*IIIEE Master's Theses 2002:2*

# Corporate Social Responsibility and Biotechnology

## Identifying social aspects for European biotechnology companies

*Antje Simon*

the international institute for
industrial environmental economics
Lund University, Sweden

iiiee

Lund University, Box 196, 221 00 Lund, Sweden. Telephone: +46 46 222 0200 Fax: +46 46 222 0210 Web: www.iiiee.org

IIIEE Master's Theses 2002:2

# Corporate Social Responsibility and Biotechnology

Identifying Social Aspects for European Biotechnology Companies

**Antje Simon**

Vladimir Dobes

Murat Mirata

Thesis for the fulfilment of the
Master of Science in Environmental Management and Policy
Lund, Sweden, September 2002

The International Institute for Industrial Environmental Economics
Internationella miljöinstitutet

Published in 2002 by IIIEE, Lund University, P.O. Box 196, S-221 00 LUND, Sweden,
Tel: +46 – 46 222 02 00, Fax: +46 – 46 222 02 10, e-mail: iiiee@iiiee.lu.se.
Printed by KFS AB, Lund.

ISSN 1401-9191

# Acknowledgements

It is not possible to express all my thankfulness towards my family within a few lines. The support I got during my studies and finally also for this master programme is something very special. Without them it would have never been possible for me to go through all those ups and downs and at last succeed with this thesis work the way I did. I love you!

My warm thanks go to my 25 Batch mates from all over the world. It was one of the greatest experiences of my life to suffer, celebrate, cook, party, lose hope, be angry, learn, laugh, and somehow live those 14 months together. By sharing our experiences and feelings and building friendships it was possible for me to, every once in a while, see the world through different eyes. Thank you all for that and I hope we can still share visions and emotions together after we will be geographically separated again.

I would like to thank Vladimir Dobes and Murat Mirata for the supervision of this thesis, for their time spent and their patience. Additionally I want to thank Holger Wallbaum in the Wuppertal Institute for his effort, time, and assistance. My thanks especially go to Vladimir, who made a substantial effort to support my work through encouragement, discussions, and valuable inputs.

Another big thank you goes to all the people contributing somehow to this magnificent and unique year: all IIIEE staff for making this incredible learning experience possible (especially those who I got to know not only on the professional but also the personal level), the people at the Wuppertal Institute, who helped me with my thesis, and all my friends in Germany, helping me to remember the life outside the "bubble".

Finally, I want to give special thanks to a very special person.

Thank you all very much. I will never forget this tremendous year of my life!

## Abstract

The biotechnology industry is an evolving sector of this century having potential to significantly influence our lives. It has unidentified potentials to contribute to sustainable development, but is also feared by society for its possible known and unknown impacts.

Amplified transparency brought about by media, new concerns and expectations of society towards business as well as social criteria are evermore influencing people's investment decisions, making corporate social responsibility of increasing importance to companies.

The author of this thesis has worked to clarify the link between biotechnology and corporate social responsibility to address the need of this industry to develop while responding to societal concerns. The objective of this thesis is to determine the relevance of social aspects for European biotechnology companies. As the main outcome, the five aspects health & safety, training & education, diversity & opportunity, community (public), and customer health & safety were identified to be of significant relevance.

Recommendations given to biotechnology companies include stakeholder involvement to address social considerations and increased information dissemination and transparency. Finally, general suggestions include intensifying research in this area to tackle the hitherto existing information gap.

# Executive Summary

Biotechnology, which is the employment of biological systems in technological applications to produce products or services, is one of the evolving new technologies of today. It possibly offers great potentials to contribute to sustainable development, but also fears, risks, and uncertainties regarding potential impacts of its use are associated with it. If applied in industrial processes, biotechnology can have a cleaner production potential. Additionally, new products/services, of which production was not possible before, can be created by means of biotechnology. Nevertheless, uncertainties about the long-term impacts of the use of living organisms generate reluctance and concerns among people. For companies to explore the potentials of biotechnology, there is a need to address those concerns in society by proving a socially responsible behaviour. Presently, corporate social responsibility and concepts for social sustainability, especially in the field of new technologies, are still in their initial stages. The author of this thesis has sought to fill this gap.

Section one ("Introduction") introduces this thesis on corporate social responsibility and biotechnology. It describes the background and states the research questions of this work and the objective of establishing a set of social performance aspects to support biotechnology companies in their move towards social responsibility. The methodology used to perform the research was literature review for gaining background information on biotechnology and corporate social responsibility. Based on that an analytical framework was built to analyse the social aspects of the biotechnology industry. The scope and limitations are discussed as well as a short overview of the content of the following sections "Background Information on Biotechnology", "Corporate Social Responsibility and Social Performance", "Results and Analysis", and "Conclusions and Recommendations" are given at the end.

The second section ("Background Information on Biotechnology") of this thesis provides the reader with background information. A definition of biotechnology is the employment of living organisms in technological applications for production purposes. Its historical development shows that this technology has already been used for thousands of years. A short discourse is given on one specific part of biotechnology, i.e. gene technology, which is defined through the use and modification of genes. The wide range of current applications and future opportunities for this heterogeneous industry are displayed, such as chemical industry, energy sector, bio informatics etc. General characteristics of biotechnology include a diverse range of opinions towards this technology in society, its dependence on knowledge and employees with high skills, and its interdisciplinary character. Two of those unique features of this technology are identified and used later on to analyse the relevance of social aspects for the biotechnology industry. One criterion was found to be the risks and uncertainties connected to biotechnology. The second criterion is the unknown (but probably significant) potential of biotechnology to contribute to sustainable development. A special emphasis is given to the possibilities of applying biotechnology for environmental protection and cleaner production to describe the potentials biotechnology might have to contribute to sustainable development. The notion of biotechnology not being well understood and associated with misunderstandings and prejudices is indicated at the end by describing opinions about this technology.

Section three ("Corporate Social Responsibility and Social Performance") deals with the concepts of social performance and social responsibility. Because businesses are increasingly recognised as an integrated part of society, nowadays social concerns need to be taken serious by companies. The description of the internal as well as the external dimension of corporate social responsibility introduces this broad field and indicates the challenge it poses for business. Reasons of why social responsibility can be economically beneficial are illustrated, such as the argument that companies subscribing to social responsibility perform better on the stock market than others. In the publication of Sustainability Reporting Guidelines the Global Reporting Initiative (GRI) provided companies with help to assess their sustainability performance. Those guidelines include aspects on the economic, environmental, and social performance to address all three dimensions of sustainable development. According to the core research question of this thesis, special emphasis is given to the social aspects, which then serve as a basis to further investigate their relevance for the biotechnology industry.

The fourth section ("Results and Analysis") presents the link between social performance and the biotechnology industry. It analyses and discusses the specific relevance of social aspects provided by the GRI for the biotechnology industry on the basis of its unique characteristics. The main result of this analysis is a set of five social performance aspects specifically relevant for companies in the European biotechnology sector. Those five aspects are health & safety, training & education, diversity & opportunity, community (public), and customer health & safety. Other aspects analysed in addition to these are concluded to have uncertain relevance with respect to the criteria and the European context. Nevertheless, it appears that their relevance might change with respect to a different background, e.g. for companies operating in developing countries. For every company to determine the specific relevance for their situation, the consultation of stakeholders can be a valuable tool, resulting in considerable benefits, e.g. reducing costs, or increasing organisational effectiveness. This thesis addresses this need and provides a first exploration of which stakeholders, including employees, NGOs, government, investors, and community, could be important for biotechnology companies.

Section five summarises the findings and gives recommendations targeting biotechnology companies. The conclusions include the identified difficulty of defining and understanding biotechnology, the fact that the characteristics of biotechnology are unique, and the experience of biotechnology posing risks on society and raising ethical questions regarding its application. The recommendations are directed to biotechnology companies, suggesting increased transparency and the provision of information to tackle the low level of knowledge and understanding among society. Additionally, companies should involve stakeholders to identify and seriously address their concerns and get support for a movement towards social responsibility. This section also presents some new questions for further research and deeper investigation of the topic.

# Table of Contents

List of Tables

# List of Tables

# 1. Introduction

## *1.1 Background*

In recent years, there have been rapid developments in new technologies such as information and communication technology (ICT), nano-technology and biotechnology. All of them are innovative and knowledge-based technologies, which have the potential to change the features of economies but also of societies and lifestyles of people, as for instance the internet did already. Because of those effects new technologies should ensure a careful and responsible development in terms of environmental, economic, and social implications.

Biotechnology is seen to be one of the key technologies of the 21st century and it is a worldwide booming business. Its importance is reflected in considerable promotion and funding of projects by national governments as well as the European Union. In the time period from 2001 to 2005 the German Ministry of education and research will have spend more than 800 Mill. Euro for research and development projects in the field of biotechnology[1]. The European Union (EU) established a biotechnology programme, which provides funds to launch research projects. In the fourth framework programme between December 1994 and December 1998 about 93 projects were funded with a budget of almost 600 million Euros[2]. Also in the sixth framework programme of the EU biotechnology is identified to be an important research area.

During the last years, biotechnology has been and still is the topic of discussions and some of them were probably led incorrectly, since the main concern appeared to be the alteration of genetic material in living organisms rather than biotechnological processes in general. Biotechnology is a broad field with many different application possibilities. Gene technology or modern biotechnology is only one part of it, that uses the modification of genetic material for its purposes. Genetic engineering can be, but does not necessarily have to be, an element of biotechnology. To assess the implications of the industry and understand its contribution to an economic development, awareness for the differences of the two applications has to be increased. Besides that, the ability to distinguish traditional from modern biotechnology and their related impacts needs to be created.

Knowledge about biotechnological processes is still low and the decision about their application in industry is mainly driven by economic considerations. Nevertheless, biotechnological processes have demonstrated environmental benefits, for instance resource savings related to water and energy use[3]. For this reason, biotechnology contributes to environmental protection, not only through the substitution of conventional processes but also through a direct application for clean-ups. This so-called bioremediation is of great importance for instance in Europe as there are many remaining contaminated sites from industrial operations. Under the aspect of sustainable development the broad field of cleaner production possibilities, i.e. substitution and dematerialisation should be investigated in detail, because it deals with potential environmental problems *ex ante*. Remediation strategies are due to existing problems likewise important but they only deal with pollution *ex post*.

A second topic of discussion increasingly gaining attention of businessmen, organisations, research institutions, (potential) investors, as well as citizens in general is Corporate Social Responsibility (CSR). According to the World Business Council for Sustainable Development (WBCSD)

---

[1] Bundesministerium für Bildung und Forschung (BMBF). (2001). *Rahmenprogramm Biotechnologie – Chancen nutzen und gestalten.* p.42

[2] European Commission. (2002). *Biotechnology Programme (1994-1998) Project reports (volume 3 – 2001).*

[3] OECD. (2001). *The Application of Biotechnology to Industrial Sustainability. Sustainable Development.*

> "*Corporate Social Responsibility is the commitment of business to contribute to sustainable economic development, working with employees, their families, the local community and society at large to improve their quality of life.*[4]"

Corporate social responsibility is the response of enterprises to a growing pressure of stakeholders, showing increasing interest not only in the economic and environmental but also social performance of the enterprise. Taking on social responsibility by going beyond regulatory requirements can create trust among the stakeholders and can be of direct economic value in the long run. The launch of a White Paper on Corporate Social Responsibility by the European Commission[5] this year indicates the growing importance of this topic.

