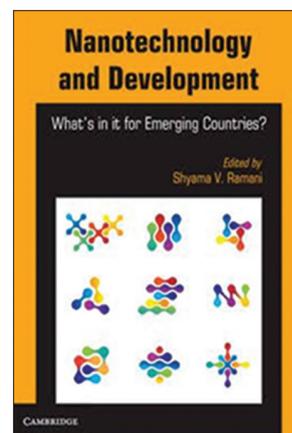


# Nanotechnology and Development: What's in it for Emerging Countries?

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Nanotechnology is promising to be the “transformative” technology of the 21<sup>st</sup> century with its boundless potential to revolutionize a wide range of industries, perceived to provide novel innovative solutions to complex technological problems, create functional and highly differentiated products in high technologies as well as in areas that are of pressing concerns in developing and improvised economies, i.e., environment, water purification, agriculture, energy and in a host of other products and services. Some of the “promises” are beginning to take shape with nanotechnology emerging as an enabling technology in improving the functionality of processes and products in various sectors and areas of developmental challenges. Unlike other key technologies, emerging economies have been actively involved in developing capability in this key field. However, translational research (converting “blue sky” research into a tradable commodity) has been an outlier in spite of promising research seen in emerging economies. What would be the effective policy interventions to bridge the “valley of death” remain a puzzle for policymakers, particularly in emerging economies. This book provides some useful insights and plausible interventions for policy makers to design new institutional mechanisms for more effective translations.

The book brings together some of the key innovation scholars exploring this area from diverse backgrounds and countries to provide a fresh insight of nanotechnology development globally. Case study method undertaken in this book is highly useful as it allows one to capture in-depth the process that led to a particular outcome. Another useful approach of the book is to draw attention to the “black box,” i.e., “what the technology is?” This

embedding makes the arguments and policy suggestions more relevant. Moreover, this critical examination of technology is refreshing as STS/innovation scholars have a general tendency to avoid understanding the intricacies of a technology in spite that being the context of their socioeconomic analysis. For policy scholars, the book posits some new strategies for developed and developing economies for exploiting nanotechnology.

The book is structured into two analytical building blocks: Case studies from developed countries and emerging economies. Chapter 1 “Introduction to nanotechnology and participation of developing countries” by Susan E. Reid, Roger Coronini, and Shyama V. Ramani makes a convincing argument of potentiality of nanotechnology and opportunities it provides for developed as well as developing countries. It provides a useful matrix of the “window of opportunity” with scientific and technological and economic capacity of countries. This introductory chapter makes the setting for the case studies that follows in subsequent chapters. Four case studies (Part II) capture the nanotechnology development in developed countries. The first case study, Chapter 2 “Learning from Solyndra: Changing Paradigms in the US Innovation Systems” by Christopher Newfield and Daryl Boudreaux gives insight of what can lead to a firm’s failure in spite of having a promising technology. Missing innovation support system at later stages of commercialization, business model that could not change with new realities and new aggressive approach by China emerges as possible failure factor. The author proposes a new model, “social innovation technology” and argues that this approach can be a useful strategy for countries.

How do knowledge intensive locations emerge? This has become an important question for policy makers as a high performing economic region strongly correlates with knowledge intensive locations. The study by Dominique Vinck and Shyama V. Ramani, “How is a regional technology cluster created? Insight from the construction of the nanotech cluster in Grenoble” addresses this issue by examining development of nanotech cluster in Grenoble. It highlights an evolutionary process of development identifying a number of stages through which the cluster developed. Among the interesting aspects covered is discussion on how the consolidation and connections emerge among institutions. A few key players can become game changer – a similar phenomenon observed in Silicon Valley. The important lesson one draws from this study is that Grenoble became successful due to visionary and motivational role of a few individuals, varied type of economic actors linking with knowledge intensive centers and functional processes (e.g., networks or value). More informed view of types of linkages between actors is explored in Chapter 4 “Co-patenting patterns in nanotechnology: A comparison of South Korea and Germany” by Ad Notten and Shyama V. Ramani. Comparison between industrial powerhouse, Germany and Korea emerging as the new hub of postindustrial economy makes an interesting case. Application of Social Network Analysis to study the patterns would motivate other scholars to explore this analytical approach.

