting time** • 28-40 min **in-vehicle travel time**
Trip Fare	• 90 €	• 53-69 €

Example 2: A trip from **Planegg** to **Taufkirchen:**

	UAM	TAXI
Trip Duration	• 8 min **access time** • 5 min **boarding time** • 8 min **in-vehicle travel time** • 12 min **egress time**	• 5 min **waiting time** • 30-55 min **in-vehicle travel time**
Trip Fare	• 53 €	• 40-52 €

Survey example

✱ 10 How much do you agree or disagree with the following statements about UAM's operation characteristics?

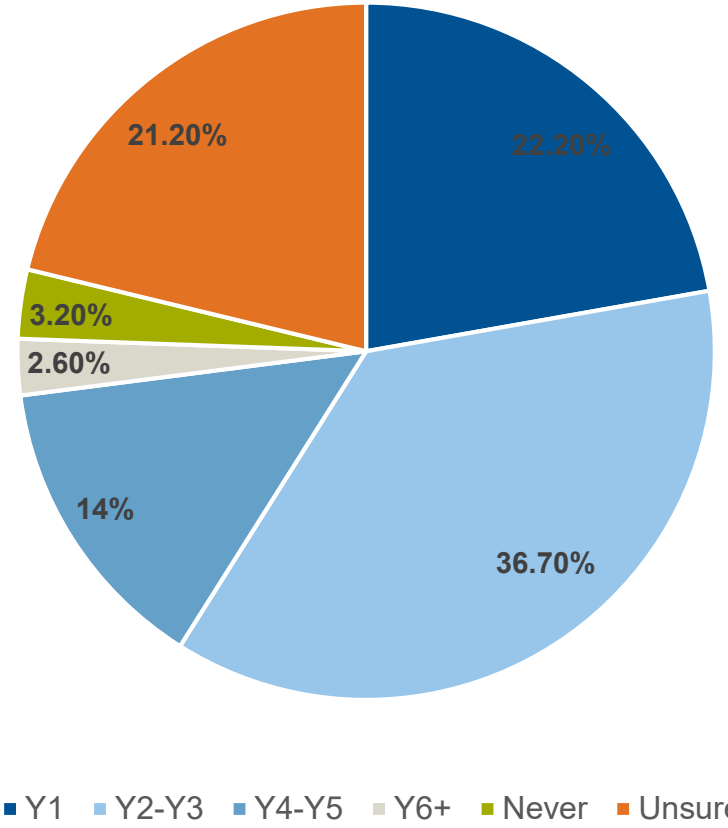
This question is mandatory
Please complete all parts.

	I strongly disagree	I somewhat disagree	I neither disagree nor agree	I somewhat agree	I strongly agree
Service reliability (on-time performance) is a very important feature for trusting UAM.	○	○	○	○	○
In order for me to feel safe, I would expect UAM's vehicles to be equipped with surveillance cameras.	○	○	○	○	○
I should be able to talk to an operator on the ground at any time.	○	○	○	○	○
The operator should be able to override the system and remotely control the UAM's vehicles, in case of emergency.	○	○	○	○	○
The service provider's reputation is very important for gaining trust to use UAM.	○	○	○	○	○