Assessing a company's social performance gets gradually more important because CSR is reflected in the image the public has of a company. To address the current lack of global standards to assess the social performance of a company the Global Reporting Initiative has investigated this issue and identified several relevant aspects (as well as categories and indicators)[6]. Those aspects are intended to provide a baseline for assessing the social performance and besides that, to provide help to communicate activities of companies connected with business operation. This assessment and communication is important with respect to accountability, which is increasingly expected from business. Companies need to be transparent about their social performance to gain a positive image in the public.

In addition to the general increasing pressure on companies to address social issues related to their operation social responsibility might be specifically important for the biotechnology sector. Since this sector works with living organisms, causing public concern the demonstration of a commitment to act socially responsible can possibly be crucial for its operation. Both, the applicability of biotechnological processes in many industries and the sophisticated scientific background make it difficult for ordinary people to estimate advantages as well as disadvantages of this technology. Since public scepticism can be a very restricting factor for the success of a company those concerns need to be addressed. For this reason, the identification of important social performance aspects tends to be crucial for biotechnology companies for showing action in this area and convincing the society of their subscription to social responsibility. The performed literature review and interviews with experts showed that there is only very little done in addressing social responsibility issues in biotechnology. Therefore this is a challenging field, requiring the attention and cooperation of social scientists, natural scientists, and engineers to tackle the lack of knowledge and experience.

In summary, the relevance of addressing social responsibility in the biotechnology sector is justified with the following considerations:

1. The rapid expansion of the biotechnology sector and its unknown potential to contribute to sustainable development.
2. The need for precaution because of the dynamic nature of living organisms and their potential impacts.
3. The threat biotechnological applications and products potentially pose on society, the fears of the public and the lack of information available so far.

As one of the research institutes at the scientific forefront, the Wuppertal Institute for Climate, Environment, Energy currently engages in research about aspects of social sustainability in the biotechnology sector. One funding programme of emphasis of the German Ministry for Education and

[4] WBCSD a. http://www.wbcsd.org/projects/pr_csr.htm [2002, September 01]

[5] European Commission. (2001)366 final. Was released as White Paper in 2002

[6] The guidelines published by the GRI also address the dimensions of economic and environmental performance. As this thesis focuses on social issues the two other elements are neglected in the research.

Research is about "Sustainable bio-production" ("Nachhaltige Bioproduktion"). On behalf of the Ministry and within this programme, the Wuppertal Institute is doing a study on the assessment of social sustainability of biotechnological products. The goal is to establish a methodology to assess the social dimension of sustainability of biotechnologically produced products. The programme not only addresses social, but also economic and environmental considerations, which are investigated by the DECHEMA[7]. The purpose of this programme is the creation of an assessment tool to evaluate innovation and cooperation processes within enterprises regarding sustainable development. To test the applicability of the findings, this work is being done together with and applied to biotechnology companies in Germany.

## 1.2 Objective

The core research question of this thesis is:

> *What is the relevance of social performance issues for companies operating in the European biotechnology sector?*

To answer this core question the following questions have also been addressed:

1. *What is biotechnology and what is corporate social responsibility?*
2. *What is the relationship between biotechnology and social responsibility?*
3. *Which social aspects are relevant for the biotechnology industry to continuously improve its performance to act socially responsibly, taking the GRI guidelines as the starting point?*
4. *Which recommendations can be given to the biotechnology industry with respect to social responsibility?*

## 1.3 Scope and Limitations

The biotechnology sector, with its variety of products and services has a very heterogeneous and complex character. To break down this complexity, this thesis mainly embraces enterprises in the European biotechnology sector aiming at improvement of environmental conditions. In that sense, the application of biotechnological processes can be divided into two groups: the utilisation of biotechnology for providing new products and for the substitution of conventional processes. Since many possible biotechnological processes (aiming at substituting conventional ones) are still at the development stage, social performance aspects can already be taken into account during the development of processes that can be industrially applied in the future. The reason to choose this application is because of its preventive approach towards environmental damage and therefore its importance to contribute to sustainable development. Additionally, utilising biotechnological processes for environmental protection does not have the strong load of ethical discussions as for instance the use of genetically modified plants and animals in agriculture. However, the use of genetically modified organisms (mainly microorganisms) does not make the factor of public acceptance ignorable[8], because any use of genetically modified organisms raises ethical questions.

Social responsibility does not only mean putting priorities on social considerations such as human and employee rights and community involvement but also includes aspects of environmental protection. If biotechnology is applied to improve environmental conditions it per se serves as a means for higher environmental protection and the emphasis of this work is on social priorities. For this reason, environmental considerations are taken out of the scope not only in describing the theoretical frame

---

[7] Gesellschaft für Chemische Technik und Biotechnologie e.V. (Association of Chemical Technology and Biotechnology)

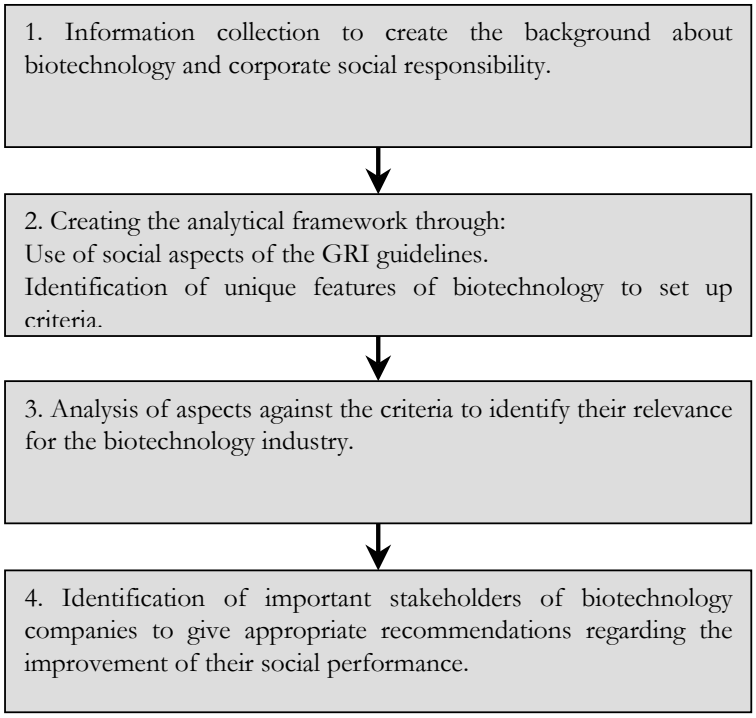
[8] Raphael, T. (1997). *Umweltbiotechnologie. Grundlagen, Anwendungen und Perspektiven.* p.1

but also in interviews and for recommendations. The recommended social aspects, at the end, are supposed to give a starting point on how the social performance of a company can be improved. Due to time limitations, this research focused only on the social aspects and does not deal with the level of indicators (as proposed by the GRI), as their detailed nature requires the availability of many resources to address them. Time constraints as well as the topicality of the issue of social performance standards restricted a deeper investigation into the topic. However, the main and to a big extent also surprising constraint proved to be the general lack of information on this emerging topic. The information provided by this thesis can serve as an indicator of importance of this topic and initial information for companies to assess and improve their social performance (including a detailed stakeholder dialogue as a means to it). The thesis can also act as a basis for deeper research in this important and for the time being neglected area.

The focus on the European context might represent another limitation, even though the nature of the recommendations does not in general restrict broader applicability. However, the author understands that the cultural background as well as moral concepts in Europe massively differ from other parts of the world, but also can differ within Europe[9]. Therefore the relevance of social aspects needs to be reconsidered according to the targeted region to be applied in.

## *1.4 Methodology*

The picture below shows the steps of research performed for this thesis work. In the following paragraphs the methodology of how those steps were done is described.




[9] A result from a study by the Büro für Technikfolgenabschätzung beim deutschen Bundestag (TAB) [Office for the estimation of consequences of technologies of the German Bundestag] is that modern Biotechnology is perceived very critically especially in Northern and Central Europe, whereas the position of people in South Europe is more positive. Cf. TAB-Arbeitsbericht Nr.19. *TA-Monitoring Bericht II. Technikfolgen-Abschätzung zu neuen Biotechnologien. Auswertung ausgewählter Studien ausländischer parlamentarischer TA-Einrichtungen.* p.41

The process of gathering background information for step one was desk-based research, where written material was used as a main source of information. A review of literature found in libraries was done as well as information search via the internet performed. The availability of data, the interest of the author, and personal communication with supervisors influenced the focus of the research.

To perform step two, the information gained about biotechnology was scanned and the most crucial ones selected. This was done with respect to the uniqueness of biotechnology, reflected in certain features, which were chosen as criteria to perform the analysis of identifying relevant social aspects for the biotechnology industry. Because of good reputation and topicality of the GRI guidelines and the focus of this work on social aspects, this GRI publication was found to serve as a valuable basis for the analytical framework. The fact that within the concept of corporate social responsibility social issues are mentioned, which are reflected in the GRI social aspects, as well as the latter's complexity, the GRI guidelines proved to be a good starting point for further analysis. The supervisors of the author from the IIIEE supported this analytical framework and the idea to process the information in this way.

To achieve the analysis described in point three, literature-based information was utilised. The information was substantiated by interviews with experts, which were chosen according to their background (biotechnology industry, academia, NGO). The interviews were done via telephone or in person and had open-ended questions. Additionally, experiences the author gained throughout the last year's master's programme at IIIEE supported the analysis. Furthermore, a questionnaire was created and sent to several groups, but the return rate was close to zero and information could therefore not be utilised. By analysing the aspects with regard to the criteria, a relationship between biotechnology and social responsibility was established.

A further step addresses the fact that the identified aspects serve as a starting point for discussion and improvement. In order to give a longer-term outline to companies, a first identification of potential stakeholders of the biotechnology industry was made to achieve this improvement. For this purpose information from literature, the internet, consultation with colleagues, and personal experiences were utilised. The stakeholders were classified to be important on the basis of this information, the influence they are known to have (e.g. high for government), and if they already expressed an opinion about the topic. Especially for the last point media information (newspapers) proved to be useful. The recommendations for companies are based on the information presented and processed and the analysis performed.

## 1.5 Outline

Section two of the thesis, "Background Information on Biotechnology", provides information such as definition, history and application of biotechnology to give the reader a picture of what biotechnology means and create the understanding that biotechnology goes far beyond pharmaceutical products and genetic modification. By describing the biotechnology sector and outlining characteristics a frame is set to enable the reader to understand discussions and future opportunities of this technology.

