Transportation Research Part A 106 (2017) 1–11

Contents lists available at ScienceDirect

Transportation Research Part A

journal homepage: www.elsevier.com/locate/tra

Emerging technological trajectories and new mobility solutions. A large-scale investigation on transport-related innovative start-ups and implications for policy

Ernesto Cassetta[a,*], Alessandro Marra[b], Cesare Pozzi[c], Paola Antonelli[b]

[a] Department of Economics and Statistics, University of Udine, Via Tomadini 30/A, 33100 Udine, Italy
[b] Department of Economic Studies, University D'Annunzio of Chieti and Pescara, Viale Pindaro 42, 65127 Pescara, Italy
[c] Department of Law, LUISS Guido Carli University, Viale Parenzo, 11, 00198 Roma, Italy

ARTICLE INFO

Keywords:
Transport
Innovation
Network analysis
Start-ups
Technologies
CrunchBase

ABSTRACT

Innovation in the transport industry is expected from the integration of new technologies and the development of new concepts of mobility. The current transport landscape is experiencing radical changes, as witnessed by the emergence of a multitude of new applications, business models and specialisations, as well as by the entry of new players. The purpose of the paper is to provide a large-scale investigation of technological trajectories and new mobility solutions outlined by start-ups and young companies in the global transport industry. The paper employs network analysis to detect productive and innovative activities of firms founded between 2001 and 2016. Our findings highlight that three clusters of interconnected technologies and transport-related solutions are emerging: new cars prototypes and alternative vehicles prompt innovation in autonomous driving; technologies for transport sharing and public transit data analysis stimulate new solutions in urban livability; management systems, platform development and vehicle-optimization technologies bring innovative specializations in the integrated logistics services. Results provide policy-makers, venture capitalists, as well as open innovation teams in large corporations, with quantitative and relevant findings on transport-related innovative solutions.

1. Introduction

Consensus exists on the need of a radical transformation of mobility to address rising and unprecedented challenges worldwide (Banister, 2000; European Commission, 2012; Lyons and Davidson, 2016; OECD/ITF, 2010a). Passenger and freight transport demand has increased considerably in the last decades and is predicted to rise further (Jaber and Glocker, 2015). In its Transport Outlook, the International Transport Forum estimates an increase in global surface passenger volumes to 2050 ranging from 120% to 230%, depending on future fuel prices and transport policies at urban levels (OECD/ITF, 2015a). Road and rail freight transports will also show an increase between 230% and 420% over the same period, as well as total international freight volume (+430% by 2050). Non-OECD countries will be majorly responsible for those trends. Despite a robust shift away from current patterns, total CO_2 emissions are expected to mount at the global level, respectively between 30% and 110% from passenger transport, between 230% and 420% from freight, and, according to different scenarios, by a factor of 3.9 in trade-related international freight transport. The transport sector's quota of global CO_2 emissions, already accounting for about 23% in 2013, will further increase in the future (IEA, 2015; OECD/ITF, 2015a).

* Corresponding author.
E-mail addresses: ernesto.cassetta@uniud.it (E. Cassetta), alessandro.marra@unich.it (A. Marra), cpozzi@luiss.it (C. Pozzi), paola.antonelli@unich.it (P. Antonelli).

http://dx.doi.org/10.1016/j.tra.2017.09.009
Received 24 March 2017; Received in revised form 5 September 2017; Accepted 5 September 2017

How to offset the unabated growth in transport demand while preventing increase in CO_2 emissions is a central question in ongoing academic and policy debates (Hysing, 2009). Current technologies and available mobility options offer only partial responses, especially when considered separately. Effective actions need simultaneous changes in multiple parts of the transport system (Hyard, 2013; OECD/ITF, 2010b; Wiesenthal et al., 2011), such as infrastructures, vehicles, services, and government policies. Moreover, technological solutions, such as energy efficiency improvements and/or increased use of less carbon intensive fuels, have only partially succeeded in offsetting the growth in road transport demand. As a result, as predicted by the rebound effect theory, absolute environmental pressures have continued to rise (Font Vivanco et al., 2016; Gillingham et al., 2016).

