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Technological change as a trade-off between social construction and technological paradigms

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Abstract

The theory of social construction of technology (SCOT) and the theory of technological paradigms (TTP) are normally regarded as competing or even incompatible perspectives on technological change. In this paper, we show how and when the perspectives are complementary by comparing how the theories conceptualise technology development, understand stakeholders, and determine driving forces for technological change. When stakeholders have different relations to the innovation process, and when the outcome of the innovation process is open, we argue that the two theories could be complementary tools for analysing the process. When using SCOT and TTP as complementary analytical tools, it becomes easier to understand and design innovation processes in which different stakeholders are attached to roles where they are able to contribute in the most productive ways.
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1. Introduction

The theory of the social construction of technology (SCOT) and the theory of technological paradigms (TTP) are generally regarded as competing or even incompatible perspectives on technological change [1–5]. The purpose of this paper is to discuss how and under what conditions SCOT and TTP can be used as complementary tools for analysing technological development. We will present some basic assumptions found in most social theories about technological development. Based on these, we will discuss complementarities between SCOT and TTP. Two extensive case studies will illustrate how a complementary application could be accomplished. Finally, we will suggest how a complementary angle may improve practical innovation projects.

Advocates for SCOT and TTP benefit from the argument that the other theory is an opposite theoretical pole. It becomes easier to explain their own positions when it is possible to contrast them with something diametrically different. Certain scholars emphasise that SCOT were developed as a sociological alternative to neo-Schumpeterian economic theory [6]. And the neo-Schumpeterian advocates take a theoretical perspective that seems to deal with the same topics but from a totally different angle. The difference between the theories

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is to a large extent expressed in behavioural assumptions about the actor. While TTP is based on the concept of bounded rationality [7,8], SCOT theorists consider the actors as socially shaped as a result of interactions, negotiations, and conflicts [9–12].

The main objections to a complementary use of the theories are that different behavioural assumptions involve different epistemological perspectives [9,11,13,14]. Therefore, it becomes meaningless to use the theories as complementary tools. Even though scholars have discussed and criticised SCOT and TTP from different theoretical angles [5,15,16], it is hard to find a systematic comparison of the two traditions. Furthermore, it is very rare to see the two perspectives used together in empirical studies, even though complementary use may actually improve the analysis and enhance the explanations of technology development [17,18].

2. The nature of technology

The term "technology" is a slippery one. The common perception is that technology is machines, devices, and tools used for some purpose. Technology is also understood as artefacts. However, both SCOT and TTP expand these definitions by including what we normally consider as "social" elements of technology. The *Concise Oxford Dictionary* defines technology as the "science of practical or industrial arts; ethnological studies of the development of such arts; application of science." Here, technology is understood as knowledge. However, this definition misses the hardware aspect that is the commonly held perception of technology in everyday language. Maybe the most common way of defining technology is to integrate artefacts and knowledge, for example "artefacts and knowledge about their operations."

But these definitions are missing the context in which all technologies exist. Galtung [19] describes the artefact and knowledge elements as the visible tip of a huge iceberg. Galtung includes structures as part of technology. Structures are the modes of production or the social relations within which tools become operational, and the cognitive structures within which knowledge becomes meaningful. This approach emphasises how social relations surrounding the application of technical knowledge determine the nature of the resulting technology [14,20–22].

Bijker identify three layers of technology [6]: (1) a layer of physical objects and artefacts, (2) a layer of activities and processes, and (3) a layer that refers to what people know as well as what they do. Those who write about industrial development based on incremental perspectives avoid the dilemmas of technology semantics by defining technology as appropriate to their analysis or they do not define it at all. These authors are more concerned about the nature of innovations, technological accumulation through social learning processes, and the institutions affecting these processes [23–25]. Analysis at the firm level normally focuses on the "development, imitation and adoption of new products, new production processes and new organisational set-ups" [3] which goes straight to the point of Dosi's analysis and is fairly representative of most studies about industrial development and technological change [26,27]. The recognition that technology also has some social aspects and determinants has led to the conclusion that it is difficult to separate the social and the technical elements of technology [2,28–30]. The borders between society and technology form a seamless web that constitutes a diligent development of technologies [31].

Regardless of their theoretical position, almost all authors agree that technological changes do not arise out of nowhere. Some of the main starting points for technological development are existing technologies, knowledge, and practices shared by groups or embedded in ongoing production. The *Oxford Dictionary* definition referred to above is based on these assumptions. Studies in different traditions establish their analytical frameworks within a context of existing technologies. The so-called autonomous technology approaches consider these frameworks to be the main imperative for change, and thus they diverge from other approaches [9,12]. Authors close to these schools of thought have developed the concept of "techno-economic paradigms" [32], and in the TTP tradition this observation is labelled "technological trajectories" [2,3]. The system-oriented schools of thought refer to "technological style" [29,33]. Others are aware of "technological traditions" [34]. In the diffusion approaches, analytical perspectives exist based on "technological regimes" [4,35]. In the social constructivist approach, the concepts of "technological frames" are developed [6]. In some way, they are all inspired by what Kuhn called "paradigms" [36], or even more precise, what Lakatos called "research programmes" [37].

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