Chapter 82
Institutions as Enablers of Science-Based Industries: The Case of Biotechnology in Mexico

Marcia Villasana
Tecnológico de Monterrey, EGADE Business School, Mexico

ABSTRACT

Biotechnology impacts across different industrial uses of the life sciences, and has acquired a relevant role in addressing challenges faced by world economies such as those related to food, water, energy and healthcare provision. Many governments in emerging economies looking to exploit some of the opportunities provided by advances in biotechnology design institutional frameworks to cope and develop this complex science-based industry. In this context, a country´s science, technology and innovation institutional structure plays a key role in shaping the outcomes, commercialization, investments, and alliance strategies of this particular industry. This chapter builds on the innovation systems perspective to describe how institutions act as enabling factors for innovation and research in biotechnology. These factors are, as defined by the Biotechnology Industry Organization, infrastructure for R&D, human capital, intellectual property protection, regulatory environment, technology transfer frameworks, market, and commercial incentives.

INTRODUCTION

The development path for science and technology-based industries is strongly linked to a co-evolutionary process with national institutions. Institutions provide the incentives that are key to economic actors by influencing the organization of production and investments in technology and physical and human capital (Acemoglu, Johnson, & Robinson, 2005). For emerging economies, such as Brazil, India, and China, this may be more preeminent, due to the stronger influence of government and society on both an organization´s processes and decision making than in developed economies (Hoskisson, Lorraine, Lau, & Wright, 2000).

DOI: 10.4018/978-1-5225-9273-0.ch082

While still many institutions appear to best suit industries in which physical capital drives growth (OECD, 2014), for some new sectors and sub-sectors growth and expansion is highly dependent on the discovery and application of new technologies (Hirsch-Kreinsen et al., 2005). For those industries with special input and skill needs, their growth and effectiveness are "strongly conditioned by how rapidly and effectively a support structure grows up" (Nelson, 1994, p. 144).

The institutional system conditions the returns generated by investments in physical capital, human capital, or in new developments through laws that protect intellectual and industrial property, the prevention of improper appropriation of benefits, among other beneficial consequences (Giménez & Sanaú, 2007). The level of institutional development supporting technological innovations conditions how institutions might change a sector´s distance to the technological frontier (Aghion, 2006), thus impacting a country´s level of economic growth (Aghion, 2006).

One of the technologies that have opened new economic spaces is biotechnology (Kenney, 1998). It is regarded as essential for ensuring long-term economic development as well as environmental sustainability (OECD, 2014). The rapid advancements in biotechnology address the challenges that the world is facing today in the provision of water, food, energy, and human and animal healthcare (OECD, 2009a); however, for nations it poses the challenge of being a global issue due to concerns such as environmental and health risks and the influence of developed countries on policy, trade, and investments (Aerni & Reider, 2001).

For many, modern biotechnology is considered a new economy industry that is rather young, with a little over four decades of existence (BIO, 2015). Still, some consider that biotechnology is not an industry in itself, with no Standard Industrial Classification (SIC) code as yet (Hermans, Kulvik, & Ylä-Anttila, 2005; Niosi & Reid, 2007). In most advanced industrial countries biotechnology is an enabling technology for other industries (Kenney, 1998). Biotech-derived products and services have applications in different industrial sectors such as pharmaceuticals, agriculture, food processing, chemicals, among others (Bartholomew, 1997; Kenney, 1998; Niosi, 2011).

The industries that involve biotechnology present the general features of a science-based sector (Owen-Smith and Powell, 2004), in which the most important sources of technical progress result not only from R&D efforts, but also from fundamental discoveries of basic science that may lead to new product markets and a wide array of potential applications (Bell & Pavitt, 1992). For example, transgenic plants are potentially one of the most economical systems for large-scale production of recombinant proteins for industrial and pharmaceutical uses (Badillo-Corona & González-Rábade, 2013); or glycosides have been recognized in their beneficial implications in the treatment and prevention of cancer and cardiovascular disease, as well as antioxidants or in self-defence processes (Brito-Arias, 2013).

Besides a strong science base, biotechnology requires infrastructures to reinforce the capabilities and innovation processes of new firms (Kaiser & Prange, 2004; Kenney, 1998). The pace of discovery and transformations in this industry calls for supportive regulatory and institutional conditions. According to the Biotechnology Industry Organization, the largest trade organization representing the biotechnology industry in the world (BioSpace, 2016), among the factors that are considered as enablers for biotechnology activity are the following: availability of human capital; infrastructure for R&D; intellectual property law; the regulatory environment; technology transfer mechanisms; market and commercial incentives; and the general legal environment (BIO, 2014). These enablers may be developed and/or promoted through the prevailing institutional framework in each country (Niosi, 2011).

This chapter addresses how biotechnology, as the key to new economic spaces, has been supported in Mexico by discussing the above mentioned enabling factors in this emerging economy. Nowadays,