It is not surprising to see that Part III of the book covering four case studies from nanotechnology development in developing countries begins with a critical examination of nanotechnology development in China. China has emerged as key player in nanotechnology, particularly when looked in terms of funding, research publications, and standard making. Chapter 5 “Sure Bet or Mirage? On the Chinese Trajectory in Nanotechnology” by Can Huang and Yilin Wu shows China’s massive investment in nanotechnology, with nanotechnology being seen as one of the enablers for its overall catch-up strategy. To some extent, the case study highlights that in spite of challenges ahead, particularly in making translation happen, China’s nanotechnology development is promising. China’s case study follows up with examination of Brazilian approach to nanotechnology development by Nedson Campos. Brazil being the leading industrial region of South America, its policy interventions for nanotechnology development makes an interesting case. The study examines development of nanotechnology in the larger context of efforts and programs by the Brazilian

government to develop scientific and technological capabilities. This analytical approach helps to situate nanotechnology development in a proper context. In spite of Brazil having developed various types of institutional mechanisms for development of nanotechnology, research to innovation, and commercialization remains, which in a sense epitomizes challenges of other developing countries.

Chapter 7 by Edward Rables Belmont and Rabeca de Gortari Rabiela examines nanotechnology development in Mexico. It would have been interesting to see how nanotechnology development has happened in a country, which is not prominently addressed by research scholars. However, this chapter emerges as a weak link in the whole book with many unanswered questions. It attempts, for example, to make a weak argument that successful nanotechnology development can happen by supporting nanotechnology within S&T programs. The important question, the chapter should have examined in the context of “catch-up,” is whether this approach is leading to knowledge commercialization/translational research. Chapter 8 “On India’s Plunge into Nanotechnology: What are good ways to catch-up?” by Shyama V. Ramani, Nupur Chowdhary, and Roger Coronini provides insights to nanotechnology development in India that similar to other emerging countries are looking toward this technology as a “window of opportunity” for addressing its socioeconomic challenges. Policy recommendations given in the chapter for promoting nanotechnology development in India would be useful for other emerging countries.

The concluding chapter “Nanotech after biotech in emerging economies: Déjà vu or a new form of catching up?” by Shyama V. Ramani and Jorge Niosi makes an assessment of nanotechnology development in emerging countries drawing from the case studies presented in the book. Can nanotechnology be the panacea for “catch-up?” and Are the strategies pursued by emerging economies can lead to promised goals? are some of the questions the authors introspect. The key argument that they posit keeping the overall presentations of this book is: That “resource investments” can go waste if it is not accompanied by “institutional reforms.”

Overall, I would say that the book is an extremely important compilation and should be a very useful addition in the reading list of scholars of STS/innovation studies and policy makers. However, missing from the repository are Environmental, Health and Safety/ethical, legal, and social

implications (EHS/ELSI), responsible nanotechnology development, scalability issues. The first chapter rightly flags the scalability of this technology as a major issue. It would have been useful if more attention was drawn to this in later chapters. Scalability further brings the issues of ELSI/EHS, translational research, and overall the argument of responsible technology development to the foreground. How policies are being developed to regulate nanotechnology (more specifically nanomaterials) in different countries and blocks such as EU are also not addressed. In some chapters, authors' resorts to directives and positivist approach wherein a reflexive position would have enriched the discussion further. Case study of nanotechnology firms from emerging economies would also be a very useful addition. However, these critical observations do not take away the excellent task undertaken by the editor to bind the different case studies together. I would say that this calls for another edited volume coordinated by the editor that addresses the above issues/aspects.

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