Capacity Area B1 Topic 2.1 Milestone 1

## Software prototype of transport need matching system & transfer to SUPSI team (within the framework of the NFP GoEco! project)

In line with the two deliverables D1 and D2 corresponding to milestone M1, we implemented a prototype system to improve multi-modal mobility resp. route recommendations (i.e. match people with a range of entities that could satisfy their transport needs). Currently, popular multi-modal route planning services do not move beyond combining regularly scheduled public transportation with walking, cycling or car driving. Often even these combinations are not provided due to a lack of personalization or contextual data (e.g., the system does not know if the user owns a bicycle or if there is a car parking spot available at the public transport stop). In addition, integrating "peer-to-peer" mobility services, such as carpooling, is currently difficult, as the available platforms are built having a traditional transport provider and customer model in mind, which requires providers to publicly announce their offers well in advance if they wish to find a potential carpooling partner. The silo-like structure (i.e. no shared data models or standardized application interfaces) of these platforms and the complexity of such semi-fixed transport offers (often car poolers are flexible as to where and when they pick up and drop off someone) also does not encourage integrating them into route planning applications.

Our prototype consists of two components, roughly corresponding to the deliverables D1 and D2. D1 describes a generic specification of transport needs that can be used to find potential transport offers irrespective of their transport provider (this could be a more conventional one such as public transport, but also a private car or a carpooling partner) [1]. For "peer-to-peer" mobility services this has the advantage that all involved parties can simply state their transport needs (and if they have a car available for example), letting the system evaluate who best cooperates with whom. The prototype application performs these matches for carpooling but is built with potential future extensions (e.g. for public transport or private cars) in mind. The functionality of the prototype was verified using generated data based on real carpooling offers.

D2 focused on multi-modal energy-efficient transport recommendations, which are used as part of the eco-feedback given to the participants of the GoEco! study. The prototype component corresponding to D2 uses a heuristic approach to incorporate personalization (such as aversion to bike on rainy days or to walk extremely long distances) [2] and a graph pruning method to determine the feasibility of certain modal combinations (e.g. during a journey where a user parks her bicycle at a train station, it is not available at a later point anymore) [3, 4]. The output of these route recommendations was validated as part of a larger survey regarding the eco-feedback given to GoEco! participants [4]. An extension to this prototype included carpooling offers (crawled from a popular carpooling platform) by transforming them into the General Transit Feed Specification format [5], which is used by most public transport providers and many public transport route planning applications and thus allowed treating carpooling offers similarly to public transport offers.

This extension, as well as the component corresponding to D1 were not used within GoEco!. Instead, the component of the prototype corresponding to D2 was made available to the SUPSI team to generate the eco-feedback for the participants, as well as to compute potentials for change (i.e. the potential of each user to reduce the greenhouse gas emissions caused by mobility) which were used as a basis for the gamification components.

References

[1] Bucher, D., Scheider, S., Raubal, M. (2017). A Model and Framework for Matching Complementary Spatio-temporal Needs. Proceedings of the 25th ACM SIGSPATIAL International Conference on Advances in Geographic Information Systems, 66.

[2] Bucher, D., Jonietz, D., Raubal, M. (2017). A Heuristic for Multi-Modal Route Planning. Progress in Location-Based Services 2016, Lecture Notes in Geoinformation and Cartography, 211-229.

[3] Bucher, D., Mangili, F., Bonesana, C., Jonietz, D., Cellina, F., Raubal, M. (2018). Demo Abstract: Extracting Eco-feedback Information from Automatic Activity Tracking to Promote Energy-efficient Individual Mobility Behavior. Computer Science-Research and Development, 33(1-2), 267-268.

[4] Bucher, D., Mangili, F., Cellina, F., Bonesana, C., Jonietz, D., Raubal, M. (under review). From Location Tracking to Personalized Eco-Feedback: a Framework for Geographic Information Collection, Processing and Visualization to Promote Sustainable Mobility Behaviors. Travel Behaviour and Society.

[5] Huang, H., Bucher, D., Kissling, J., Weibel, R., Raubal, M. (under review). Multimodal Route Planning with Public Transport and Carpooling. IEEE Transactions on Intelligent Transportation Systems