



## The evolution of science policy and innovation studies

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### ARTICLE INFO

#### Article history:

Received 4 April 2011

Received in revised form

23 November 2011

Accepted 6 March 2012

Available online 5 April 2012

#### Keywords:

Innovation studies

Science policy

History

Evolution

Highly cited publications

Key contributions

### ABSTRACT

This article examines the origins and evolution of the field of science policy and innovation studies (SPIS). Like other studies in this Special Issue, it seeks to systematically identify the key intellectual developments in the field over the last 50 years by analysing the publications that have been highly cited by other researchers. The analysis reveals how the emerging field of SPIS drew upon a growing range of disciplines in the late 1950s and 1960s, and how the relationship with these disciplines evolved over time. Around the mid-1980s, substantial parts of SPIS started to coalesce into a more coherent field centred on the adoption of an evolutionary (or neo-Schumpeterian) economics framework, an interactive model of the innovation process, and (a little later) the concept of ‘systems of innovation’ and the resource-based view of the firm. The article concludes with a discussion of whether SPIS is perhaps in the early stages of becoming a discipline.

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### 1. Introduction

The field of science policy and innovation studies (SPIS) is now around 50 years old. From humble beginnings involving just a few researchers in the late 1950s, it has grown to become a significant field involving several thousand researchers (Fagerberg and Verspagen, 2009). Some of its contributions have had a major impact on neighbouring disciplines as well as within the field itself. It is therefore timely to look back and analyse what has been achieved.

The overall aim of this exploratory study is to systematically identify the most influential intellectual developments in the field of SPIS and analyse how these have evolved over time with a view to addressing the following research questions. First, what are the intellectual origins of the field and the disciplines upon which it has drawn, and how have these relationships evolved over time? Secondly, is the field beginning to coalesce around a common conceptual framework and set of analytical tools? Thirdly, are there potential links with other fields that are either absent or only weakly developed, and, if so, why? Fourthly, what is the geographical breakdown of important SPIS advances, in particular with regard to the relative contributions of North America and Europe, and what

might explain that breakdown? Finally, is SPIS perhaps in the early stages of becoming a discipline?

To address these questions, however, we first need to construct a systematic overview of the field. Such an overview may be useful for research students or ‘newcomers’ to the field, and to academic faculty developing lecture courses and reading lists. It may also offer SPIS ‘insiders’ a more comprehensive ‘map’ of field as a whole, especially of areas seen as less directly linked (e.g. work on medical or health innovations, or on organisational and other non-technological forms of innovation). More specifically, it might enable researchers to identify ‘gaps’ in the field, or potential synergies between previously rather separate bodies of research, and hence offer guidance as to where they might most fruitfully concentrate their efforts. Lastly, the article may provide some insights as to how ideas originate and come to exert a major influence and how research fields develop. (However, detailed analysis of the factors affecting the impact of influential publications is left to future research.)

In what follows, Section 2 first defines the scope of the field of ‘science policy and innovation studies’, while Section 3 reviews the literature on previous attempts to map or review the field, including similar studies in neighbouring social science fields. Section 4 sets out the methodology employed to identify the SPIS contributions that have had most impact on the academic community. Section 5 then analyses the origins and early development of the field, as social scientists from a number of disciplines began to become interested in science, technology and innovation, while Section 6 focuses on the most influential contributions from the 1980s

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onwards, showing how SPIS by then was becoming a more coherent field centred on the adoption of an evolutionary economics framework, an interactive model of the innovation process, the concept of 'systems of innovation', and the resource-based view of the firm. Lastly, Section 7 discusses the broad findings with regard to the original research questions, assessing how far SPIS has coalesced as a field and whether there are any 'missing links' with neighbouring fields that, if developed, might further strengthen the field. We consider the large and growing dominance of US authors and identify possible reasons for this. Finally, we explore the question of whether SPIS is perhaps in the early stages of becoming a discipline.

