Chapter 5
Towards the Sixth Kondratieff Cycle of Nano Revolution

Jarunee Wonglimpiyarat
Thammasat University, Thailand

ABSTRACT

Nanotechnology is currently seen as a paradigm shift towards scientific revolution or ‘nano revolution. This chapter discusses the nano revolution within the global context. It is interesting to see that the governments around the world have formulated policies to manage the research and development (R&D) efforts and exploit the potential of nanotechnology to increase industry's ability in the global economy. The chapter analyses the successive waves of technological change based on Kuhn's model of scientific change and Schumpeter's model of Kondratieff cycles. As nanotechnology would have significant impacts on virtually every commercial sector, many countries commit to foster nanotechnology developments. This chapter will focus on nanotechnology framework policy recommendations. The policies and research activities of the most preeminent nations discussed in this chapter represent global research trend towards nano revolution in the next decades.

INTRODUCTION

Nanotechnology is widely perceived as one of the key technologies of the 21st century that would transform the world's economy (Roco and Bainbridge 2002). The supramolecular architectures represent a new revolutionary approach in research and production. The nature of interdisciplinary technology research makes it useful in many applications. Nanotechnology has been recognized as a promising new growth technology, opening up a floodgate of opportunities for developing viable applications (Roco 2001, Luther 2004). In other words, this field of technology offers the possibility of transforming the international science and technology policy landscape and making significant impacts on the direction of research and development for a wide range of nations and companies (Michelson 2008). Given that nanotechnology is one of the fastest-growing

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research areas in scientific and technical fields in the world, it is expected that nano revolution would create a wealth of new materials and manufacturing possibilities (Ikezawa 2001, Wilson 2002, National Science and Technology Council 2006). It is now a science and technology priority area for many countries with the governments' efforts to put the results of nanotechnology development to commercialization. The national policy for nanotechnology is to change the existing technology system and bring about an industrial revolution (the nano revolution). Under the pressure of competition, the key to a success would lie in how each country could find the right application to focus on in order to survive through international competitions.

At present, the limit of mono-disciplinary science to reach a solution to a particular problem sets the stage for the possibility of scientific revolution - the progress towards broad research areas such as physics, biology, materials and engineering sciences. Within the global economy, there is a large potential given by the opportunities of nanostructures for the commercialization. The scientific and technical challenges of working at the nano scale are huge as nanotechnology is expected to cause discontinuous progress and provide massive industrial applications. Many industrialists see that the commercial potential of nanotechnology will have at least the same magnitude as biotechnology. However, while previous research studies have focused on improvements of advanced materials and manufacturing techniques, the policy perspective of nanotechnology has received little attention. The study attempts to fill this gap by looking into a global perspective of nano revolution with an aim to understand developments in nanotechnology innovations and the extent to which the nanotechnology would affect the whole economy. The focus of this chapter is on policy recommendation to assist the science and technology-based economic development in the global economy.

The structure of this chapter is as follows. Section 2 presents the literature review on the models of technological change. Section 3 discusses nanotechnology as a revolutionising technology bringing about a paradigm shift in industrial research. Section 4 discusses the structural crisis and technological forecasting of nanotechnology. It also reviews nanotechnology policies and research activities of some of the most preeminent nations in nanotechnology initiatives - USA, China, Germany, South Korea, France, Taiwan. The policy recommendations to encourage the undertakings of nanotechnology research and development towards the revitalisation of the global economy as well as conclusions are drawn in Section 5.

MODELS OF TECHNOLOGICAL CHANGE

There is a clear implication that technological change is the phenomenon of structural crises of adjustment (Freeman and Perez 1986, 1988; Dosi 1982, 1988). From reviewing the common ground in relation to the progress of business cycles, the technological change is argued to be a fundamental driving force bringing about economic growth. In respect of evolutionary economics, technological change reflects the innovative efforts with varying degrees of appropriability and uncertainty about the technological and commercial outcomes. According to Dosi's models of technological paradigms and trajectories, the term 'technological paradigm' is defined as a pattern for solution of selected techno-economic problems based on highly selected principles (Dosi 1982, 1988). Similarly, Freeman and Perez (1986, 1988) used the term 'techno-economic paradigm' to refer to an innovation that affects the whole economy e.g. steam power, electric power, electronic computer. Tushman and Anderson (1987) further argued that there are 2 processes of technological change: competence-enhancing and competence-