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Nanotechnologies and new dynamics in risk management.

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The purpose of this paper is to explore new dynamics in risk management by focusing on the case of the development of nanotechnologies. The development of any new technology raises issues relating to the process of measuring or assessing risk and developing strategies to manage it (Cothorn, 1995; Johnson & Covello, 1987; Singh, 2006; Vogel, 2003). The difficulty with nanotechnologies is that it is at present extremely difficult to measure or assess the risks linked with the development of nanostructures. Nanotechnology refers to the science and technology of developing new materials and devices by working at the atomic and molecular level, at a scale which is inferior to 100 nanometres in one dimension ($1\text{nm}:10^{-9}$ metres). In many cases, materials that are sub-divided to a nanometric scale display different behaviours than their bulk counterparts. The reasons for such nano-effects remain an active topic of research but include a higher relative dominance of surface reactivity, quantum confinement of electrons that lead to phenomena such as narrow bands of fluorescence, and a size scale that is comparable to that of many biomolecular structures. The unique properties of nanoscale materials are inspiring a wide range of applications that span computer storage, semiconductors, medical treatments, advanced manufacturing and energy. The differences between materials in their

nano- and bulk- formats that make them of interest in new applications also suggest that these materials may interact differently with ecosystems and living cells. The development of nanotechnologies seems to raise as much hype as fear concerning its future impact on society: on the one hand, it lies at the core of technological innovations said to have the potential to revolutionize society so deeply as to bring a new post industrial era; on the other hand, it raises questions linked to ethics, to the management of the unknown, to potential harms in a way that is seemingly entirely new.

Drawing from this highly topical empirical context, in this work we analyse changes in risk management that consider potential benefits and risks associated with these emerging technologies. We first consider factors that may set apart nanotechnology applications from previous innovations, particularly in terms of metrology and risk assessment. We then analyse two sets of public engagement experiments undertaken in the last five years in the nanotechnology field and how these relate to the emergence of a new type of institutional framework around the development of nanotechnologies. We observe that in the area of risk management, the development of nanotechnologies appears to be generating a mechanism for aggregating the expectations of various stakeholders, resulting in a new form of institutionalisation that grows out of previous, largely negative, experiences with technological innovation.

The paper is firmly anchored in institutional theory. It integrates the findings of institutional economics which establish relations between the performance of economies and institutions and institutional change (North, 1990). Institutional theory also provides the theoretical model of analysis for the process of institutional

construction around the development of nanotechnologies (Lawrence, Hardy, & Phillips, 2002; Lawrence & Suddaby, 2006; Phillips, Lawrence, & Hardy, 2004; Tracey, 2005).

The major finding of the paper is that a traditional top down approach of risk management alone is likely to be insufficient in addressing the concerns raised by emerging nanotechnologies. It also highlights that technology and society run on a system of checks and balances: in the constant and parallel evolution of both technology and society, society ratchets-up technological innovation, using the latest technological developments to safeguard itself against other possible technological dangers. This is what underscores the trends in nanotechnology risk management and regulation.

The paper makes the following contributions: firstly it confirms previous studies which show that society plays an important regulatory role in innovation (Chataway, Tait, & Wield, 2006; Jaffe, Newell, & Stavins, 2005). Secondly, in studying the relations between technological innovation and the shaping of institutional structures, it provides new insights into the emergence of institutions. In particular, by placing the construct of a new form of risk management at the core of institutional emergence, it provides a fresh approach of institutional theory. It also extends the emerging body of institutional theory literature which explores how institutional change is emergently produced by heterogeneous activity at various locations by actors with varying kinds and levels of resources. Finally, by assessing the relative importance of the characteristics of nanotechnologies in the design of an institutional framework for their development – particularly in the areas of risk assessment and management – it sheds new light on the links between institutions and technology (Wiesner, Lowry, Alvarez, Dionysiou, & Biswas, 2006)

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