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Analysis

Achieving Global Climate and Environmental Goals by Governmental Regulatory Targeting☆

Nicholas A. Ashford[a,*], Ralph P. Hall[b]

[a] Technology & Law Program, Massachusetts Institute of Technology, USA
[b] School of Public and International Affairs, Virginia Tech, Blacksburg, USA

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ABSTRACT

Strategic niche management and transition management have been promoted as useful avenues to pursue in order to achieve both specific product or process changes and system transformation by focusing on technology development through evolutionary and co-evolutionary processes, guided by government and relevant stakeholders. However, these processes are acknowledged to require decades to achieve their intended changes, a timeframe that is too long to adequately address many of the environmental and social issues many industrialized and industrializing nations are facing. An approach that involves incumbents and does not consider targets that look beyond reasonably foreseeable technology is likely to advance a model where incumbents *evolve* rather than being *replaced* or *displaced*. On the other hand, approaches that focus on creating new entrants could nurture niche development or deployment of disruptive technologies, but those technologies may only be marginally better than the technologies they replace. Either approach may take a long time to achieve their goals. Sustainable development requires both radical disruptive technological and institutional changes, the latter including stringent regulation, the integration of disparate goals, and changes in incentives to enable new voices to contribute to new systems and solutions. This paper outlines options for a strong governmental role in setting future sustainability goals and the pathways for achieving them.

1. Introduction

This paper traces the strengths and weaknesses of the evolutionary/co-evolutionary processes of transition management (TM) and strategic niche management (SNM) in achieving sustainable development. These approaches mirror ecological modernization (EM) in their focus on learning processes within the firm and among firms in an evolving technological regime that hope to change and accelerate innovation processes in order to achieve more sustainable technologies (Ashford, 2002a). Their early proponents rejected revolutionary and disruptive changes brought on by government fiat, i.e., by regulation (Rotmans et al., 2001), although, curiously, in still earlier work some of them acknowledged the potential of regulation to change technological trajectories dramatically (Schot et al., 1994). Later proponents do argue that a dual policy approach focused on the destabilization of incumbents (echoing a belief in Schumpeterian waves of creative destruction) and the creation and development of new niches are required (Kivimaa and Kern (2016); Grin et al. (2010). However advances in achieving sustainable development may be slow and marginal in nature.

This paper argues that regulation-induced technological innovation has a much greater potential in making the significant changes required to achieving sustainable development by encouraging *radical* rather than *incremental disrupting innovation*, especially from new entrants displacing incumbents (Ashford and Hall, 2011). The new entrants who develop radical disrupting innovations are not niches waiting "in the wings" to develop/evolve further their technologies and eventually displace potentially competitive incumbents, but are more likely to be entirely new firms (such as TESLA) or firms not previously doing business in the area (such as DowSilicone fluid replacing Monsanto's PCBs in transformers and capacitors). TM and SNM processes are argued to be "too little, too late." Nowhere is this more evident than in the area of global climate disruption. Progress that is too little and too late has been made internationally through evolutionary processes. It is time to embark on a different pathway. Stringent regulation has the potential to encourage discontinuous and radical, rather than incremental evolutionary change (Ashford et al., 1985; Ashford and Hall, 2011). Even with stringent regulation, regulatory capture in theory can be as serious a problem as the capture of TM by the incumbents as

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* Corresponding author.
E-mail address: nashford@mit.edu (N.A. Ashford).

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occurred in the energy sector in the Netherlands (Smith, 2003; Smith and Kern, 2007), but the literature reveals that regulation-induced innovation is likely to result in more siginficant change than advances made through TM and SNM.

Unsustainable systems, such as energy production and use, agriculture, and transportation consist of inter-connected components and economic actors characterized by technical (and political) "lock-in" which is difficult to change. We are convinced that strategic stringent regulation of those components, if conceived in an integrated fashion, would be a more successful pathway to sustainability, even if greeted by political resistance.

In this paper, we address the theories of system innovation (Section 2), the strengths and weaknesses of the TM and SNM approaches (Section 3), the argument in favor of a stronger role for government than mere guidance (Section 4), regulation-induced technological innovation as a more viable alternative than TM and SNM for achieving more sustainable development (Section 5), and finally conclude with a discussion of the importance of diffusion (as opposed to innovation) in achieving sustainable development (Section 6).

2. The Innovation Process: Distinguishing Singular Product and Process Changes From Systemic Innovation

Much faith and hope in transforming industrial systems has been placed on the concept of innovation. After all, the root of the word implies change. The innovation process is acknowledged to encompass three related and interactively-connected activities: invention, innovation, and diffusion. Invention is the first working prototype of a technology; it can involve a product, a process, or a manufacturing/service system. Innovation is the first or new market application, while diffusion refers to proliferation of the innovation throughout an industry. When the innovation is then used in other industries, applications, or national contexts, we often also use the term technology transfer to describe diffusion. Finally, if significant adaptation is required in a new context, it is sometimes referred to as a separate innovation (for a full discussion of innovation see Ashford and Hall, 2018, Chapter 6).