In section three, "Corporate Social Responsibility and Social Performance", the concept of corporate social responsibility is introduced. The description of economic benefits, which can be achieved when a company is committed to social responsibility, outlines its importance for business operation. The introduction of the social performance aspects of the GRI guidelines shows the complexity of this issue and later on the aspects are utilised as the baseline for further analysis.

Based on the previous parts, in section four, "Biotechnology and Society", the importance of social responsibility for the biotechnology industry is addressed. A discussion about which social aspects are of specific relevance for biotechnology is done to answer the core research question. At the end a first idea of which stakeholders might be important for this technology sector is presented and their relevance is explained.

Section five, "Conclusions and Recommendations", summarizes the findings of the research, and give recommendations to the biotechnology industry with respect to their socially responsible behaviour. Limitations of the thesis are described as well as questions for further research presented.

# 2. Background Information on Biotechnology

In the last decade biotechnology has developed to become one of the most promising sectors (besides for instance nano-technology and information and communication technology). Its applications can be found in a variety of industries including pharmacy, medicine, agriculture, environmental protection, and the energy sector. This section presents some information on biotechnology to provide the reader with a background to follow the analysis in section four and to allow the reader to create her/his own view on the issue.

## *2.1 Definition of Biotechnology*

Caused by a set of different applications and cultural backgrounds, several definitions of the term biotechnology exist at the moment. It appears that there is a difference between "traditional biotechnology" and "modern biotechnology". Some sources emphasise this distinction while others do not, but in general the difference is crucial especially since ethical values and public attitudes change a lot if genetic modification is part of the question or not. Some information reflecting on this are addressed in the sections 2.3 (Gene technology) and 2.6 (Opinions about biotechnology). An example of three different definitions, displayed in the textbox below, illustrate the difference, even though all of them mention the general use of biological systems for production.

Definition 1:

1. Biotechnology is a set of powerful tools that employ living organisms (or part of organisms) to make or modify products, improve plants or animals, or develop microorganisms for specific uses.

2. Early biotechnology includes traditional animal and plant breeding techniques, and the use of yeast in making bread, beer, wine, and cheese.

3. Modern biotechnology includes the industrial use of recombinant DNA, cell fusion, novel bioprocessing techniques, and bioremediation.

(Source: National Science and Technology Council. (July 1995). http://www.wabio.com/definition_biotech.htm)

Definition 2:

"Biotechnology" means any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use.

(Source: Convention on Biological Diversity (Article 2: Use of terms))

Definition 3:

"The application of biological organisms, systems, and processes to the production of goods and services".

(Source: OECD. (1998))

The differences in definition can also be seen as two separate approaches to the origins of biotechnology. One refers to the beginning of mankind and the early (partly unconscious) use of microorganisms without any scientific knowledge (approach of traditional biotechnology) and the other

one is connected to first achievements in genetic engineering in the early 1970s (approach of modern biotechnology). The second approach is favoured for example in the USA. However, as stated by the European Initiative for Biotechnology Education (EIBE) "*a person's concept of biotechnology is influenced by many factors including local culture, available skills, and level of education*"[10]. Because those factors differ, the ideas people have, when thinking of biotechnology, are diverse. On the other hand, people might have one impression of biotechnology and do not distinguish between a variety of applications. Hence, it is not easy for companies to communicate their activities, which are very heterogeneous and for that reason, are likely to have different impacts on society and the environment.

Becher et al.[11] use furthermore the term "commercial biotechnology" and define it as the use of knowledge based on natural sciences and technology for making profit in private enterprises. This definition is made from an economic point of view and clearly embraces traditional as well as modern biotechnology since both of them are means for making profit in private enterprises. In some cases, biotechnology is addressed from a fundamental studies point of view, any other kind of application in industry is likely to be commercial.

## 2.2 History of Biotechnology

Biotechnology itself is hardly anything new. Biotechnological processes have been used already for thousands of years to create, for instance, a diversity of food products to increase the quality of life. It started with simple things like making bread or beer and later, when the science of microbiology was founded in the middle of the 19th century, developed rapidly due to new knowledge and skills. The ways biotechnological processes are applied as well as the impacts they might create have changed tremendously since then. Table 1 shows a short overview of some Milestones in the history of biotechnology to demonstrate the long development and the incredibly fast changes of this technology in recent time.

As table 1 illustrates, the more recent developments in biotechnology are mostly achievements of modern biotechnology, which uses techniques of genetic engineering. Those techniques and its achievements are influencing our everyday lives, e.g. by the use of hormones (e.g. insulin) or the appearance of transgenic plants for food and feed. The distinction between traditional and modern biotechnology has been discussed in more detail in the section of definitions (2.1).

[10] EIBE (1999). *Unit 17 Biotechnology: Past and Present*. p.7

[11] Becher, G., Schüler, J. & Schuppenhauer, M. In: Kaiser, G. (ed.) (1997). *Wirtschaftsfaktor Bio- und Gentechnologie*. p.12

*Table 1: Milestones in the history of biotechnology. Important developments*[12].

| Date | Important developments in Biotechnology |
|---|---|
| 9000 BC | Alcoholic fermentation, bread, cheese, yoghurt |
| 6000 BC | Beer made by Sumerians |
| 1670 | Commercial production of beer, metal extraction by microbial action |
| 1876 | Observation of micro-organisms in beer fermentation |
| 1910 | Sewage purification systems based on microbial activity introduced (UK) |
| 1918 | Agricultural University Wageningen (Netherlands) founded, beginning of scientific approach to agriculture |
| 1938 | Florey and Chain begin to work on Penicillin |
| 1944 | Industrial production of Penicillin begins in the USA |
| 1950 | Industrial production of new antibiotics |
| 1972/73 | Industrial production of wider range of enzymes for washing powders |
| 1980 | Factory construction starts for industrial production of "human insulin" made by using genetic engineering |
| 1989 | Use of gene therapy for treatment of genetic disorders postulated; Gene for cystic fibrosis isolated |
| 1995 | Genetically modified soy bean and tomato on sale |

## 2.3 Gene Technology

Gene technology is not the same as biotechnology; it is rather a part of it[13]. This short section explores the difficulty for the general public to distinguish between biotechnology and gene technology. Knowledge of molecular processes in organisms is the basis to specifically change genetic information of living beings and use those genetically modified organisms (GMOs) in production processes. But this knowledge, especially the knowledge created by the deciphering of the human genome, also leads to many fears in society. Driven by information given by the media, people are afraid of the techniques used in gene technology, for instance cloning. Confusion is repeatedly created as modern biotechnology is a synonym to it and people have problems to distinguish between them. To avoid this and create a common understanding, gene technology needs to be defined. The definition displayed in this thesis uses the definition published by the Commonwealth Scientific & Industrial Research Organisation (CSIRO), stating that:

> "*Gene technology consists of tools and techniques that scientists can use to study, identify or modify the genes of living organisms*[14]."

An example of a successful and accepted application of the technology of genetic modification is the production of human insulin by genetically altered bacteria and yeast cells[15]. Producing insulin in this way has advantages such as higher availability and a better compatibility. The application of this technology for manufacturing medicines is widely accepted since it has a direct positive impact on human health and the quality of life. On the other hand, there are several applications where genetic engineering is subject to many discussions because of ethical values, such as cloning (e.g. public

---

[12] EIBE (1999). *Unit 17 Biotechnology: Past and Present.* pp. 26-31

[13] Heiden, St., Burschel, C. & Erb, R. (ed.) (2001). *Biotechnologie als interdisziplinäre Herausforderung.* p.11

[14] CSIRO Australia (2000). http://genetech.csiro.au/whatisgt.htm [2002, July 13]

[15] Deutsche Industrievereinigung Biotechnologie (DIB) im Verband der chemischen Industrie e.V. (2001). *Biotech 2001. Die wirtschaftliche Bedeutung von Biotechnologie und Gentechnik in Deutschland.*

concerns when Scottish scientists created the sheep Dolly[16]) or the use of human stem cells from embryonic tissue for the production of organs.

In the sector of environmental biotechnology, the use of genetically modified microorganisms is one important application, for instance their employment to digest persistent pollutants. A barrier for their utilisation in practice is not necessarily their modified genome but rather the restricted knowledge about the ecological context they work in, i.e. ecological interactions with other organisms in nature. This implies factors like environmental conditions but also the relationship between the used microorganisms and naturally occurring species. Since there is still too little knowledge about the characteristics and the ability of microorganisms to carry out degradation processes, the application of even genetically modified organisms is on early stages of development thus far.[17]

## 2.4 Characteristics of the Biotechnology Sector

Biotechnology is one of the so called "new technologies", which can be described as rapidly growing and changing and their development is neither risk-free, nor certain in terms of market acceptance. In case new technologies are successfully introduced to the market, changes in attitudes and lifestyles may result[18]. The two opposite approaches of biotechnology having big potential to improve our quality of life on the one hand and being feared for its use of (partly modified) living organisms and their possible impacts on the other hand, is a characteristic of this technology. For this reason, to explore all possibilities of biotechnology, interdisciplinary teams are needed to guide the development, not only natural scientists and engineers but also social scientists.

Innovation and knowledge are two crucial prerequisites for the evolution of the biotechnology industry, which provides high-quality and hence good-paying jobs. In connection to this the sector is dependent on well-educated, highly-skilled, and flexible labour to secure its continuous development. Highly advanced equipment is another prerequisite for the operation of the biotechnology sector. Since many educational possibilities in this field have been established recently, it is likely that especially young people need to be addressed as future employees.

Many applications in biotechnology are still in the stage of research and development. For this reason a big and distinct conventional infrastructure (e.g. as existing for the aluminium industry where long and reliable supply chains are crucial for the operation of the industry) is not needed for operation. The fact that significant amounts of the revenues raised (if there are revenues) are put into new research & development (R&D) programmes is another characteristics of this developing industry[19]. Furthermore, the sector is characterised by an uncertain environment, which means that single events can create extreme ups and downs in this sector. An example of this is consumer reaction to genetically modified food, which can determine success or bankruptcy of a company.

In general, living organisms manage their chemistry, e.g. energy requirements, more efficient than industrial, man-made plants. Regarding this higher efficiency of processes, the application of living organisms for production purposes in industry can potentially contribute to a more sustainable development of industry. In the literature, "biotechnology" is referred to as crossover technology ("Querschnittstechnologie"), which is not an industrial sector itself but rather has different applications

---

[16] A nucleus of a cell from an adult sheep was taken and injected into an egg cell without nucleus, this was treated as a normal fertilised egg. Therefore Dolly is the genetic clone of the animal the nucleus was taken from. Cf. CSIRO Australia (2000). http://genetech.csiro.au/whatisgt.htm [2002, July 13]

[17] Raphael, T. (1997). *Umweltbiotechnologie. Grundlagen, Anwendungen und Perspektiven.* p.158

[18] WBCSD b. http://www.wbcsd.ch/projects/pr_innovation.htm [2002, September 1]

[19] Ernst & Young (2000). *Evolution. Ernst & Young's Seventh Annual European Life Sciences Report 2000.* p.7

in a variety of industries[20]. Therefore, the structure of the biotechnology industry and its enterprises, as well as their products, is very heterogeneous. To get a picture of the organisational structure as described in the literature, refer to Appendix 1.