Although, major innovations in the transport industry are increasingly expected from the development of new concepts of mobility and the potential integration of new technologies (Citylab, 2014; OECD/ITF, 2010b; Wiesenthal et al., 2015). Technological advances are creating new opportunities, and start-ups as well as established firms in other sectors (e.g., powerful high-tech corporations, information technology companies, data management companies and energy companies) are offering disruptive solutions as in the case of the automotive sector (Cohen and Kietzmann, 2014; Dodourova and Bevis, 2014). As a consequence, the transport industry has received increasing venture capital interest over the last few years. According to Volvo Group Venture Capital (Volvo Group, 2013), the amount of venture capital going to transportation start-ups quadrupled in 2014 to $7 billion and doubled to $14 billion in 2015. Moreover, governments at the national and local level are also changing their priorities by introducing a set of measures to create more efficient and sustainable transportation systems and by increasingly favouring tech firms in experimenting their innovative solutions.

To our knowledge, a systematic, comprehensive and up-to-date study on transport-related innovation has yet to be completed (Wiesenthal et al., 2015). Attention at both academic and policy levels has been mostly paid to the automotive industry and to large players (Bonilla et al., 2014; Juliussen and Robinson, 2010; Zapata and Nieuwenhuis, 2010). Studies are often top-down, investigating innovation activities starting from companies' annual reports and financial efforts in corporate research and development (R & D) investments. Such 'case by case' analyses would not allow taking a large picture of new solutions, applications, or technologies towards which innovative companies are directing their R & D and productive efforts. Moreover, literature on innovation in the transport industry have largely ignored the role of newcomers and start-ups, except leading ones such as, for example, Tesla. Start-ups and young companies provide a key level of analysis for scholars in the examination of production and innovation activities as well as for policy makers in the design and implementation of targeted measures to support productive and R & D activities in the transport sector. The ability to monitor latest market and technological developments is also critical for large manufacturers to support their external growth strategies (Dilk et al., 2008; Dodourova and Bevis, 2014; Karlsson and Sköld, 2013). Increasing interdependences and new mobility solutions have the potential to drastically change firms' hierarchies, as for the debated process of commoditization in the automotive industry (PwC, 2013).

The purpose of the paper is to provide a large-scale investigation of technological trajectories and new mobility solutions outlined by young and innovative companies in the global transport industry. Using metadata, collected from AngelList and CrunchBase, on innovative companies founded between 2001 and 2016, a network analysis is employed to describe in which technologies, applications, mobility solutions are worldwide start-ups investing and how and to what extent they are linked by technological and market complementarities. The underlying hypothesis is that the nature of innovative activities can be proxied by metadata, which are keywords and terms that help to describe items, and in relation to the database reveal start-ups' technological and deployment strategies, markets, and scope of business. We thus refer to technological trajectories as the paths by which innovations in a given field or technological paradigm occur (Dosi, 1982; Nelson and Winter, 1982). Accordingly, new mobility solutions are understood as transport-related products, services and business models defining the range of existing firms' specializations. New mobility solutions thus potentially include products such as drones, remotely piloted aircrafts, or sensors and devices for autonomous driving; services like car and bike sharing, real time traffic management, route optimization, or fleet management; as well as innovative business model, as in the case of new for-hire passenger transport services or Commercial Transport Applications (CTAs).

In the light of these arguments, the paper well complements existing studies, which have been mainly focused on incumbent manufacturers. Moreover, the analysis may contribute in partially overcoming some limits of standard industrial classification codes, conventional datasets, and product categories by implicitly recognising the highly fragmented and cross-industry nature of many transport-related initiatives. The presence of cross cutting technologies makes the detection of new transport-related solutions and technological trajectories extremely challenging. Intelligent Transport System (ITS) well exemplifies this: the "cross nature" of ITS applications throughout all transport modes implies that many of the underlying Information and Communications Technology (ICT) and software developments are carried out by companies outside the transport sector (Wiesenthal et al., 2011). Results provide policy-makers, venture capitalists, as well as open innovation teams in large corporations, with quantitative and relevant findings on transport-related innovative solutions.

The rest of the paper is organized as follows. In Section 2, the literature background is presented, in which the difficulties to identify emerging industries and innovative technologies in the transport industry are emphasised both from a theoretical and empirical point of view. Sections 3 and 4 respectively present the method and data. Section 5 discusses the results and the three relevant clusters of interconnected technologies and transport-related solutions that are actually emerging. Section 6 draws conclusions and provides some policy implications.

2. Theoretical background

The detection of emerging technological innovation is not an easy task (Cohen, 2010; Phaal et al., 2011). The recognition of the relevance of new industries for future economic growth and the need for a better understanding of their features to define effective