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Car and the city: Socio-technical transition pathways to 2030

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ABSTRACT

The socio-technical approach to innovation is used to show that the future of urban mobility will depend on the competition between coalitions of innovative actors who support alternative transport systems. A new graphical tool—the socio-technical map—is introduced in order to represent the positioning of supporting coalitions with reference to three variables: business models, propulsion technologies and power. Three transition pathways to 2030 may emerge from the current situation of urban mobility: 1) 'AUTO-city', i.e. the reconfiguration of the 'individual car' dominant system through the stable integration of producers of batteries; 2) 'ECO-city', i.e. the further empowering and diffusion of local coalitions which already integrate all non-car modes of transport; 3) 'ELECTRI-city', i.e. a new 'electricity vehicles + smart grids' system established by a coalition led by electric operators. Because of the cumulative processes between the transformation of supporting coalition and their access to higher level of competence and power, both technologies and policies can be considered as endogenous variables to transition pathways. The resulting policy prescriptions are clear-cut: if not destabilized by policy pressure, the 'AUTO-city' will prevail; to support the 'ECO-city' and the 'ELECTRI-city', a multilevel policy for urban and transport planning and a national innovation and industrial policy are needed, respectively.

1. Introduction

In recent years several scholars have tried to analyze the future of the transport sector, also with the aim of understanding how its environmental impacts may be reduced drastically (see e.g. [16,44,85]). This paper contributes to this research stream by providing an analysis of the current and future dynamics of urban mobility which explicitly draws on the socio-technical (ST) field of innovation and future studies [29]. This paper is part of a specific subset of ST future studies, that is, ST scenarios. ST scenarios differ from other forecasting techniques as they provide a better systemic and dynamic representation of future changes. In particular—and more relevant here—ST scenarios are useful not so much for the static description of future outcomes, as for the analysis of the multi-dimension and multi-actor dynamics of alternative transition pathways and the role played by public interventions at critical points [28]. The ST analysis of scenarios and transition pathways is usually focused on specific sectors, such as energy [25,93] or transportation [21,36,51].

As stressed by several authors in the ST research field, the analysis of scenarios and transition pathways suffers from the lack of integration of political issues. Politics and policy are usually considered as exogenous factors, thus hindering the ability of ST future studies to envisage mid- and long-term structural changes [26,49,59,82]. Starting from these considerations, this paper aims at understanding whether a genuinely dynamic analysis of the role played by relevant actors in transitions may help the ST approach to consider both technologies and political institutions as endogenous variables. In order to provide useful cues for this purpose, this paper builds an original analysis of future transition pathways of urban mobility where: a) coalitions of innovative actors motivated by different interests and/or ideas and

Abbreviations: (CA), common action; (EV), electric vehicle; (IUTS), integrated urban transport system; (PP), policy package; (SG), smart grid; (ST), socio-technical.

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promoting different transport systems are at the heart of the process of changing urban mobility; b) the actual deployment of transition pathways strongly depends on the cumulative process between the transformation of coalitions, the access to higher levels of competence, legitimacy and power, and the evolution of both technologies and political institutions. Moreover, a new graphical tool—the ST map—is introduced in order to reduce the resulting complexity in transitions in an intelligible way; the current and future positioning of actors and coalitions is represented with reference to three variables: business models, propulsion technologies and power.

The description and analysis of transition pathways is not limited to the car and its future evolutions, but attention is paid to two different dynamics: the reproduction of the currently dominating car-based system of urban mobility, and the embedding into new systems of urban mobility of emerging low-carbon innovations (such as, electric propulsion, shared systems, stronger integration of all non-car transport modes, and so on). The current situation of urban mobility is considered at first; then, three alternative transition pathways to year 2030 scenarios of urban mobility are considered. Year 2030 is chosen as reference for scenarios because it is near enough to ensure a sufficient knowledge of the relevant constituents of future transitions, and it is distant enough to allow alternative transition pathways to deploy.