Besides structural differences there are also big differences regarding the acceptance of the various biotechnological products. While goods such as pharmaceutical products, or the use of biotechnology for environmental clean-ups are broadly accepted in society the application of similar techniques for the production of food is still a critical issue[21]. Nevertheless the establishment of new biotechnology enterprises can contribute positively to the development of an economy. Amongst others it can promote innovations in several industrial sectors, create new qualified jobs and therefore make an impact on the structure of the economy of countries[22]. On the other hand the increasing utilisation of biotechnology creates fears in society, as the general public does often not understand the implications of this technology.

New companies in the biotechnology sector have been created rapidly in Europe during the year 2000, with a growth rate of 15%[23]. Especially Germany experienced a high growth rate, proving the effectiveness of the activities of the government to promote biotechnology. The year 2000 has been one of the best for biotechnology so far when only European companies raised 6 billion € (worldwide 39 billion € were raised). By this time the quoted value of the European biotechnology companies was 75 billion €.[24]

### 2.4.1 Applications of Biotechnology

The applications of biotechnological processes in industry are very heterogeneous. According to the Organisation for Economic Co-operation and Development (OECD) the industrial use of biotechnology can be distinguished into two groups. The first is the use of renewable (biomass) raw materials to replace fossil fuel raw materials. The second embraces conventional, non-biological processes, which are replaced by processes based on biological systems (e.g. using whole cells or enzymes as reagents or catalysts)[25]. In addition to that biotechnology provides the ability to be applied for the creation of completely new products and the exploration of new industries. The bullet points below give an overview of applications of biotechnological processes in different industries mentioned by different sources in the literature[26]. Some of them are overlapping, as for instance biosensors are used in medicine, or enzymes are employed for food production.

- Medicine and hygiene (e.g. improved diagnostics, production of medicines and vaccines, gene therapy)

---

[20] Becher, G., Schüler, J. & Schuppenhauer, M. In: Kaiser, G. (ed.) (1997). *Wirtschaftsfaktor Bio- und Gentechnologie.* p.13

[21] As an example an inquiry of the office for the anticipation of technology consequences of the German Bundestag about gene technology and genome analysis in 1992 found that: "The production of genetically engineered food is unacceptable, while there is a clear support for genetically engineered pharmaceuticals." More recent results have not been available. Cf. Hamstra, I. A. (1998). *Public Opinion about Biotechnology: a Survey of Surveys.* p.A 4.1

[22] Deutsche Industrievereinigung Biotechnologie (DIB) im Verband der chemischen Industrie e.V. (2001). *Biotech 2001. Die wirtschaftliche Bedeutung von Biotechnologie und Gentechnik in Deutschland.*

[23] Ernst & Young (2000). *Evolution. Ernst & Young's Seventh Annual European Life Sciences Report 2000.* p.5

[24] Ernst & Young (2001). *Integration. Ernst & Young's Eighth Annual European Life Sciences Report 2001.* p.12

[25] OECD. (2001). *The Application of Biotechnology to Industrial Sustainability. Sustainable Development.* p.17

[26] WBCSD Scenario Unit (2000). *Biotechnology Scenarios. 2000-2050 Using the future to explore the present.* p.30; Xue, D. & Tisdell, C. (2000). *Safety and Socio-economic issues raised by modern Biotechnology.*p.700; OECD (1998). *Biotechnology for clean industrial products and processes. Towards industrial sustainability.*

- Agriculture, fisheries, and forestry (e.g. create resistant crops and increase growth of feedstock through genetic engineering)

- Bio-informatics, bio-computers, biosensors (includes assembly, storage, retrieval and analysis of data-bases containing biotechnology relevant information, for example DNA-sequences)

- Enzyme manufacturing (used for catalysing (speeding up or facilitating) chemical reactions, e.g. the use of enzymes in washing powders, decreasing the need for high washing temperatures)

- Energy and chemical industry (e.g. the production of renewable energy sources like bio-ethanol or polymers)

- Metallurgical and mining industries (e.g. use of bacteria to leach valuable metals such as copper from minerals)

- Food and light industries (e.g. production of beverages and food additives, feed processing)

- Environmental protection (discussed in section 2.5)

However, the usefulness and innovative character of the substitution of conventional by biotechnological processes in industry has to be evaluated critically. As observed by the OECD, environmental improvements achieved by biotechnological processes are not enough to promote implementation; the economic advantages are still the most important driving force whereas social considerations have not yet been mentioned at all[27]. This realisation shows the need to complete the considerations regarding potential applications of biotechnology by taking the dimension of social aspects into account.

### 2.4.2 Future Opportunities

Biotechnology is repeatedly seen as a key technology of the 21st century having excellent opportunities and perspectives for the future. Half of the Europeans believe biotechnology will improve their lives in the next 20 years even though the support of biotechnological research very much depends on the field of application[28]. The OECD identified energy, environment, costs, quality, productivity, and regulatory factors as the drivers for biotechnological innovations[29]. The importance of the factors depends on the particular industry and would probably be different in each application (i.e. water and energy may be more important for the paper industry while quality may dominate in pharmaceuticals). Economic benefits created by the application of biotechnological processes can mainly influence the development of certain industries. Numbers published by the OECD estimate, for example for the pulp and paper industry, a growth rate from 5% market share of biotechnology related sales (BRS) in 1996 up to 35% in 2005[30]. In a recent publication, the WBCSD listed a variety of opportunities for biotechnology, stating that this technology can make a contribution to[31]:

- Reduce water and energy used in food production,

---

[27] OECD. (2001). *The Application of Biotechnology to Industrial Sustainability. Sustainable Development*.p.43

[28] Hamstra, I. A. (1998). *Public Opinion about Biotechnology: a Survey of Surveys*. p.A1.1

[29] OECD. (1998). *Biotechnology for clean industrial products and processes. Towards industrial sustainability*.

[30] OECD. (1998). *Biotechnology for clean industrial products and processes. Towards industrial sustainability*. p. 64 Biotechnology Related Sales (BRS) is used as an indicator of market penetration and is given as percentage of total market value of products.

[31] WBCSD Scenario Unit. (2000). *Biotechnology Scenarios. 2000-2050 Using the future to explore the present*. p.42

- The remediation of depleted agricultural land, soil conservation,
- Enhanced medical diagnosis,
- Offer medical cures with limited or no side effects,
- Create plants that can be used as bio-reactors,
- Provide new mining applications,
- Enzyme manufacturing,
- Provide biosensors, bio-informatics, and therapeutic vaccines.

This list shows the heterogeneity of possible biotechnological applications in the future. Research will show which of them will have a real potential to become successful in the long run and many of them are very likely to influence and reinforce each other. Public demand, economic demand, and scientific and technological feasibility have been identified by a biotechnology report by the OECD[32] to clarify research need and assess the future possibilities of applications. To drive the use of biotechnology, the combination of all three of them is needed. According to the same OECD report on biotechnology, the three drivers can be related to stakeholders, i.e. the general public, industry and government. The influence the three stakeholders have on the application of industrial biotechnological processes shows their importance for companies operating in this sector – not only now, but also in the future.

### 2.4.3 International Cooperation

The USA, currently has a leading position in the biotechnology sector. To not just become a market but rather a producer of biotechnology products, the Group of Advisors on Ethical Implications of Biotechnology[33] gives the general advice for the industry in Europe to harmonise practices with the world and to review the current regulatory framework. This framework has to be flexible, preventive (for environmental protection, but also for social acceptance to show that dangers are taken seriously and evaluated carefully), and harmonised throughout the world. This harmonisation is seen as a basis for innovation, but in addition needs the support of all scientists to be established and successfully implemented. Furthermore, networking and the exchange of information, especially amongst small and medium-sized enterprises, is an important part of the development of this industry, since there are large amounts of data generated by research, all over the world. The creation of accessible and interactive databases as well as reference standards for quality assurance are essential for the future development of high quality and reliable research.

## *2.5 Biotechnology & Environmental Protection*

The protection of the environment is a crucial component for a sustainable development. The potential of biotechnology to contribute to environmental protection can be either directly through remediation processes or indirectly preventive through substitutions of conventional industrial processes. Biotechnology can play a role in supporting the rehabilitation of degraded ecosystems[34]; hence can be used in remediation processes. One example for prevention is the use of biocatalysts in chemical processes to avoid the creation of dangerous by-products and to reduce waste in the first place.

---

[32] OECD (1998). *Biotechnology for clean industrial products and processes. Towards industrial sustainability.* p. 63

[33] European Commission (May 1994). *Ethics and Biotechnology.*

[34] United Nations Division for Sustainable Development. Agenda 21. Chapter 16. *Environmental Sound Management of Biotechnology.* p.6

Applying biotechnology in industry has helped to shift the focus from the perspective of remediation to one of prevention. Exploring the possibilities of a design for the environment strategy by integrating, for instance, biocatalysts or enzymes into production processes is an example of a preventive approach. The use of biotechnological instead of conventional methods promises a higher efficiency as the chemistry of biological systems is usually more efficient than the artificial processes[35]. Those processes are widely used now in different industries like chemicals industry, pulp and paper production, textiles and leather, food processing, metals and minerals as well as in the energy sector, together accounting for about 30% to 50% of all manufacturing in developed countries[36]. The combined size of those industry sectors gives an impression of the amount of resource savings that might be affected by the use of biotechnology.

An improvement in environmental quality can also be achieved by means of genetic engineering, for instance to change genetic traits of plants in a way to increase their resistance against pests or droughts. The benefits in this case are a reduced need for bringing out pesticides and a decrease in amount of water required. The problem here is public and scientific concern about potential impacts of genetically modified plants in the natural environment. Because of little knowledge, uncertainty about impacts and the fact that genetically modified food has not yet been proven to provide obvious advantages, compared to conventional food, the acceptance of the biotechnological application in agriculture is rather low, especially in Europe.

### 2.5.1 Environmental Protection through Substitution

Since cleaner production and the prevention of environmental damage are becoming more and more important, applications of biotechnological processes to substitute for conventional ones become increasingly attractive. The potential applications of biotechnological processes tend to be specific for certain industrial sectors, for instance pulp and paper, chemicals and pharmaceuticals or the energy sector[37]. All of them have high resource intensity in common and with the help of biotechnology anticipated the possibilities to decrease demands of water and energy as well as to reduce the output of waste. As one of the largest industries facing growing demand, the pulp and paper industry was chosen as a case study[38] to demonstrate three examples of the industrial application of biotechnology and its achievements in terms of cleaner production.

