



Contents lists available at ScienceDirect

Environmental Innovation and Societal Transitions

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



The technological innovation systems framework: Response to six criticisms[☆]

Jochen Markard^{a,*}, Marko Hekkert^b, Staffan Jacobsson^c

^a Swiss Federal Institute of Technology Zurich, Department of Management, Technology and Economics, Group for Sustainability and Technology, Weinbergstrasse 56/58, 8092 Zurich, Switzerland

^b Utrecht University, Copernicus Institute of Sustainable Development and Innovation, Department of Innovation Studies, Heidelberglaan 2, 3584CS Utrecht, The Netherlands

^c Chalmers University of Technology, Environmental Systems Analysis, 412 96 Gothenburg, Sweden

ARTICLE INFO

Article history:

Received 28 June 2015

Received in revised form 4 July 2015

Accepted 6 July 2015

Available online xxx

Keywords:

Technological innovation systems

Technological change

Transitions

Sustainability

Critique

ABSTRACT

The technological innovation systems framework (TIS) is widely used to study the emergence and growth of new technological fields and industries. At the same time, it has been criticized for a number of issues and innovation scholars have made suggestions of how to improve the framework. In this viewpoint, we respond to six areas of criticism: (1) TIS context, (2) system delineation, (3) spatial aspects, (4) transitions, (5) politics, and (6) policy recommendations. We point to promising conceptual developments of how to address shortcomings and highlight needs for further research. We also discuss the prospects of the TIS approach for the analysis of socio-technical transitions. The TIS framework, in our view, has the potential to outgrow its original scope – explaining the dynamics and performance of a technological field – and to address many of the issues relevant when studying transitions.

© 2015 Elsevier B.V. All rights reserved.

1. Introduction

The technological innovation systems (TIS) approach has gained quite some attention¹ in recent years for the study of emerging technologies in and beyond the context of sustainability transitions. It focuses on understanding the dynamics of an innovation system centered around a specific technology. In particular, the approach is often used to assess the performance of a TIS, to identify shortcomings and to derive recommendations for the design of policies in support of a specific technology (Alkemade et al., 2011; Jacobsson and Karltorp, 2013; Weber and Rohracher, 2012; Wieczorek and Hekkert, 2012). Indeed, the latter was a central motivation for developing the framework (Carlsson et al., 2010).

Since its inception (Carlsson and Stankiewicz, 1991), the framework has seen several conceptual developments, including a clarification of scoping issues (Carlsson et al., 2002), TIS functions as a central tool for performance assessment (Bergek et al., 2008a; Hekkert et al., 2007; Jacobsson and Bergek, 2006), specifications for selected TIS functions (Dewald and Truffer, 2012;

[☆] The present viewpoint is part and parcel of a debate about the challenges of TIS research in the current issue of EIST. See Truffer (this issue) for an introduction and overview on the different contributions to the debate.

* Corresponding author. Fax: +41 44 632 1045.

E-mail address: jmarkard@ethz.ch (J. Markard).

¹ From 2008, when the term was coined, to 2014, the Scopus Database reports more than 80 papers, which refer to “technological innovation systems” either in their title or keywords. Note that this number does not cover the many publications on the origins of the framework under the notion of ‘technological systems’ since 1991.

Bergek et al., 2008b), a strategic perspective on system building (Hellsmark and Jacobsson, 2009; Musiolik and Markard, 2011; Musiolik et al., 2012), international ties within TIS (Bento and Fontes, 2015; Binz et al., 2014), and suggestions for the analysis of TIS contexts (Bergek et al., 2015; Markard et al., 2009; Wirth and Markard, 2011). In fact, the TIS framework is constantly evolving and the debate at the International Conference for Sustainability Transitions in 2014 and in this special issue is part of this development.

As the TIS approach became more widely adopted, it was also criticized. In this article, we address and reflect on the critique. We respond to the three viewpoints in this special issue (Bening et al., 2015; Coenen, 2015; Kern, 2015) and to earlier criticisms in the literature on innovation and transition studies.

