# Mediating the Uncertainty and Abstraction of Nanotechnology Promotion and Control: "Late" Lessons from Other "Early Warnings" in History

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**ABSTRACT**

*Against the lengthy record and many lessons of past societal experience with the commercialization and regulation of emergent, transformative technologies, which has traditionally emphasized quantitative risk-assessment paradigms, this article suggests the need to consider new constructs for better managing the integration of technologically innovative products and services into society from a risk and liability perspective. Specifically, it posits that the 20th-century emphasis on a classically linear, expert-driven, "black box" approach to technological risk assessment and management is ill-suited to the unique nature and scale of 21st-century technologies—owing chiefly to the fact the relevant calculus for megasciences like nanotechnologies is complicated by a good deal of ambiguity and uncertainty that renders comprehensive risk quantification largely impossible. Another shortcoming of this approach lies in its treatment of technological innovation and its broader cultural (or qualitative) impacts as abstract externalities subsequently attaching to the commercialization of a product or service, as opposed to an endogenous process naturally arising from within that must be integrated into (not imposed upon) society. To better guide the promotion, oversight, and social integration of nanotechnologies from the earliest stage of a product's lifecycle, and for a better risk mitigation strategy from both a civil litigation and regulatory enforcement perspective, the author recommends that regulators and private nanotechnology firms alike consider adopting alternative approaches to technological risk assessment that combine traditional risk assessment tools with those of "constructive technology assessment."*

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## I. INTRODUCTION

Nanotechnology presents all stakeholders something unique in regard to general high-tech innovation: the chance to get things right the first time, by building on the lessons of past societal experiences with transformative technology. There are enough published accounts to avoid repetition here—genetically modified foods, civilian nuclear power, and, more recently, biofuels. The common denominator is lack of public trust and confidence in the ability of government, science and industry to characterize and manage the human health and environmental risks of new technology effectively, all the more so considering the exponential scale and pace of nanoscale science and engineering.

## II. 20TH CENTURY REGULATORY PARADIGMS MEET 21ST CENTURY SCIENCE

It is intuitively difficult to assume—on the basis of "substantial equivalence" or otherwise—that early 20th century regulatory models rooted in the peculiar nature and scale of 19th century industrial development can keep pace with something as robust and dynamic as nanoscale science, on all counts. This seems especially significant in light of the novel nature of nanotechnology itself, which one observer has likened to "rediscovering the periodic table of elements."[1]

On close study, one failing of past regulatory oversight of emergent technologies has chiefly been the closed nature of its decision-tree structure. Except through the relatively limited, passive filter of representative democracy and "open public meetings," there has been little real multi-stakeholder dialogue with regard to the business of managing the risk landscape of so-called "megasciences," from biotechnology to nanotechnology. As a vestigial part of an earlier industrial age, regulators and risk managers typically take a classic risk assessment approach, grounded on the premise that *x* amount of health risk, environmental harm and associated costs, narrowly defined, is (or is not) outweighed by *y* amount of consumer benefit, industrial commerce, and revenue. The relevant calculus for megasciences like nanotechnology, however, is more complicated. In the first instance, the risks and benefits are largely undefined and unknown, rendering their full quantification largely impossible. Additionally, taking account of uncertainty, which Donald Rumsfeld once famously called "unknown unknowns," arguably takes one a long way to understanding how to improve the chances of successfully commercializing nanotechnologies, while at the same time balancing risk and benefit—broadly speaking.

## III. NEW PROMOTION AND CONTROL PARADIGMS: CONSTRUCTIVE TECHNOLOGY ASSESSMENT

Clear and coherent nano-specific regulatory oversight is probably years off, which is almost certainly too long when one considers that "a nanosecond is to a second as a second is to 30 years."[2] In brief, there is not enough quantitative certainty surrounding nanotechnology to satisfy traditionally linear risk assessment parameters (that is, control or oversight models) at any point in product or process lifecycles. Further, market forces such as commercialization cannot (and will not) await the arrival of nano-focused regulatory oversight. With nanotechnology, there is simply too much opportunity to be lost awaiting the arrival of clarifying regulatory sanctions, standards or guidance.

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[1] *See* Press Release of Congressman Lamar Smith (R-TX), "Smith Nanotechnology Bill Passes House," June 5, 2008 (quoting Dan Holladay, Director of SVTC Strategic Development) (available at http://lamarsmith.house.gov/Read.aspx?ID=1063).

[2] *See* CHRYSTI THE WORDSMITH, VERBIVORE'S FEAST: A BANQUET OF WORDS & PHRASE ORIGINS 234 (2004) (quoting remarks made in 1964 by David Sarnoff, a longtime RCA executive).