The following five paragraphs in the paper explain: the basic concepts of the ST approach and the ST map (Section 2); the current situation of urban mobility (Section 3); the development of the three ST transition pathways (Section 4). Finally, the last two paragraphs provide discussion and conclusions, respectively.

2. The socio-technical approach: basic concepts and a new graphical representation

2.1. What is specific of this approach

This paper is based on a socio-technical (ST) approach to the analysis of innovation processes. It goes beyond the scope of this paper to review all the contributions coming from scholars who refer to the ST approach; here two of its specificities which are relevant for the subsequent analysis are highlighted.[2] The first one lies in the ST approach not being a reductionist one: complexity is explicitly considered as a relevant feature of the process of innovation; this is why the overall picture is never explained by looking at one or more specific elements. In particular technology is not the core driver of innovation, but just a structural element in the functioning of the society, interacting with other institutional and economic constituents, and with agency [33]. Another specificity is that the ST approach focuses on actions rather than on functions[3]: the purposeful action of individuals and groups is at the heart of the analysis. All relevant attributes of action stay at the center of the analytical scene: power, interests, conflicts, agendas, policies, intentional pressure for—and resistance to—change, etc. [5,26,81]. This does not mean that the ST approach is teleological, with innovation as the intended effect of individual and collective action; it only means that there is no innovation without human action.

2.2. Socio-technical systems

The ST system is a basic concept in the ST approach to innovation. Societal functions (housing, feeding, mobility, lighting, etc.) are fulfilled by one or more ST systems. All ST systems are (more or less) stable configurations. The ST system is a meso-concept: the micro level is composed by its constituents (rules, artifacts, knowledge, actors, preferences, financial resources, etc.); the macro level includes exogenous socio-economic phenomena and trends.[4] The functioning of ST systems can be conceptualized as structured agency [37]. Two more basic concepts complete the framework: 1) the dominant ST system: a stable and powerful ST system which strongly influences the dynamics of—and co-exists with—all other subaltern or residual ST systems and generates pervasive lock-in phenomena [33][5]; 2) the ST 'niche': a space which is partially or totally protected from the selection pressures generated by the dominant ST system [77]. ST niches are particularly relevant for the generation and experimentation of innovations and for the gradual structuring and empowerment of new ST systems [5,83].[6]

2.3. Actors and coalitions: a cumulative process

Actors—all featuring bounded rationality—are the engine of a coevolutionary process of change: through action and learning, they replicate the structure of the ST system; at the same time, they generate—directly or indirectly, intentionally or unintentionally—the variation and selection of structural variables. Every actor features a vector of material and immaterial endowments (physical and financial resources, knowledge and skills, social capital and legitimacy, etc.) and is motivated by his/her interests, ideas and visions. Every actor's power—hence her/his ability to influence the dynamics of ST systems—is a function of the above vector.

Supporting coalitions are defined as groups of actors who are interested in the reproduction or the emergence of ST systems [5,30,46]. Actors' membership is then crucial to understand the dynamics and interactions of ST systems: coalitions of 'core-actors' are interested in—and actively act for—the reproduction of an existing ST system [80]; coalitions of 'enactors' try to transform an innovation into a social practice, in order to establish a new ST system [86]. In this approach, competences, power and legitimacy are linked to coalition building by a cumulative process which is essential

[2] For critical analyses of this research field see [53,92]. For an interesting attempt to operationalize this approach see the results of the EU funded 'MATISSE' project [41].

[3] For a structured approach to the study of the functions of innovation systems see [48].

[4] This is the 'landscape' in the terminology used by Frank Geels [29] and other scholars of the so-called multi-level perspective.

[5] The concept of subaltern or residual ST systems has been introduced only recently in the ST literature [33] in order to consider those ST configuration that are not dominant systems nor niches. Inter alia, this novelty implies that the use of the term 'regime' as a synonymous of 'dominant ST system' should be abandoned: in the ST terminology the 'regime' is the specific set of rules shared by the supporting coalition of a ST system, that is, also of a subaltern one.

[6] Brown et al. [10] use a similar concept, but with a different terminology: 'bounded socio-technical experiment' instead of niche.

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