One example of the biotechnological applications to decrease environmental impacts is bio pulping. In this process, lignin-degrading fungi are employed to treat lignocellulosic materials prior to pulping. Using this fungal pre-treatment can result in energy savings as well as cellulosic fibre strength improvements compared with mechanical pulping[39]. When both bio pulping and mechanical pulping are used sequentially, energy savings of about 30% can be made.

Another example is the use of enzymes to improve the recycling process. The operational speed of the paper machine partly depends on the drainage rate and recycled fibres tend to decrease the drainage rate from the pulp mat. For this reason, the production rate decreases as the content of recycled fibres

---

[35] OECD Observer. (1999, March 01).

http://www.oecdobserver.org/news/fullstory.php/aid/2/Biotechnology_and_industry:_a_union_of_promise.html [2002, August 12]

[36] OECD Observer. (1999, March 01).

http://www.oecdobserver.org/news/fullstory.php/aid/2/Biotechnology_and_industry:_a_union_of_promise.html [2002, August 12]

[37] OECD (1998). *Biotechnology for clean industrial products and processes. Towards industrial sustainability.* p. 29

[38] OECD (1998). *Biotechnology for clean industrial products and processes. Towards industrial sustainability.* pp.146-150

[39] Mechanical pulping: Involves the use of mechanical forces to separate wood fibres.

increases. Enzymes can be used as drainage aids and hence result in a more efficient pulp and paper processing.

A last example is the application of biotechnology in the bleaching process. Since chlorination is not used any more due to consumer resistance, the industry is utilising other bleaching chemicals (e.g. chlorine dioxide, oxygen, peroxide). As an alternative, enzymes have been developed, which are better suited to temperatures and pH found in the process. Their application could result in considerable savings of chemicals and therefore help to make the transition to cleaner production.

### 2.5.2 Environmental Biotechnology

This application of biotechnology mainly refers to the use of living organisms for environmental protection in order to maintain and restore the quality of the environment. In the environmental field "*Biotechnology can be used to assess the well-being of ecosystems, transform pollutants into benign substances, generate biodegradable substances from renewable resources and develop environmentally safe manufacturing and disposal processes*"[40]. In Europe the main applications in this sector are air pollution control, waste management, remediation of contaminated land, and waste treatment[41]. On the other hand the most known application of environmental biotechnology is probably wastewater treatment. Especially waste treatment and remediation play a big role in Europe as the amount of waste is steadily increasing and the industrial development led (and still leads) to thousands of contaminated sites. Nevertheless, wastewater treatment but also waste treatment are of importance all over the world and provide a broad potential basis for biotechnology to be applied.

The process of reducing or eliminating environmental hazards by physical or chemical means is called remediation[42]. In the case of bioremediation, biological systems are utilised to do this process. Bioremediation has, so far, been successfully applied on many sites contaminated with hydrocarbons (e.g. oil spills). At present, there is some research going on to explore the bioremediation potential of microorganisms. Those organisms are attractive because of the wide range of substances – natural as well as artificial – they are able to metabolise. One of the examples is *Geobacter metallireducens*, which has the ability to reduce metals. This species is especially interesting as it can remove uranium from drainage water and therefore, has a big potential to be applied in the mining industry, e.g. for clean-up of contaminated groundwater[43]. Other living systems that are useful in the field of bioremediation are plants, due to their ability to extract and accumulate substances, e.g. metals from the soil into the plant body.

According to a representative from the biotechnology industry[44] political frames and economic considerations are the main driver for decision-making if bioremediation techniques are applied. Taking the example of polluted soil, if land filling is cheaper than treating it biotechnologically the soil will be taken to a disposal site. The political frameworks of a country therefore very much determine the amount of research in this area. If a decision for applying bioremediation technologies is made, the treatment can be divided into two groups, *in situ* (application directly in the polluted area) and *ex situ* (polluted material is removed from the site and treated somewhere else)[45]. The well-known wastewater treatment in specific sites is one example for an *ex situ* treatment. For the *in situ* treatment it is

---

[40] EBI. http://www.bio.calpoly.edu/EBI/ebi.html [2002, August 9]

[41] EIBE. (2000). *Unit 16 Biotechnology and the Environment.* p.24

[42] EIBE. (2000). *Unit 16 Biotechnology and the Environment.* p.23

[43] National Science and Technology Council (NSTC). Biotechnology Research Subcommittee. http://www.nal.usda.gov/bic/bio21/environ.html [2002, July 10]

[44] Representative from the Biotechnology Industry. (2002, August 08). Telephone interview.

[45] EIBE. (2000). *Unit 16 Biotechnology and the Environment.* p.24

important to understand the way in which microorganisms work, as ecosystems are generally very complex. Often genetic modification is used to adjust organisms to certain conditions, e.g. extremely cold and dark environments (as the deep sea) or make them able to specifically break down one persistent or hazardous substance. Nevertheless, the use of GMOs for bioremediation has its limits. On the biological side those organisms have to function well and also be physiologically robust. Furthermore public concerns about safety regarding the on-site, large-scale treatment[46] as well as stringent legislation can possibly be barriers for their practical use. Those two potential limitations to the application demonstrate that also in this field the social performance of companies is of importance.

## 2.6 Opinions about Biotechnology

In society, people's opinion on certain industrial sectors is mainly influenced through the media, but also through government and information given by the industry itself. This also applies for the biotechnology sector. Governments as well as industry are supporting research and application of biotechnology. With respect to this, the impression is that the media seems to have a very big influence on people's attitudes, reflected in a rather sceptical public opinion towards biotechnology. This does not surprise this author since negative stories about accidents, dangers, or other harmful impacts are given prominent coverage in the media and remembered by people a lot more than reasonable arguments or positive news.

One of the biggest problems identified so far touched the definition question. In many cases – e.g. church, media, public, but also scientists – the term biotechnology is used equally to gene technology. For this reason, it is difficult to evaluate the general attitude towards biotechnology. One result of a survey carried out by the Concertation Unit for Biotechnology in Europe is that the support for or opposition against biotechnology and genetic engineering not only depends on its application, but also on risks related to it[47]. As one interest group, the church has a strong attitude towards (modern) biotechnology[48]. Their interest mainly lies in the potentials of gene technology to influence and change our lives and the general manipulation of human life, i.e. biomedicine (treatment of diseases via genetic engineering). Apparently, those techniques are seen as being very critical from the Christian viewpoint of the inviolability of human life.

As the OECD[49] showed, biotechnology has a negative image among the public since it is associated with rDNA technologies, i.e. gene technology. This fact raises the issue of influencing social acceptance by the means of information and education. A more positive image expressed through public acceptance could help to sustain biotechnology in the long run. The current, predominantly negative, image has been identified by OECD to be one of the most important competitive disadvantages of this technology, compared to other technologies applied in the environmental sector (as already mentioned the application of biotechnology in the environmental sector (e.g. water, soil treatment) has big potentials). On the other hand it was demonstrated, through a survey within member countries of the EC[50], that people accept research in the biotechnology sector for the purpose of environmental protection at the same level as for medicines and vaccines. Surveys like this illustrate also the high awareness of people for the need of environmental protection in Europe and their trust (or hope) in biotechnology to improve the situation. Nevertheless, people also believe that a regulative framework for these applications is needed.

---

[46] EIBE. (2000). *Unit 16 Biotechnology and the Environment*. p.24

[47] Marlier, E.. Eurobarometer 35.1: Opinions of Europeans on Biotechnology in 1991. In: Durant, J. (1992). *Biotechnology in Public. A Review of Recent Research.*

[48] Cf. Zentralkomitee der deutschen Katholiken. http://www.zdk.de/aktuelles/ [2002, September 02]

[49] OECD (1994). *Biotechnology for a clean environment. Prevention, Detection, Remediation.*

[50] OECD (1994). *Biotechnology for a clean environment. Prevention, Detection, Remediation.*

The director for west Switzerland of the Swiss Association for Environmental Protection (Direktor für die Westschweiz der Schweizerischen Gesellschaft für Umweltschutz) in Gent said that biotechnology cannot be considered on its own. It is, together with computer science and nuclear energy, one of the technical revolutions of today. Computer science can be considered accepted from the society, whereas nuclear energy is hardly controllable. According to his opinion, gene technology is somehow in between: is needs strong control.[51] This statement again clearly shows the difficulty of people to distinguish between biotechnology and gene technology and indicates the need for more transparency but also for increased information dissemination by business.

## 2.7 Special Characteristics of Biotechnology

The introduction and characterisation of biotechnology showed that this technology has unique features. Those features are the bases for the criteria developed to analyse the relevance of social aspects for biotechnology. For this reason, special emphasis is given to them in this short paragraph. The characteristics of biotechnology can be summarised as follows:

1. Biotechnology, by the use of living organisms, has a considerable possibility to contribute to sustainable development and increase our quality of life.

2. Biotechnology has potentials for being applied in cleaner production (through dematerialisation and substitution), but is also applicable for End-of-life purposes.

3. Biotechnology is knowledge based and requires highly-skilled labour.

4. Biotechnology is new, developing, and growing rapidly.

5. Because of the use of living organisms, biotechnology has a dynamic (and maybe uncontrollable) nature. The reason is that living things can change (randomly or if outside conditions change), which leads to an uncertainty regarding future impacts.

6. Due to the fact mentioned in point 5, biotechnology raises concerns among the public but also scientists (they are concerned about the technology and its potential impacts).

7. Biotechnology requires interdisciplinary teams to explore its potentials.

8. Biotechnology raises, to a certain extent, ethical questions, i.e. the application of genetic engineering.

[51] B.I.C.S. (Biotechnology Information and Communication Switzerland of the Priority Programme Biotechnology of the Swiss National Science Foundation). (2002). http://www.bioweb.ch/de/forum/1999/1/08 [2002, August 11]

# 3. Corporate Social Responsibility and Social Performance

As there are few regulative requirements regarding social reporting today many company's activities are based on voluntary actions. The concept of Corporate Social Responsibility (CSR) implies action on a voluntary basis, going beyond compliance and investing in social (human) capital and stakeholder relations. As stated in section 1.3 (Scope and Limitations) the perspective of environmental concerns for behaving socially responsible are not addressed in the following sections.

According to the European Commission there is a set of factors driving this recent move towards CSR[52]:

- *New concerns and expectations from citizens, consumers, public authorities and investors in the context of globalisation and large scale industrial change;*
- *Social criteria are increasingly influencing the investment decisions of individuals and institutions both as consumers and as investors;*
- *Increased concern about the damage caused by economic activity to the environment;*
- *Transparency of business activities brought about by the media and modern information and communication technologies.*

Those factors show the need for businesses to communicate their social performance, be transparent and open about their activities, and to respond to the expectations of stakeholders in order to achieve long-term acceptance and support. On the other hand, it is becoming increasingly difficult for businesses to address all those issues since it requires companies to open themselves in a way they might not feel comfortable with (e.g. the protection of business secrets becomes increasingly difficult). However, the nature of social aspects is that they influence society and they could do so negatively. For this reason, and with respect to the precautionary principle, openness and transparency should be required to avoid negative impacts in the first place. Innovative companies, who are pioneers regarding social responsibility, daring to experiment and take risks also in the field of openness, will likely be able to set standards for others to follow. These standards are usually later required by public and codified by governments in order to push followers to do the same[53].