Altogether, we cover six major critical issues. The first is about the TIS approach being inward-oriented, thus, downplaying the importance of external context structures. This is related to the second issue of how to delineate a TIS. The third point is about geographical issues being not well enough covered. Fourth, it has been questioned whether the TIS framework is actually a useful framework for analyzing transition processes. The fifth criticism is about a marginal role of politics. The sixth and final point relates to normative issues and the type of policy advice that follows from TIS analyses.

For each of these issues, we will briefly summarize the main aspects of the critique, clarify where we agree or disagree and explain why. In particular, we discuss what the TIS framework can embrace and what is beyond its capacity. With this contribution, we want to further improve the TIS approach. We view conceptual development as an important and ongoing process that – hopefully – takes a step forward with this debate but certainly does not end here.

Note that much of the critique is related to the original purpose of the TIS framework, i.e. how it is used (i) to study the dynamics and performance of (novel) technological fields, (ii) to identify shortcomings, and (iii) to make (policy) recommendations for improvement. Some of the critique, however, also relates to new challenges arising from the study of sustainability transitions—a novel field of research occupied with large-scale transformation processes of sectors such as energy, transportation, food or water towards more sustainable production and consumption (Markard et al., 2012). The TIS approach is viewed as one of the key frameworks in this field for mainly two reasons. First, the emergence of novel technologies is a central processes in socio-technical transitions and several new technologies have meanwhile matured to a degree that they very much threaten established technologies, organizations, and institutional structures. Second, a host of recent empirical work using the TIS approach has studied technologies (e.g. renewable energies, alternative vehicle technologies) that are associated with sustainability promises. As a consequence, the TIS framework is increasingly confronted with both issues, transitions (cf. Section 5) and sustainability (cf. Section 7).

2. How does the TIS deal with context?

A recurring critique of the TIS approach is about a perceived myopia and lack of attention to context factors. It has been argued, for example, that the framework is “inward oriented and does not pay much attention to the system’s environment” (Markard and Truffer, 2008; p.610) or that “...the actual success of innovation is mainly regarded as a consequence of the performance of the innovation system itself.” (Smith and Raven, 2012; p.1029). In particular, it was argued that the TIS approach might miss out on the emergence of complementary or competing technologies in its context, as well as on the struggle for dominance with incumbent technologies.

This critique became an anchor point to suggest more explicit context analyses, for example, by differentiating other technological innovation systems, socio-technical regimes and landscape influences in the context of the TIS (Markard and Truffer, 2008; Wirth and Markard, 2011). However, the critique was also used to rule out the applicability of the TIS concept for analyzing transitions (Geels, 2011; Smith and Raven, 2012). We will come back to that in Section 5.

2.1. Response

We are sympathetic to conceptual extensions of the TIS framework, which aim at a differentiated analysis of context structures, their dynamics, and interplay with the focal TIS. In fact, together with co-workers, we make further suggestions for a systematic TIS context analysis in a paper that is part of this special issue (Bergek et al., 2015). At the same time, we also have to make clear that the TIS framework has never ignored the context. To explain this, we have to go back to the origins of the approach, arguing that the TIS functions represent an explicit approach to take context factors into account.

The late 1980s and early 1990s saw the emergence of innovation system concepts with different delineations. These included national, regional and sectoral innovation systems. In addition, Carlsson and Stankiewicz (1991) developed a framework focusing on technologies and products, which was the start of work on TIS. Throughout the 1990s, structures of systems with different delineations were explored. These included knowledge fields, e.g. biomaterials (Rickne, 2000), industries, e.g. factory automation (Carlsson and Jacobsson, 1994), and sectors, e.g. biomedical (Carlsson, 2002). In the 1990s, research on TIS shifted from exploring static structures to analyzing the dynamics of systems. It was then argued that, in times of technological discontinuities, transformation processes at various levels, e.g. technological, sectoral, and national, interact. As a consequence, scholars pointed to a variety of context factors that affect TIS development:

“...industrial growth is not only influenced by factors specific to a technological system, but also by those that a range of technological system has in common... thus, our analytical framework... also needs to consider elements drawn from other system approaches... These factors may be fully technology-specific, but may also influence several

Download English Version:

<https://daneshyari.com/en/article/6559407>

Download Persian Version:

<https://daneshyari.com/article/6559407>

[Daneshyari.com](https://daneshyari.com)