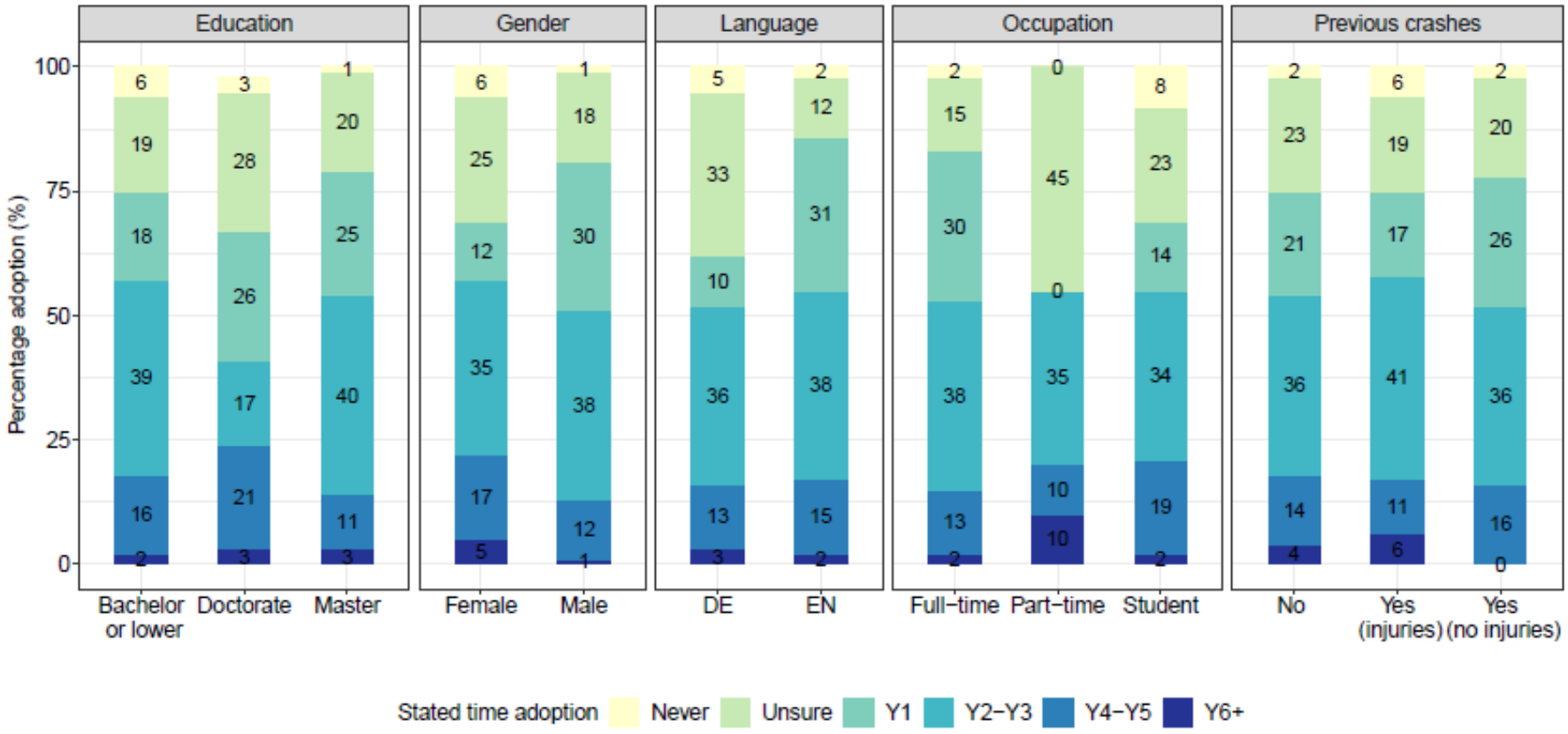
Research on user acceptance (cont‘d)

- Safety ranked **first**

  for more than 50 % respondents



Attitudes of different demographics



Main findings

Based on the **EFA** and the **DCM** models:

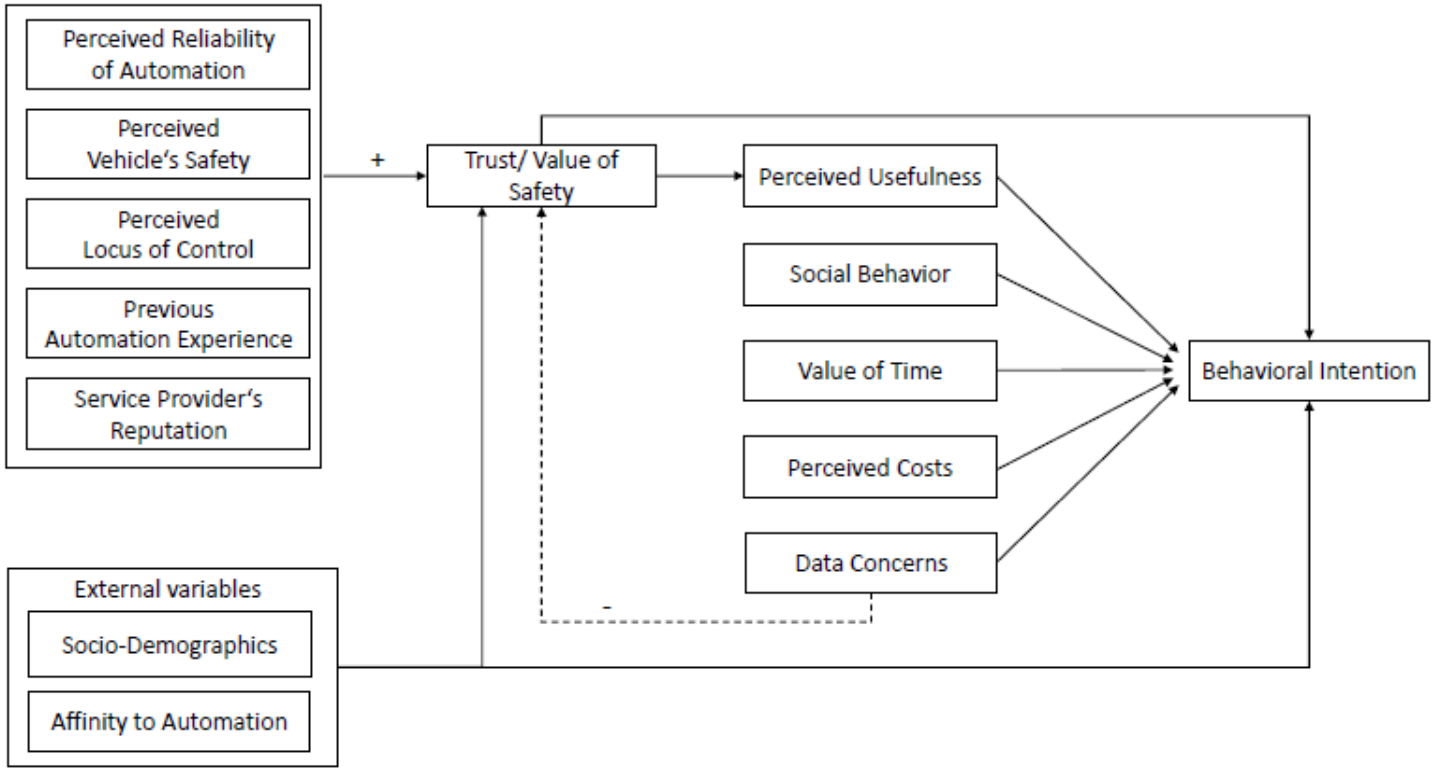
- Safety perception
- Trip cost
- Trip time
- Service reliability
- Operation characteristics
- Socio-demographics
- Previous crashes
- Trust impact
- Affinity to automation

Policy implications

- Automation awareness
- Safety considerations
- Stress on the **human factor**
- Service attributes regulations
  - Prices in of taxis, regulations for noise, visual, and data
  - Integration with PT

Source: http://clipart-library.com/image_gallery/299032.jpg

Proposed Technology Acceptance Model for Disruptive Transport Technologies



Adapted from the original TAM by Davis et al. (1989) and the Automation Acceptance Model (AAM) by Ghazizadeh et al. (2012)

Ongoing project OBUAM

- **Main objective:**
  Research of the potential integration of Urban Air Mobility (UAM) to the existing transportation systems in the region of Upper Bavaria (Oberbayern)

- Managed by the **German Aerospace Center (DLR)** and awarded for the year 2019 to: Bauhaus Luftfahrt e.V., Technische Hochschule Ingolstadt, the TUM Chair of Modeling Spatial Mobility, and the TUM Chair of Transportation Systems Engineering.

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Overall goals

- **Simulating** UAM scenarios in Upper Bavaria, including medium (2030) and long-term (2050) time frames

- **Analyzing** the challenges of this service's integration

- **Assessing** possible business models for the service

- **Evaluating** the advantages and disadvantages of the service integration to PT and the impacts on social, economic, and environmental levels

- **Identifying** future research needs

Acknowledgments

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Research on urban air mobility

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