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# Characteristics of the Italian biotechnology industry and new business models: the initial results of an empirical study

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## Abstract

This study focuses on the Italian biotechnology industry, with particular reference to the way in which innovation is generated and managed in Italian biotechnology companies. A preliminary analysis of the literature regarding this topic resulted in two significant findings: the empirical data on biotechnology companies is limited and incomplete and the definition of these companies is ambiguous. Therefore, the first objective of the study was to precisely define biotechnology companies. Once this was done, a survey was carried out using postal questionnaires in order to make a profile of the industry based on the data gathered from the questionnaires that 100 companies completed. This information was then used to make initial hypotheses regarding the business models adopted by the companies in the industry. More precisely, five business models were identified, whose validity will be analyzed by case studies as a part of the continuation of this research.

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## 1. Introduction

Biotechnologies are one of the most important emerging technologies due to the numerous possible applications they have, many of which are yet to be explored, and for the pervasiveness that characterizes them. The knowledge and competencies of many different scientific fields come together in biotechnologies and consequently the applications that can be derived from them can be used in many different fields. Therefore, biotechnologies are one of the most important 'engines' of growth for knowledge-based industries. The aim of this study was to analyze biotechnology companies which, in addition to having the unique characteristic of being high tech and science-based companies, are characterized by a significant evolution in company organization and management.

In order to carry out a study of this nature, an empirical database containing data regarding the situation of biotechnology companies in Italy was needed to serve as a starting

point for analyzing this type of company. An analysis of the literature regarding this topic made it possible to conclude that the data available is quite limited, e.g. there is not even a catalogue of biotechnology companies in Italy, and, what data does exist is quite ambiguous since in the studies thus far carried out, the definitions of biotechnology companies used appear to be extremely vague and varied.

Therefore, the specific objectives of this study were to:

- take a census of biotechnology companies in Italy, after having defined them as companies which are innovative and carry out research and development, or at least industrial development;
- describe the organization of these companies, with particular reference to their innovative processes;
- identify the business models adopted by these companies with the aim of continuing this research with a case study of these models.

The method chosen for the study included:

- an analysis of the international literature, with particular attention given to previous empirical research studies aimed at characterizing biotechnology companies;

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- a postal questionnaire survey was used to gather and process data regarding 100 companies in the industry in Italy;
- a comparison between the results found in the literature and the results obtained from this study.

## 2. The many applications of biotechnologies

According to the Organization for Economic Cooperation and Development (OECD, 1989), biotechnology is the use of scientific and engineering principles (based on microbiology, genetics, biochemistry, chemical and biochemical engineering) to transform materials using biological agents (such as microorganisms, enzymes, animal or vegetable cells) with the aim of producing goods and services (OECD, 1989). Pharmaceuticals, new diagnostic kits, foods, chemical compositions, and new therapeutic methods are some examples of the goods obtainable, and environmental control and the treatment of effluents are among the services obtainable.

The use of biotechnology actually goes back thousands of years and can be considered to coincide with the beginning of agriculture: biotechnological type processes are used to obtain products known since ancient times, such as beer (produced by the fermentation of grains), yogurt and wine, just to name a few.

In order to better understand the many uses of biological technologies made throughout history, the OECD has classified biotechnologies into three categories:

- traditional biotechnologies, which are thousands of years old, such as fermentation;
- modern biotechnologies, which were developed after the industrial revolution, such as the biological processes used to obtain vaccines, enzymes and hybrids;
- new biotechnologies, which have been developed since 1970, thanks to the discovery of DNA recombination and cell fusion.

Recent discoveries in the field of genetic engineering have led to a significant increase in and diffusion of the possible uses of biological technologies. In fact, these technologies can be applied in many different fields, the most important of which are listed here below (see website: [www.assobiotec.it](http://www.assobiotec.it), Spalla, 1996; Alberghina and Cernia, 1996):

- *Healthcare*: Biotechnologies have so far been developed more in this field than in any other field and regard both pharmaceuticals and diagnostics. In the field of pharmaceuticals, research in biotechnology has made it possible to identify new types of pharmaceuticals as well as produce vaccines, anti-infection and anti-tumor pharmaceuticals, hormones and antibiotics using new methods. In the field of diagnostics, the use

of monoclonal antibodies (which specifically recognize antigenic substances) and gene probes (which recognize specific DNA sequences) make it possible to obtain reliable and repeatable diagnostic tests that can define a clinical situation quickly and economically and provide useful information on the therapy to be used.

- *Agriculture/zootecny*: In agriculture, genetic engineering techniques make it possible to ‘increase the productivity of crops, improve the quality of crops and the nutritional properties of products, reduce the environmental impact of agricultural activities’ (see website: [www.assobitec.it](http://www.assobitec.it)), increase the resistance of plants to harmful insects and to diseases caused by pathogenic agents. However, the use of new biotechnologies in the agricultural industry is limited by strict legislation on genetically modified organisms (GMOs). Innovative biotechnologies can be used not only to obtain transgenic plants, but also to produce microbiological mixes which help plants defend themselves against harmful insects, in other words, without modifying a plant’s DNA. This is the case, for example, of the Italian company Isagro, which produces pheromones used in developing eco-compatible plant defense systems.
- *The food industry*: The development of traditional biotechnologies made it possible to improve biological and fermentation processes which in turn made it possible to produce food on an industrial scale in a standardized and controlled way. Modern biotechnologies can be used to ‘manipulate organisms and intervene on fermentation technologies to improve the characteristics of food or even ‘invent’ new ones’ (Alberghina and Cernia, 1996). Therefore, the main areas of application go from the production of new enzymes to the improvement of the stocks of microorganisms used in fermentation. In recent years, in fact, there has been a tendency in the food industry to substitute chemical processes with biological processes, which better conserve the qualities and properties of products.
- *Fine chemistry*: In the last two decades, important applications have been developed for the use of biological technologies in the chemical industry. In particular, these applications deal with the development of new products (e.g. the Italian company Novamont developed a new biodegradable material called Mater bi), i.e. the development of alternative processes for producing chemical compositions. Enzymes, which were discovered thanks to modern biotechnologies, are used as catalysts in many industrial processes. Some important examples are the use of enzymes as a substitute for phosphoric acid to produce acrylamide, or, in the paper industry, where the use of these microorganisms has significantly reduced the use of chlorine.

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