## 2. Definition and scope of field of 'science policy and innovation studies'

Before proceeding further, we need to specify exactly the focus of analysis in this review. One problem is that different people have labelled the various research activities on which we are focussing in different ways. Another is that those labels have changed over time. For example, in the 1960s, a common designation was 'science policy' (or 'research policy'), while in the 1970s and 80s various combinations of science, technology and innovation (and variations on these such as engineering and R&D) were employed. By the 1990s, however, the preference of many was to use 'innovation' as the generic noun for characterising the field, with this term being assumed to include aspects of 'science' and 'technology'. Over time, it likewise became apparent that the term 'policy' was too narrow and misleading, with many researchers focusing more on the management or economics of R&D, technology or innovation. Rather than coming up with a label involving some combination of 'policy', 'management' and 'economics', many have therefore settled on the simple, succinct label of 'innovation studies'. However, I have opted for the fuller, if slightly clumsier, label of 'science policy and innovation studies' (or SPIS) to reflect the earlier history.

How might this field be defined? It is difficult to give an exact definition of an emergent field like SPIS (Fagerberg et al., 2012). A natural starting point may be the definition provided by the leading journal in this area (ibid.; Fagerberg and Verspagen, 2009), namely *Research Policy*. Consequently, the definition of SPIS used here is studies "devoted to analyzing, understanding and effectively responding to the economic, policy, management, organizational, environmental and other challenges posed by innovation, technology, R&D and science. This includes a number of related activities concerned with the creation of knowledge (through research), the diffusion and acquisition of knowledge (e.g. through organizational learning), and its exploitation in the form of new or improved products, processes or services."<sup>1</sup>

This definition of 'science policy and innovation studies' is quite broad but the essential element is that the subject matter, characterised by the terms innovation, technology, R&D and science, is studied using a range of social science disciplines (economics and economic history, policy studies, management science, organisational studies, sociology, etc.). Included within it are the science, technology and innovation-related components of the following:

- economics—including the economics of science, research or R&D, of technology, and of innovation; also included is (neo-) Schumpeterian economics (with its central focus on the role of innovation), a considerable part of evolutionary economics (like-wise), and a significant component of endogenous growth theory

(which also gives particular prominence to technology and innovation);

- economic history and business history—the history of technology and innovation, and the relationship of technology/innovation to industrial development and economic growth;
- policy—this includes the older terms 'science policy' and 'research policy', 'technology policy', and more recently 'innovation policy';
- management—R&D management, industrial R&D, new product development, technology and innovation management, much of entrepreneurship and of knowledge management, and those parts of strategic management relating to R&D, technology and innovation;
- organisational studies—including organisational innovation, and a large part of the resource-based view of the firm (e.g. focusing on routines, core competences, dynamic capabilities, absorptive capacity), along with certain aspects of organisational learning;
- sociology of innovation—especially sociological work on the diffusion of innovations; however, most sociology of science and technology has been excluded, since this comes more under 'science and technology studies' (see below).

Excluded under the above definition of SPIS are the following areas (which tend to have their own research communities and separate journals):

- most sociology of science and technology, along with much of the history and philosophy of science—these form part of 'science and technology studies', a largely separate field and research community (Bhupatiraju et al., 2012; Martin et al., 2012);
- most scientometrics or bibliometrics research—again, this is a rather distinct research community from SPIS (ibid.), so it has been excluded here except where the research is clearly linked to 'science policy', 'technology management', etc.;
- most energy and environment policy research, except where technology or innovation is a key element (e.g. recent work relating innovation and sustainability);
- most literature on economic development, again except where technology or innovation is again a key element (e.g. 'technology transfer' or 'appropriate technology').

There are also certain areas that, although not specifically excluded, may be only partially covered (perhaps because the search revealed few highly cited publications for these). They include 'technology assessment', 'engineering management', public sector innovations, work on implementation of new technology (e.g. IT), some literature on innovation diffusion (e.g. by marketing researchers), and contributions by psychologists (e.g. on the relationship between organisations and innovation, or on creativity in research and innovation).

Any attempt at a definition of the field of science policy and innovation studies may seem somewhat arbitrary and subjective; in the world of social science, there are no simple, unambiguous boundaries differentiating one set of research activities from another. However, the above specifies exactly what has (and has not) been included here and why.

## 3. Literature review

Next, let us consider the relationship of this study to previous efforts to review the field. There have been several such attempts in textbooks or handbooks and in review articles. Highly cited examples include Freeman [1974 & 1982], Freeman and Soete [1997], Nelson and Winter [1977], Dosi [1988], Griliches [1990] and Brown

<sup>1</sup> See [http://www.elsevier.com/wps/find/journaldescription.cws\\_home/505598/description](http://www.elsevier.com/wps/find/journaldescription.cws_home/505598/description) (accessed October 2011).

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