



Scripting possible futures of nanotechnologies: A methodology that enhances reflexivity

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A B S T R A C T

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Nanoscience is full of promises. However, these promises often do not take into account the realities of product development and the limited coupling with scientific research. On the basis of literature and earlier projects, we have developed a mapping methodology (“bridging gaps in the innovation chain”) and explored it for a particular case, scanning tunnelling microscopy in the liquid phase with two possible applications. The methodology can be used instrumentally, to improve valorisation of scientific research, but also reflexively, to enable scientists (particularly junior scientists) to gain a better understanding of the possible societal contexts of their work.

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1. Introduction

Nanotechnology is surrounded by promises, from grandiose visions about human enhancement and a third industrial revolution, to more pedestrian but nevertheless important expectations about improving a coating or creating a better/cheaper fuel cell. Such promises are important for mobilising resources, both financial and symbolic (political). There are also the risks of hype and ensuing disappointment [1].

The promises can be referred to by nano-researchers in their research proposals and presentations, and may then become more specific. However, in general the promises of nanotechnology are like an aura around ongoing research rather than that there are actual connections made with applications and uptake in society. This, of course, depends on the location of the researcher. In a public research institute devoted to applied and strategic research, connections are being made, and there are networks in place. In universities, the situation is different. While there are now university-based research centres that combine ‘excellence’ and ‘relevance’ [2], applications are far removed from the researcher at the workbench, and particularly for junior researchers (Ph.D. students, postdocs).

This is a challenge, and we believe it is important to explore potential research connections even when they are not (yet) linked to applications. We see this as a way to increase the reflexivity of nanoscientists, in particular junior scientists, about present and future societal contexts of their work, by mapping and evaluating possible linkages rather than just referring to a broadly formulated promise. Such a mapping approach can also help to improve the valorisation of university research.

Such reflexivity is important in general, but definitely so for nanoscientists and engineers. There is an asymmetry: on the one hand, concern about the general public’s lack of awareness and understanding of nanoscience and technology [3,4], but on the other hand, no concern about the limited understanding of society on the part of nanoscientists and engineers. Of course, these scientists and engineers need not become social scientists, but they might become more knowledgeable about relevant tools and insights.

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This is what we want to contribute to in our research project: elaborate a methodology to turn open-ended promises into concrete challenges. At the same time, the project is an attempt at reflexivity-in-action. Our mapping methodology was inspired by the idea of ‘future scripts’ [5,6], which we specified as a possible future innovation value chain that could take up and realize the potential of some nanoscience research. Comparison with the present situation then allows identification of gaps and barriers in the present networks. Such a scripting exercise can be done in considerable detail, including checks and counterchecks with various relevant actors. This is necessary if it is to provide support for strategic choices and robust action. For the task of increasing reflexivity, an exploratory version will be sufficient, particularly if the exploration is conducted by the nanoscientist himself or herself (who will have little time to spare anyway). In this article, we outline the methodology and offer findings from our exploration, including an evaluation of the ways reflexivity is enhanced.

2. Mapping methodology

There are always gaps in actual, and certainly in projected, innovation value chains; these are bridged by global expectations (promises) and projections of what others might do to realize them. Such bridging is reflected in (and actually part of) what is called strategic research. Strategic research is basic research carried out with the expectation that it will produce a broad base of knowledge likely to form the background to the solution of recognized current or future practical problems [7].

Promises can remain empty hand-waving. There might be attempts to check the extent of the emptiness by asking “how realistic is this promise?” Our mapping methodology translates the question of being realistic into a more productive question about present and future value chains, and where nano is going to insert itself. (A similar double question, in terms of present and future networks, was studied in the SocRobust project [8].)

In order to specify an innovation value chain, we started with a sophisticated model of innovation, the Chain-Link model [9,10], which is shown in Fig. 1. In our version, however, we not only look at the intra-organisational innovation chain, but add inter-organisational links and so-called framework conditions—external contexts and structures, like regulation, that are not directly involved with the creation or application of knowledge but do influence what happens.

Key points of the chain-link model are the forward and backward interactions along the chain, and the notion of research as delivering to a knowledge reservoir on which other actors can draw, rather than being part of a linear chain from invention to innovation to (hopefully) market success. The framework conditions are relevant for what happens in the innovation chain (e.g., patent regulation frameworks), but also for embedding in society [11]. Our extended model is also informed by Abernathy and Clark’s 1985 approach [12], where they map innovations along two dimensions: (1) as requiring few or many new competencies and capabilities within the organisations, and (2) having few or many new customer, market, and user linkages. Thus, the scripting exercise should include an assessment of the need for new capabilities in companies and other organisations and for new links between actors, also checking whether and where new actors are emerging in the networks.

The next step is to distinguish between the present innovation value chains, networks, and frame conditions, and the potential future chains, networks, and frame conditions. We use the notion of fictive script [6]: what should be in place in order for the envisaged innovation actually to occur and be successful? One can ask knowledgeable actors about their

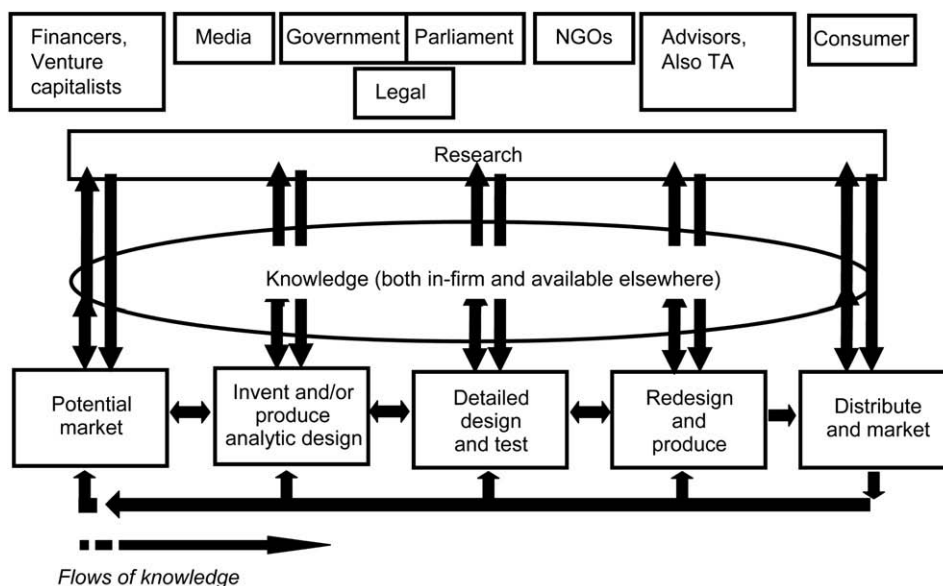


Fig. 1. Chain link model (Phillips 2003 [10]), with additional framework conditions.

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