While governments, as well as the private sector, generally devote significant resources to create innovations, especially in saleable products although process innovations also receive attention, it is important for our purposes to distinguish what motivates a particular innovation and who provides the financial capital to spur both innovation and diffusion (Ashford and Renda, 2016, p. 36).

Innovation may be driven by technology-push or market-pull forces (see Fig. 1) (Ashford and Renda, 2016, p. 36). Industrial sectors routinely engage in the R&D necessary to develop saleable technologies with the hope that the market will absorb them, even in the absence of nascent market demand. This occurs naturally (as an evolutionary process) and can take decades. Traditional industrial policy that provides government assistance is often said to "grease the wheels of innovation" in hopes of the nation enjoying financial rewards (see the discussion below).

The role of the government in promoting innovation is presented in Fig. 2, indicating all the traditional ways in which innovation might be stimulated (Ashford and Hall, 2011).

The interventions depicted in the figure are of course familiar to those involved with traditional industrial (or perhaps more accurately, innovation) policy that focuses on singular product or process changes. System innovations, discussed below, such as the transportation system or the agricultural system necessarily involve multiple economic actors interacting in larger venues and this model does not adequately represent the complexity involved in system transformations. Technology-push innovations are pursued by profit-seeking firms and by countries seeking to enhance domestic and trade revenues.

In contrast, there are often nascent or express market needs demanding to be satisfied. Market-pull innovations can also be pioneered (Jänicke and Jacob, 2005) by firms recognizing an unmet societal or market need and direct their innovative efforts towards that end. Often the demand is difficult to assess and can wane over time. An example is the need for a better chemotherapeutic approach to cancer, or increased concern for finding a cure for Alzheimer's disease. Often, the R&D need is cutting-edge and financially risky. Government often supports the initial forays into research that is considered too risky by the private sector as exemplified by the development of computers, aircraft, and the Internet (Mazzucato et al., 2015).

When it comes to stimulating innovation (and diffusion) of system transformations – and as we argue in this article – there seems little doubt that government setting of specific medium- to long-term mandatory targets, plus economic support, are essential for achieving transformations within a reasonable period of time (Ashford et al., 1985; Pelkmans and Renda, 2014). For a discussion of targets in the context of evolutionary and co-evolutionary pathways, see Section 4 of this paper. Regulation and mandated targets essentially collectivize public demand or needs through the setting of standards and requirements (Ashford et al., 1985). Costs are imposed on the private sector with cost-sharing achieved through business and R&D deductions. Sometimes direct subsidies are provided. Governments need to understand the different forces giving rise to innovation and diffusion, and not succumb to traditional industrial policy if serious transformations – especially involving the displacement of incumbents or system changes involving many different economic actors – is what is needed. For a further discussion of industrial policies, see Andreoni (2017), Norman and Stiglitz (2017), and Stiglitz et al. (2013). For a discussion of targets in the context of evolutionary and co-evolutionary pathways, see Section 4 of this paper.

In the last decade, the concept of co-evolutionary innovation has been introduced by Dutch researchers injecting government and stakeholder guidance in the selection process entailing strategic niche management and transition management (Grin et al., 2010). This co-evolutionary process is advocated for system innovation, but its promoters admit the transformations can also take decades to achieve.

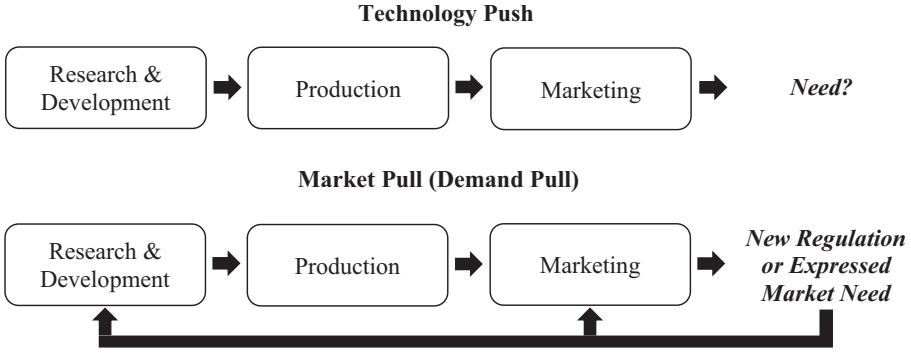

Fig. 1. Technology push vs. market pull innovation.