Doctoral Dissertation
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The Future of Carsharing: A System Dynamics Model

By

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Abstract

The diffusion of carsharing in cities can support the transition towards sustainability and help build a circular economy. Carsharing service providers in Turin started their activities in 2015 with non-electric vehicles and in 2016 with electric vehicles. However, despite the growth potential of carsharing in this city, the market share of such services has remained low. In order to design and recommend a proper policy to improve the diffusion of this potentially sustainable mode of transport, a System Dynamics model is developed in this thesis to simulate the diffusion of shared and electric vehicles along with the changes expected in the market of privately-owned non-electric vehicles.

The simulations are conducted for the period 2010-2050 based on the current passenger cars market of Turin, including privately-owned non-electric cars, privately-owned electric cars, non-electric shared cars, and electric shared cars. Various scenarios are run to test the role of (i) marketing campaigns, (ii) training programs, (iii) implementation of the 'green transition' policy in Italy, and (iv) the intervention of decision-makers in changing the attractiveness of using more sustainable modes of transport and promoting the attractiveness of these options through media. While implementing each of the mentioned potential policies separately resulted in the market failure of carsharing in Turin, a comprehensive policy called '*carsharing survival policy*' containing intensive marketing activities, intensive training programs, and media efforts (with the support of decision-makers) to increase the attractiveness of more sustainable transport options in the presence of the implementation of the 'green transition' policy showed potential success for the carsharing market. Testing this policy in three scenarios with different starting points and durations showed that employing this policy in 2023 and keeping it in place for at least 30 years can support both carsharing and privately-owned electric vehicles to achieve a sustained market. In this case, the

growth of carsharing leads to a decrease in car ownership, an extensive reduction of CO_2 emission from different life stages of the passenger cars, and a lowering of the climate change cost of the emitted CO_2.

The model structure in this research can support decision-makers in the field of urban transport to gain a holistic and systemic approach to analyzing the issues within the transport sector due to their complexity. Moreover, the findings of the simulation can help regulators and policy-makers in intensifying the diffusion of more sustainable modes of transport by highlighting the role of familiarity and also the knowledge of the people about the existing alternative modes of transport. While exposure to a platform increases the familiarity of people, increasing people's knowledge about the benefits and positive outcomes of an alternative technology requires adequate education and training. The simulation of the CO_2 emissions and the estimation of climate change costs also emphasizes the role of carsharing adoption and utilization of electric vehicles in building a cleaner environment. The developed model for Turin supports researchers and practitioners within the field of sustainable urban transport, since it can be used for any number and combinations of privately-owned and shared vehicles with different types of fuel in any nation or region.