## *3.1 What is corporate social responsibility? Why is it important for business?*

Because business is currently seen not as something different but as an element of society and its values, CSR plays an important role in business operations. The Millennium poll on CSR in 1999 revealed that out of 25000 interviewed people (from 23 countries on 6 continents) about half are paying attention to the social behaviour of companies[54]. This shows that CSR is widely acknowledged as an important issue, but there is still little guiding help for enterprises of how to put the concept into practice. Acknowledging its importance, the WBCSD (to complement the description already given in section 1.1 (Background Information)) has identified corporate social responsibility as being

[52] European Commission. COM (2001)366 final. p.5

[53] Dobes, V. (2002, August 27) Personal interview.

[54] Business in the Community's Business Impact Task Force. (2000a). *Winning with Integrity. Summary*. p. 5

> "*…the ethical behaviour of a company towards society. In particular, this means management acting responsibly in its relationship with other stakeholders who have a legitimate interest in the business…*[55]".

The importance of stakeholder interests for the performance of organisations operating today is clearly indicated by this definition, since organisations more and more need to align their values according to the expectations expressed by society. This statement is supported by the GRI, which perceives the social performance as a key ingredient in assuring an organisation's licence to operate[56]. The aim of the GRI is to give guidelines for sustainability reporting. CSR does not address sustainability itself directly, but is one vital part of sustainable development[57]. Additionally, there are many overlapping social issues, such as community involvement, human, employee, and stakeholder rights that are identified to be important when it comes to social performance. CSR is a social investment motivated by long-term thinking and hence contributes to sustainable development, which per definition not only aims at meeting needs of current but also those of future generations. However, needs will be defined, they for sure include claims on the social level. Based on this connection, a company can make a contribution to sustainable development by showing a socially responsible behaviour.

In addition to that, acting socially responsible is also in the interest of the company and makes good business sense. Having knowledge about external expectations and the position of the company related to that and using this knowledge as a strategic management tool can also lead to a successful performance in the economic dimension. For a long-term strategy, CSR should be seen more as an investment in the company rather than as a cost or burden. The European Commission points out that going beyond compliance through investing in social capital such as employee training and working conditions is very likely to improve the company's competitiveness[58]. Besides that, subscribing to the concept of CSR influences factors such as risk management and reputation. The values of a company are reflected in the way employees behave and this influences the perceived image of the company by the public (e.g. a single focus on profit might lead to mistrust and a loss of reputation, respect, and loyalty[59]).

### 3.1.1 The Internal Dimension of Corporate Social Responsibility

The internal dimension basically covers social responsibility practices within the enterprise and involves employees. Issues such as health & safety, investing in human capital, and managing change are dealt with from this perspective[60].

The subject of health & safety is already addressed by legislation. Nevertheless, enterprises try to increase the quality of performance by implementing standards beyond legislation not only within the company but also require those from their contractors and suppliers. By promoting this preventive approach, companies can gain a competitive advantage, because they are able to make financial savings. Those savings are realised, for example, through fewer absent hours of employees caused by accidents. Furthermore, companies proving high health and safety standards and as a result less risks could potentially have lower insurance premiums to pay than other companies.

---

[55] WBCSD. *Meeting Changing Expectations. Corporate Social Responsibility*. p.3

[56] GRI. (2000). *Sustainability Reporting Guidelines on Economic, Environmental and Social Performance*. p.33

[57] WBCSD. *Meeting Changing Expectations. Corporate Social Responsibility*. p.3

[58] European Commission. COM (2001)366 final. p.8

[59] Business in the Community's Business Impact Task Force. (2000b). *Winning with Integrity. Chapter 01. Putting your heart into it. Purpose and values*. p. 1

[60] European Commission. COM (2001)366 final. p.9

The matter of human resource management includes several aspects that determine success. Especially in the sector of new technologies, the main resources for enterprises are highly-skilled and motivated employees. To ensure retention of those workers the enterprise should provide activities including "*lifelong learning, empowerment of employees, better information throughout the company, better balance between work, family, and leisure, greater work force diversity, equal pay and career prospects for women, profit-sharing and share ownership schemes, and concern for employability as well as job security*"[61]. Besides that, non-discriminatory practices are likely to create commitment from employees (especially from minorities) to the enterprise.

The widespread restructuring going along with globalisation causes serious concerns among stakeholders. Involving affected parties in early discussion stages as well as building social inclusion partnerships and having a long-term labour strategy, can facilitate the adaptation to change and lessen the social impacts of restructuring.

### 3.1.2 The External Dimension of Corporate Social Responsibility

CSR is not restricted to issues within a company but extends beyond the boundaries of enterprises and requires the involvement of all affected stakeholders. Besides employees and shareholders, the European Commission mentions business partners and suppliers, customers, public authorities, and non-governmental organisations (NGOs) as additional stakeholders[62]. Local communities are especially important to enterprises, as there is often a close interaction (and dependence) among them. The reputation at the company's location mainly influences the interest of local people to work as employees or to act as customers and therefore, affects the competitiveness of the company. Regarding consumers, the design of products and services in a socially responsible manner needs to fulfil criteria of quality, reliability, safety, and availability for as many people as possible. Socially responsible acting also positively impacts business-to-business relationships. The reliable delivery of high-quality products and long-term contracts with suppliers are just two examples of this. For larger companies, another practice to demonstrate social responsibility is the promotion of small start-up enterprises or local small- and medium-sized enterprises (SMEs), thus improving the economic situation of the region.

Human rights are another very important external dimension of CSR, including, for example, the problem of corruption and child labour. The identification of the company's responsibilities is a challenging question especially because "*human rights are a very complex issue presenting political, legal and moral dilemmas*"[63]. Several legal requirements set minimum standards applicable to all enterprises. Nevertheless, to a greater extent, sectors and companies establish their own voluntary codes of conduct to demonstrate commitment to social concerns.

### 3.1.3 Social Responsibility and Economic Benefits

One of the driving forces mentioned above by the European Commission is the influence social criteria have on investment decisions made by people. Since many companies are listed in the stock market those investment decisions can directly affect the economic success of a company. There are indices existing that especially value the commitment of companies towards a more sustainable development. GreenEffects for example is an international, ethic-ecological fund investing in the Nature Share Index (NAI) (Natur-Aktien-Index). NAI is a measure of the economic success of enterprises contributing to an ecologically and socially sustainable development and consists of 20 international companies from different sectors that are estimated to be economically successful in the long run. The decision of which companies are represented in the NAI is based on binding

[61] European Commission. COM (2001)366 final. p.9

[62] European Commission. COM (2001)366 final. p.12

[63] European Commission. COM (2001)366 final. p.14

performance criteria, including environmental and social performance aspects.[64] With regard to social performance, some aspects are mentioned that can also be found in the GRI guidelines, such as emphasis on health & safety issues at the workplace, employee participation in decision-making processes, provision of training possibilities, and the promotion of minorities[65]. Commitment to consider those aspects (among others listed) and improve their performance gives companies the chance to be represented in the funds. The index shows a better performance on the market as for instance compared to the DAX (Deutscher Aktien Index) (German Share Index) and the S&P 500 (Standard & Poor's 500)[66], suggesting that responsible behaviour and long-term thinking is economically advantageous.

A second benefit of demonstrating socially (and environmentally) responsible behaviour is with regard to financial institutions such as insurance companies and banks. The business of insurance companies is risk, and the lower the risk is, the better they are off. Since CSR implies a better risk management, insurers should welcome those companies, which are already active in this field. Furthermore, if a company can prove a socially responsible behaviour, the insurer might be more open to lower the premiums than if this was not the case, certainly creating economic benefits for the company in question[67]. With regard to banks operating in a socially responsible way, it might be advantageous as the economic performance of those companies is likely to be better (better risk management, reputation, customer loyalty etc.) and the risk for banks to invest in them is lower. Those two examples suggest the close link between the social performance of a company and its long-term economic success.

## 3.2 Assessing the Social Performance

In a fast-changing world, it is becoming more and more difficult to determine what exactly is expected from businesses. Due to uncertainty caused by fast changes and the impacts of globalisation, people tend to withdraw their trust from companies. Based on that, a move from a 'trust me' to a 'show me' world can be observed[68]. In cases where scepticisms even grew further, the claim of people towards business is now 'convince me' if there is trust to be established again. One step for the company to meet those expectations is to convince people of their responsible behaviour. This not only includes proving economic viability and environmental friendliness (e.g. the approach of pollution prevention) but also social correctness and responsible behaviour towards society. If the attempt to behave socially responsibly is to be translated into reality it must be based on some aspects that describe the social performance of an enterprise. Only by this means it is possible to assess and benchmark the situation and achieve continuous improvement.

For general use, the GRI has identified a set of categories and aspects (as well as indicators) concerning the social performance of a company. This classification was done in a multi-stakeholder process and the result is aimed at giving companies guidelines for their sustainability reporting activities[69]. Those guidelines are a response to the challenges of globalisation, which are, for instance, expressed in changing governance structures, since the capacity of existing institutions to manage corporate activity is limited[70]. Social considerations are broken down into the four categories: labour practices and decent

---

[64] Academic expert 1. (2002, August 21). Personal interview.

[65] The pdf-File "Die Kriterien des Natur-Aktien-Index (NAI)" (list of criteria for the NAI) is available at (in German only): GreenEffects. http://www.greeneffects.de/seiten/index/index2.htm [2002, August 31]

[66] Cf. GreenEffects (a). http://www.greeneffects.de/seiten/fonds/fonds2c.htm [2002, August 31]

[67] Academic experts 1 and 2. (2002, August 21). Personal interviews.

[68] WBCSD. *Meeting Changing Expectations. Corporate Social Responsibility.* p.4

[69] GRI. (2002). *2002 Sustainability Reporting Guidelines. Pre-Publication Release.* p.38

[70] GRI. (2002). *2002 Sustainability Reporting Guidelines. Pre-Publication Release.* p.6

work, human rights, society, and product responsibility. Within those categories, several relevant aspects are identified which describe the social performance of a company. In Table 2 the categories and aspects are shown as they are listed in the GRI guidelines. Because of its broad scope and complexity, those guidelines were found to be suitable to serve as a baseline for research to investigate which social aspects are important for the biotechnology sector. For more detailed information of what the aspects imply, please refer to Appendix 3. The selection is discussed in part four of this thesis (Results and Analysis).