In the meanwhile, companies in the field can either follow uncertainty (uncertainly) or proactively lead on the basis of bold, new governance paradigms every bit as innovative and transdisciplinary as the nature of nanotechnology itself. More specifically, nano interests should consider establishing defensive positions on the foundation of classic technology assessment (TA) tools supplemented by what is called constructive technology assessment (CTA), which includes social and environmental considerations as factors relevant to the integration of new technology into society. With CTA, the goal is to understand and manage technological risk on a more pro-active, inclusive, transdisciplinary, and collaborative multi-stakeholder basis than has been standard governmental or industrial practice to date.[3]

## IV. PUBLIC PERCEPTION IS CRITICAL TO INVESTMENT IN AND CONSUMER ACCEPTANCE OF NANOTECHNOLOGIES

One lesson of past experience is the need to open the deliberative process to different perspectives and inputs by bringing all interested and otherwise impacted stakeholders to the table for transparent, participative discourse on matters that are ultimately as much about the social sciences as they are about the so-called hard sciences.

As part of this process, one of the voices that must be heard—in many respects the most important nanotechnology stakeholder—is the public's. It is public perception that ultimately drives, *first*, investment in the markets and, *second*, consumer acceptance of nano-based products due to the perceptions of nanotechnology's wider social costs. In short, the public should be brought into the risk management process at the earliest opportunity. Without it, the risk is that the nanotechnology bridges already being built on many fronts will become bridges to nowhere. There is also much litigation peace to be won and costs to be saved due to seeking multi-actor dialogue and collaboration from the outset—(a) in the framing of relevant risk assessment questions, (b) in the marshalling of evidence representing broadly diverse societal interests to better inform socially responsible action, and (c) in terms of how the integration of nanosciences and products into society—the balancing of *promotion* and *control*—might be managed for the widest possible good.

The U.S. is a good example because the process of reauthorizing the National Nanotechnology Initiative has exposed a deeply polarized debate over the amount of federal nanotechnology dollars that should be devoted to further research and better understanding of the environmental, health and safety (EHS) risks of nanotechnology as a percentage of the nation's total annual nanotechnology budget ($1.5 plus billion federal dollars for 2008). Only $76 million of this outlay has been earmarked by the White House for EHS-related research of nanotechnologies (significantly less than the annual payroll of a number of major league baseball teams). Early in the debate, there were calls to require that ten percent of the federal government's nanotechnology R&D budget be set aside for EHS-related studies, which was vigorously opposed by the White House and ultimately deleted from the House bill. However, there must be better balance between the government's promotion and control of nanotechnologies if their integration into society is to succeed.

Instead of assigning arbitrary values or percentages to EHS research, a better alternative might be to run all federally and privately funded nanotechnology research and development work using a combination of classic TA and the new paradigm of CTA for risk assessment and management purposes, accounting for EHS and other risks as an integral part of the promotion process. Adding a qualitative CTA component to traditional quantitative risk management could help to shape public understanding and lead to acceptance of nanotechnologies at the earliest possible state of the product development cycle.

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[3] *See generally* A. RIP *ET AL.*, MANAGING TECHNOLOGY IN SOCIETY: THE APPROACH OF CONSTRUCTIVE TECHNOLOGY ASSESSMENT (1995) (collecting essays outlining CTA in theory and practice).

## V. CONCLUDING THOUGHTS

In the end, with or without the intervention of clear regulatory oversight, the management of technology in society is about the democratic process, defined by the consent of the people (*i.e.*, impacted stakeholders). The need to capture diverse, outcome directed decisional inputs on a multi-stakeholder basis through transparent deliberative processes is of overriding importance in the mediation of uncertainty inherent to the process of technological innovation. While industry decision-makers and risk managers may not have the luxury of waiting for regulatory guidance in the ongoing race to market, neither are they necessarily without precedent for being more proactive about the issue of EHS risk management in the interim.

Careful study of the "late lessons" of man's experience with innovative technologies since the late 1800s generally suggests that the methodology of traditional technology assessment (TA), treating technological innovation as "black boxes" to be opened only by "expert" scientists in relatively closed-network discourse with government and industry leaders, is not enough by itself to reduce potential liabilities.[4] This history illustrates the need to consider new paradigms for managing the socio-environmental risks of technological innovations like nanotechnology. In light of these considerations, active multi-actor and public engagement over competing spheres of nanotechnology *promotion* and *control*, in recognition of the fact that new technologies are endogenous, not exogenously imposed on society from without, may be the best risk mitigation strategy from both a civil litigation and regulatory enforcement perspective.

While regulators outside of the Netherlands and Denmark (where CTA is official policy) are unlikely to adopt CTA in the near term, nanotechnology firms could meanwhile strive for greater market stability and avoid *post hoc* operational disruptions (in the form of PR problems, litigation, and *ad hoc* regulation) by proactively combining classic technology assessment tools with those of constructive technology assessment to better guide product promotion and control efforts from the earliest stages of nanotechnology product lifecycles, beginning with design.

This recommendation reflects the observation of Rip, *et al.*,[5] and the "late lessons" of other "early warnings" in regard to the integration of technology into society. The social and environmental impacts of technological innovation are not abstract externalities subsequently attaching to the products of technological innovation in the marketplace after the fact. Rather, they are factors actually co-produced by the very products born of technological innovation in the first place, and should ideally be managed from this perspective.

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[4] *See* European Environment Agency, *Late Lessons From Early Warnings: The Precautionary Principle 1896-2000*, Environmental Issue Report No. 22 (2001) (cataloguing international experience with the regulation of new technologies).

[5] *See* RIP, *supra*, note 3.