



a. Autonomous Vehicles

The Society of Automotive Engineers (SAE) defines automated driving systems as “the hardware and software that are collectively capable of performing the entire dynamic driving task on a sustained basis” (SAE International 2018). Thereby, the term is specifically used for SAE automation levels 3, 4, or 5 of driving automation with levels of automation ranging from level 0 (no driving automation) to level 5 (full driving automation). While SAE levels 0, 1, and 2 provide advanced driving assistance systems (ADAS) still requiring the driver to drive and constantly monitor the environment, levels 3, 4, and 5 allow the driver to hand over control to the vehicle with a decreasing degree of required supervision up until level 5 where the car can fully drive on its own.

Traditional automotive manufacturers as well as technology companies make big bets by investing large amounts in the development of self-driving cars or autonomous vehicles (AV). For example, the US car manufacturer GM has set an annual budget of \$4.35 billion (Welch and Behrmann 2018) and the German automotive supplier Bosch plans to spend \$4.6 billion by 2021 (Buchenau 2019) to boost the development of connected and autonomous vehicles.

On a broader level, society expects to drastically reduce traffic deaths as 94 percent of today’s crashes are due to human error (NHTSA 2018). Furthermore, expansive AV adoption concerns politics: Emission and congestion reductions might help to achieve the goals defined in the Paris climate agreements (Greenblatt and Saxena 2015).

I. What We Seek for our Theses:

Our goal is to assess how we need to adapt and reinvent our knowledge of information systems and transportation research to deal effectively with the challenges and opportunities of AVs. We are looking for theses that draw upon and contribute to the stock of knowledge on the adoption and use of AVs, but to do so with full appreciation of the disruptive potential of self-driving vehicles. Do our assumptions about adopting and using technology and mobility still hold? What is different about AV usage patterns and contexts? What is different in technology, product, and interface design and innovation in regard to AVs?

In sum, bachelor theses, student research projects (i.e., “Studienarbeiten”), or master theses on AVs should meet three criteria:

1	Theses must distinguish fundamentally between AVs and other forms of digital technologies, and theorize on the specific differences. Direct applications of existing theory on IT, individuals, organizations, and society (without differentiating AV from generic IT or mobility offerings) are not suitable.
2	Theses must provide novel contributions to knowledge about the implementation or use of AVs. Any form of theoretical (conceptual or empirical) or practical contribution using any scholarly method is welcome.
3	Theses can consider the social and/or technical aspect of AVs. We encourage studies on AVs at and across a variety of levels of analysis, including individuals, organizations, environment, ecosystems, and societies.

Potential topics include, but are not limited to:

- **Adoption of AVs:** Autonomous vehicles or self-driving taxis are expected to solve many societal issues like the high number of traffic accidents, congestions and air pollution. But, like with every innovation, AVs can only become successful and help to solve the above challenges when the society adopts and uses self-driving vehicles. Research already identified various factors that facilitate the adoption (e.g., perceived traffic safety, efficiency, environmental protection...), but there are still many related areas to explore: By which means can the actual, but also the perceived traffic safety be improved? Which role does IT-Security play in the adoption of autonomous vehicles? Do the adoption factors vary between various usage scenarios (e.g., private car, car sharing, taxi)? How high will be the market penetration and which factors will be a limiting factor?

Further Reading:

- Bornholt, Jennifer; Heidt, Margareta (2019): To Drive or not to Drive - A Critical Review regarding the Acceptance of Autonomous Vehicles. In: Proceedings of the 40th International Conference on Information Systems, Munich, Germany
- Buckley, L., Kaye, S.-A., & Pradhan, A. K. (2018). A qualitative examination of drivers' responses to partially automated vehicles. *Transportation Research Part F: Traffic Psychology and Behaviour*, 56, 167–175
- Hegner, S. M., Beldad, A. D., & Brunswick, G. J. (2019). In Automatic We Trust: Investigating the Impact of Trust, Control, Personality Characteristics, and Extrinsic and Intrinsic Motivations on the Acceptance of Autonomous Vehicles. *International Journal of Human-Computer Interaction*, 1–12.
- Hein, D., Rauschnabel, P., He, J., Richter, L., and Ivens, B. (2018): What Drives the Adoption of Autonomous Cars?. In Proceedings of the 39th International Conference on Information Systems, San Francisco, CA, USA.

- **Trust in AVs:** One of the most important adoption factors of AVs is trust in AVs. Current research only started to investigate this area leaving much room for students to explore the trust building mechanisms. How can trust in AVs be conceptualized? How can initial trust in AVs be improved? What are the antecedents for trust in AVs? Can trust be transferred (e.g. from current cars) to AVs? Which forms of trust (e.g. cognitive trust vs. emotional trust) is more relevant for the adoption of AVs? How does trust in AVs differ from trust in other IT artefacts/smart systems?

Further Reading:

- Koester, Nils; Salge, Torsten-Oliver (2020): Building Trust in Intelligent Automation: Insights into Structural Assurance Mechanisms for Autonomous Vehicles. In: Forty-First International Conference on Information Systems. A virtual conference, 13.-16.12., pp. 1–17
- McKnight, D. Harrison; Carter, Michelle; Thatcher, Jason Bennett; Clay, Paul F. (2011): Trust in a specific technology. In: *ACM Trans. Manage. Inf. Syst.* 2 (2), pp. 1–25.
- Komiak, Sherrie Y. X.; Benbasat, Izak (2006): The Effects of Personalization and Familiarity on Trust and Adoption of Recommendation Agents. In: *MIS Quarterly* 30 (4), pp. 941–960.
- Stewart, Katherine J. (2003): Trust Transfer on the World Wide Web. In: *Organization Science* 14 (1), pp. 5–17.

- **AV User Interface:** As soon as cars take over the riding task, the cockpit needs to be redesigned to support the rider. Hereby, students need to distinguish between partially automated vehicles and fully self-driving cars. For both, research and practitioners are interested in: Which design requirements need to be fulfilled for AVs? How can Which information should be displayed during the ride? How can users be supported when taking over the driving tasks in partially automated vehicles? How could a user interface be designed to enable the user to realize changes or threats in regard to security or privacy? How could a AV cockpit be personalized for various user groups?

Further Reading:

- Bengler K, Rettenmaier M, Fritz N, Feierle A (2020) From HMI to HMIs: Towards an HMI Framework for Automated Driving. *Information* 11 (2), 61
- Moore, D., Currano, R., Strack, G. E., & Sirkin, D. (2019). The Case for Implicit External Human-Machine Interfaces for Autonomous Vehicles. Proceedings of the 11th International Conference on Automotive User Interfaces and Interactive Vehicular Applications - AutomotiveUI '19.
- Debernard, S., Chauvin, C., Pokam, R., & Langlois, S. (2016). Designing Human-Machine Interface for Autonomous Vehicles. *IFAC-PapersOnLine*, 49 (19), 609–614.

II. Possible Methodologies

Theses should cover one or more methodologies, such as:

- *Structured literature reviews*
- *Qualitative interviews*
- *Quantitative online surveys*
- *Experiments*
- *Simulations*
- ...

III. Application Requirements

Important: If you are interested in writing a thesis on AVs, please send an email application that includes:

1. a **brief CV**,
2. a current **performance record** (can be downloaded in TUCaN),
3. a **short description** of your proposed topic including a **research question**, and
4. the **time period** in which you would like to work on the thesis

to: mariska.fecho@tu-darmstadt.de.