*Table 2: Social Performance Categories and Aspects.*[71]

| Category | Aspect |
|---|---|
| Labour Practices and decent work | Employment |
| | Labour/Management relations |
| | Health & safety |
| | Training and education |
| | Diversity and opportunity |
| Human Rights | Strategy and management |
| | Non-discrimination |
| | Freedom of association and collective bargaining |
| | Child labour |
| | Forced and compulsory labour |
| | Disciplinary practices |
| | Security practices |
| | Indigenous rights |
| Society | Community |
| | Bribery and corruption |
| | Political contributions |
| | Competition and pricing |
| Product responsibility | Costumer health and safety |
| | Products and services |
| | Advertising |
| | Respect for privacy |

As pointed out before, some of those aspects are overlapping with issues addressed by the concept of CSR and are therefore useful to help a company to identify the means of behaving socially responsibly. The WBCSD, for example, mentions issues like human rights, employee's rights, and community involvement as being addressed through corporate social responsibility[72]. To create the ability for companies to measure and evaluate the social performance and also to benchmark results the GRI furthermore established a number of indicators for each aspect. Those indicators are not discussed here but are important in a process for continuous improvement.

As already stated, the GRI guidelines were established in a multi-stakeholder process. The involvement of stakeholders in the long run is important for a company since they have the ability to identify

[71] GRI. (2002). *2002 Sustainability Reporting Guidelines. Pre-Publication Release*. p.38

[72] WBCSD. *Meeting Changing Expectations. Corporate Social Responsibility*. p.5

relevant social aspects of concern. A good proposal for a definition is given by the Stakeholder Forum, describing stakeholders as those:

> "… *who have an interest in a particular decision, either as individuals or representatives of a group. This includes people who influence a decision, or can influence it, as well as those affected by it.*[73]"

In that sense, stakeholders are interest groups with certain expectations towards a company's performance. The European Commission[74] identified a group of stakeholders, which can generally be applied for business such as employees, shareholders, investors, consumers, public authorities, and NGOs. Besides those mentioned, there are other stakeholders such as governments, free trade unions, religious institutions, or academics (research institutions, universities). The relevance of stakeholders for diverse industries obviously differs. As the description of the concept of CSR already indicated, there are internal (employees) and external stakeholders (e.g. consumers, NGOs, governments, shareholders, local communities etc.). All of them mostly have different interests but on the other hand their expectations often overlap. As governments are, for instance, interested in the creation and retention of jobs, so are the communities where a company is located. The relevance of stakeholders and their involvement into decision-making processes of a company are addressed further in section 4.1.4 (Stakeholder Participation for continuous Improvement).

This section introduced the concept of corporate social responsibility and addressed reasons why commitment to it is important. The social aspects established by the GRI were found to be suitable to serve as a basis for addressing social issues in the biotechnology industry. Based on this theoretical framework and the information given about biotechnology in chapter 2, the following chapter aims at identifying social aspects specifically important for the biotechnology industry to act socially responsibly.

[73] Stakeholder Forum. http://www.earthsummit2002.org/ic/process/stakeholders.htm [2002, July 26]

[74] European Commission. COM (2001)366 final.

# 4. Results and Analysis

The chapters 2 and 3 resulted in an answer to research question number *1. What is biotechnology and what is corporate social responsibility?*

To summarise the answers: Biotechnology is the application of biological organisms, systems, and processes to the production of goods and services'. CSR is the ethical behaviour of a company towards society and is important as business is a part of society and needs to respond to society's values.

This section provides an answer to research questions number *2. What is the relationship between biotechnology and social responsibility?* and *3. Which social aspects are relevant for the biotechnology industry to continuously improve its performance to act socially responsibly taking the GRI guidelines as the starting point?*

## *4.1 Biotechnology and Society*

Research in and the application of biotechnology is recognised to have strong societal impacts. A variety of emotions, little interest in the technology itself and a lack of confidence are associated with biotechnology[75]. Nevertheless, there are several social aspects, which are of significant importance to companies operating in the biotechnology sector. This section presents those aspects, which have been identified based on the theoretical framework of the GRI social aspects and characteristics of the biotechnology industry supported by expert interviews.

### 4.1.1 Importance of Social Responsibility for Biotechnology

Despite the fact that biotechnology is widely recognised as having great potential for contributing to a more sustainable future, concerns about its application remain. The effects technologies being developed today can have on society could reach dimensions going far beyond our imagination. Consequently, companies performing research and development need to investigate reactions of society to these technologies even before bringing them on the market[76]. As outlined in chapter 2 (Background Information on Biotechnology) of this thesis, there are risks and uncertainties connected with the employment of living organisms with regard to their ability to change and actively interact with their environment, causing a reserved reaction of the public towards biotechnology. The doubts people have are created partly due to a lack of knowledge and awareness of how the technology works, but are also based on ethical considerations and potential risks associated with this new technology. The main concerns the public has towards biotechnological applications regard plant and animal breeding whereas on the other hand applications in medicine are widely accepted[77].

For the reason that biotechnological innovations and developments might not be acceptable to society, companies need to know society's values, fears and expectations. Having this knowledge can also contribute to saving investments in money, time, and human resources as developments of risk-loaded and potentially non-acceptable products/services can be avoided. On the other hand, if industry can find out and prove that the fears of the public are not based on real risks, companies or industry associations could launch information campaigns to inform people and change their perceptions. As

[75] Kestens, M. (2002). *Biotechnology in Europe. The Way forward.*

[76] Dormann, J. & Holliday, C. (2002). *Innovation, Technology, Sustainability & Society. A World Business Council for Sustainable Development Project.* p.25

[77] Hansson, M.G. (2002). *Swedish Biotechnology and Bioethics go Hand in Hand.*

already described in section 3.1.3 (Social Responsibility and Economic Benefits) there are definite economic benefits for companies achievable, especially with regard to the fact that biotechnology companies are interacting with insurance companies as well as banks (e.g. insurance for accidents as they work with living organisms and banks because of the investment need of start-up enterprises).

The vast potential of biotechnology to drive economies towards a more sustainable development has also been recognized by the Commission of the European Communities[78]. Nevertheless, use of this potential can only be made if public support and acceptance is existing and secured for the future. To fulfil this condition, social responsibility demonstrated and lived by companies is essential besides education and information, dissemination by other bodies such as governments, authorities, and NGOs. The International Confederation of Free Trade Unions (ICFTU), being concerned with social impacts of industrial operations, shows interest in the biotechnology sector and requires the industry to demonstrate accountability and transparency[79]. One of their requests to the World Summit on Sustainable Development was the establishment of a plan for social and employment impacts of biotechnological developments. Companies can take their share to evaluate and address those impacts, and therefore, demonstrate their commitment to social responsibility.

### 4.1.2 Relevant Social Performance Aspects for the Biotechnology Industry

The development of the GRI aspects has happened in a multi-stakeholder process and they are meant to be generally useful to all industries. Hence, all of them are likely to apply to the biotechnology sector too. Nevertheless, because of this very general focus of the original GRI aspects some of them may be more relevant with special respect to the biotechnology industry.

In order to answer the research question of this thesis the relevance of the social aspects for the biotechnology sector in Europe were determined and the most important ones chosen. To do this the special characteristics of biotechnology, which have already been introduced in section 2.7 (Special Characteristics of Biotechnology), are used as criteria to explain and justify the relevance. In order to give a better overview, the characteristics of biotechnology, already mentioned in section 2.7, are summarised here again[80]. Biotechnology:

1. **By the use of living organisms has a considerable possibility to contribute to sustainable development and increase our quality of life;** (This point is unique because only biotechnology uses living organisms and therefore can explore the potential of them.)

2. **Has big potential for application in cleaner production (through dematerialisation and substitution), but is also applicable for End-of-life purposes;** (This point is unique in connection with the first point; the fact that living organisms are used.)

3. Is knowledge based, requires highly-skilled labour; (This point is not unique as those features also apply, for instance, for the ICT sector)

4. Is new, is developing and growing rapidly; (This point is not unique because other new technologies do so too.)

---

[78] Commission of the European Communities. COM (2001)454 final. pp.3-4

[79] ICFTU (2002). *Fashioning a new Deal. Workers and Trade Units at the World Summit for Sustainable Development Assessing our Performance. The Workplace Perspective.* p.31

[80] Points in Bold are unique features of biotechnology. Characteristics of other points can also apply for other industry sectors. Explanations for each point are given in brackets in smaller font.

5. **Uses living organisms, therefore shows a (maybe uncontrollable) dynamic, because living things can change (randomly or if outside conditions change), which leads to a uncertainty regarding future impacts** (This point is unique as it reflects the definition of biotechnology)

6. **Due to the fact mentioned in point 5, it raises concerns among the public but also among scientists (they are scared of the technology and its potential impacts);** (Unique, because the impacts can have a dynamic character and many of them are not known yet.)

7. Requires interdisciplinary teams to explore its potentials; (important but not unique; interdisciplinary teams are increasingly required in many other fields)

8. Raises, to a certain extent, ethical questions, i.e. application of genetic engineering. (This point is not unique; ethical questions are also raised, for instance, with respect to the production and use of weapons.)

Out of the characteristics of biotechnology some unique features can be identified. Those features are reflected in the points one, two, five, and six. Since points one and two together have positive and points five and six have negative implications, it is possible to form two groups out of the four points. One group stands for the large potentials of biotechnology to contribute to sustainable development and thus perhaps to improve the quality of our life (1 & 2). The way in which this contribution is done was described in section 2.4.2 (Future opportunities) and in section 2.5 (Biotechnology for environmental protection). The other group describes the risks, fears, and uncertainties connected with this technology (5 & 6). To investigate the relevance of social aspects two criteria can be created out of this:

1. **Risk & Uncertainty criterion**: Concerns and uncertainty about potential (future) impacts (because of the dynamic nature of living organisms and resulting possible changes)

2. **Potential benefits criterion**: Contribution to sustainable development and improvement of our quality of life.

The reasoning to investigate the specific relevance of aspects to the biotechnology industry is: if certain social performance aspects are specifically relevant for the biotechnology industry, the aspects should address those unique characteristics, i.e. the criteria. The aspect can either be important or relevant with respect to the criterion or might have a low meaning so far. Additionally aspects with uncertain relevance according to available information were identified. This selection will be done with regard to the given information about biotechnology in part two of this thesis and the requirements of social responsibility described in part three. In addition to that outcomes from interviews will be utilised for the selection process. The choices will result in a set of social performance aspects specifically important to be addressed by biotechnology companies, aiming at a socially responsible performance. In the following part the relevance of the aspects for the biotechnology industry are discussed. A short description of the aspects is given in brackets, for more details, please refer to Appendix 3.

Employment (Employment type, employment contract, employment net creation, average turnover)

Regarding this aspect the quality of jobs needs to be considered, because biotechnology might create new jobs, but on the other hand in cases of substitution former jobs might be lost. However, quality criteria, such as satisfaction of employees, level of payment, or working atmosphere etc. are not explicitly mentioned in the GRI guidelines. But since development not only refers to changes in quantity but also in quality these criteria should be taken into consideration when impacts of industries – in this case the biotechnology industry – are evaluated. To take a reasonable decision about applying

biotechnological processes on a large scale and its impact on employment an evaluation of the total impact of biotechnology on the economy is necessary.

| Risk & uncertainty criterion | Potential benefits criterion |
|---|---|
| Based on the available information a **low relevance** could be determined. | The rapid development of the biotechnology sector could create jobs, but there could also be a loss of jobs through substitutions. Additionally, quality features of the jobs (e.g. more safety vs. more stress) can influence the result.<br><br>Based on the available information the relevance is **uncertain**. |

Labour/Management relations (Percentage of employees being members of independent trade union organisations, procedures regarding information, consultation and negotiation with employees)

One example for those relations is the involvement of employees in decision-making processes. This participation was mentioned by an interviewee to be important[81].

| Risk & uncertainty criterion | Potential benefits criterion |
|---|---|
| Based on the available information a **low relevance** could be determined. | The evolution of the biotechnology industry very much depends on the innovative potential of its employees. This potential can only be explored if the employees are satisfied with their working environment and the relation to the management. The creation of a comfortable working environment also implies flat management structures in a company[82].<br><br>Based on the available information the relevance is **uncertain**. |

Health & Safety (Recording and notification of occupational accidents and diseases, existence of health & safety committees)

Common international standards are already addressing the issue of health & safety[83]. Aspects in this area have traditionally been approached by legislation but increasingly play a crucial role for the promotion of products and services. This is, for example reflected in labelling schemes including health and safety requirements for certification. Thus, companies, governments, and sector organisations intensify efforts to promote voluntary commitments to higher standards[84] and consequently establish a preventive culture. The health and safety of people not only is of importance to the company but also has an intrinsic value. To appreciate this it is important to act according to the precautionary principle in the sense of 'better safe than sorry'. Another issue of importance in the biotechnology industry is a

[81] Academic expert 3. (2002, August 27). Personal interview.

[82] Dobes, V. (2002, September 01). Personal interview.

[83] Cf. European Agency for Safety and Health at Work. (last modified 06.08.2002). http://europe.osha.eu.int/ [2002, August 21]

[84] European Commission. COM (2001)366 final. p.10

high workload and stress for employees, which often goes together with jobs in this sector. Since the balance between work and private life can considerably influence the well being of people, those concerns need to be addressed[85].

Risk & uncertainty criterion

Employees can have direct contact with the processes and therefore the living organisms, which can pose risks to them, e.g. infections or allergies. Besides immediate risks there is a danger of long-term impacts on employee's health. Especially when microorganisms are employed high safety standards are crucial. Since a significant amount of work is done in laboratories in the biotechnology sector special safety measures have to be taken to prevent accidents from happening (e.g. labelling of dangerous substances).

Based on these reasons this aspect is **important** for the biotechnology industry.

Potential benefits criterion

The use of living organisms can result in better working conditions, such as lower process temperatures or less input of chemicals (through the use of biocatalysts compared to chemical reactions that often require high temperatures and pressures), which will improve the health and safety of employees in the long run. Dangerous substances could possibly be phased out or substituted (e.g. in paper production).

Based on these reasons this aspect is **relevant** for the biotechnology industry.

Training & Education (Hours of training per employee, skills enhancement, lifelong learning)

The aspect of training and education seems to be especially worth to consider as the development of the biotechnology industry very much depends on the creation of knowledge and skills of employees. Learning enhances human resources, provides people with better knowledge, and therefore influences their background/information basis to make reasonable decisions. The involvement in international cooperation and information exchange should be mentioned here as another important aspect to foster the development of a company (and the biotechnology industry in general) (Cf. section 2.4.3 (International Cooperation)).

Risk & uncertainty criterion

Employees need to be trained to assure their safety when dealing with living organisms in the company and to avoid incidents with potential negative impacts from happening. The estimation of dangers and risks of biotechnology and responses to them are probably easier for well-educated employees having sufficient information about the issue.

Based on these reasons this aspect is **relevant** for the biotechnology industry.

Potential benefits criterion

Continuous training and education can provide and maintain highly-skilled labour, being crucial for innovations in, and the development of the biotechnology industry. The provision of possibilities for life-long interdisciplinary learning is necessary to explore potentials and possible impacts of this technology (as mentioned in section 2.7 (Special Characteristics of Biotechnology)). Biotechnology has the potential to bring together different backgrounds, which has positive implications for learning[86]. Extending the scope of education to the public can have a positive influence on their acceptance of

[85] Cf. Novozymes. (2002). *Environmental and Social Report 2001.* p.38. This enzyme-producing company recognised through a survey the problem of work-related stress. Their policy now actively addresses the issue of stress and contains statements dealing with the balance between work and family life.

[86] Dobes, V. (2002, August 27). Personal interview.

biotechnology, especially because people's concepts of biotechnology differ and the variety of applications is not well known yet (Cf. sections 2.1 (Definition of Biotechnology) and 2.6 (Opinions about Biotechnology)) or causes fears among people (Cf. section 2.3 (Gene Technology)). Education can contribute to the state of information of stakeholders and enable and facilitate discussions with them (the relevance of stakeholders will be discussed in section 4.1.4 (Stakeholder Participation for continuous Improvement)).

Based on these reasons this aspect is **important** for the biotechnology industry.

Diversity and opportunity (Equal opportunity policies and programmes, composition of senior management)

The ability to sell on an increasingly globalised market for biotechnological products and applications can be explored much more efficiently if a greater diversity of workforce is employed.

Risk & uncertainty criterion

The different knowledge and experience of a diversity of employees could contribute to the definition of what the precautionary principle should imply in the company. Evaluating the risks from different perspectives could lead to high standards and consequently might reduce the risk of negative impacts occurring.

Based on these reasons this aspect is **relevant** for the biotechnology industry.

Potential benefits criterion

Employing people with a diversity of working backgrounds from different disciplines can support the company to explore the potentials of biotechnology and at the same time can improve the estimation of its long-term impacts (need for interdisciplinary teams was mentioned in section 2.4 (Characteristics of the Biotechnology Sector)). Additionally employees from different cultural backgrounds can bring up a variety of perspectives (e.g. fears caused by biotechnology or possible applications), which the company would otherwise miss. This balanced view could support sustainable development from the beginning as the sector is still evolving.

Based on these reasons this aspect is **important** for the biotechnology industry.

Strategy and management (Policies, procedures and monitoring systems to deal with all human rights relevant to the operation)

The importance of this aspect is explained through the fact that policies to address social aspects have to be written and managed. It is crucial for public acceptance to not only put social responsibility into words but also to put it into practice. Therefore, systems have to be established to monitor and benchmark the performance of the company. Even though being generally important, low specific relevance of this aspect for the biotechnology industry could be found.

Risk & uncertainty criterion

Potential benefits criterion

| | |
|---|---|
| Based on the available information a **low relevance** could be determined. | Based on the available information a **low relevance** could be determined. |

Non-discrimination (Policies and programmes to prevent all types of discrimination)

The respect for talents of employees, fairness and stated non-discrimination policies towards, for instance, race or gender strengthens the position of a company to be an employer of choice[87] and for this reason, helps them to secure a good reputation and long-term economic viability. The importance of this aspect for any kind of business also includes the biotechnology industry. Besides that, a special relevance of this aspect, which distinguishes the biotechnology industry from other industries, could not be found.

| Risk & uncertainty criterion | Potential benefits criterion |
|---|---|
| Based on the available information a **low relevance** could be determined. | With regard to the reasons given for the aspect of diversity, non-discrimination is important for the biotechnology sector in the sense that valuable potential employees should not be refused on the basis of preferences or cultural/political backgrounds.<br><br>Based on the available information the relevance is **uncertain**. |

Freedom of association and collective bargaining (Existence and extent of application of a freedom of association policy)

This question has already been addressed at an international level and is of general interest. As a guideline for companies to address and respect the right of freedom of associations and collective bargaining of employees the International Labour Organisation (ILO) published conventions, which are legally binding to parties verifying them[88]. However, there does not seem to be a specific relevance of this aspect for the biotechnology industry.

| Risk & uncertainty criterion | Potential benefits criterion |
|---|---|
| Based on the available information a **low relevance** could be determined. | Based on the available information a **low relevance** could be determined. |

Child labour & Forced and compulsory labour (Policy excluding child labour and preventing forced and compulsory labour)

| Risk & uncertainty criterion | Potential benefits criterion |
|---|---|
| Based on the available information a **low relevance** could be determined. | Biotechnology companies can get their resources from all different countries. When social responsibility is to be taken along the supply chain those labour issues become important. Especially when resources are imported from developing countries where |

[87] Business in the Community's Business Impact Task Force. (2000c). *Winning with Integrity. Workforce*. p.1

[88] ILO Convention 87. (1948). *Freedom of Association and Protection of the Right to Organise Convention*. and ILO Convention 98. (1949). *Right to Organise and Collective Bargaining Convention.*

| | |
|---|---|
| | standards regarding working conditions are lower, action of the company is required.<br><br>Based on the available information the relevance is **uncertain**. |

Disciplinary practices (Description of appeal practices and non-retaliation policies, confidential employee grievance system)

| Risk & uncertainty criterion | Potential benefits criterion |
|---|---|
| Based on the available information a **low relevance** could be determined. | Based on the available information a **low relevance** could be determined. |

Security practices (Human rights training for security personnel)

| Risk & uncertainty criterion | Potential benefits criterion |
|---|---|
| Based on the available information a **low relevance** could be determined. | Based on the available information a **low relevance** could be determined. |

With respect to the meaning given to the aspect from the GRI no specific relevance could be found. Nevertheless regarding the possibility of misuse this aspect could become important. As microorganisms are a potential resource for biological weapons security measures for every company working with them are recommended. This especially applies for companies doing R&D regarding modifications of microorganisms to produce them for certain purposes.

Indigenous rights (Policies and procedures to address needs of indigenous people)

| Risk & uncertainty criterion | Potential benefits criterion |
|---|---|
| Based on the available information a **low relevance** could be determined. | As mentioned before biotechnology companies can get their resources from all different countries. Since high genetic diversity can often be found in developing countries indigenous people living there are of importance when social responsibility is to be taken along the supply chain. Their integration can avoid conflicts and result in more knowledge, which fosters the development of the biotechnology industry.<br><br>Based on the available information the relevance is **uncertain**. |

Community (and public) (Involvement in or contributions to the community, dialogue with community in areas where community is affected by activities, benefits to society)

During research and discussions the equivocal nature of the term community was proved to be difficult. On the one hand it was understood as local community, on the other hand as global community, i.e. the general public. One characteristic of biotechnology is the use of living organisms, which have the potential to travel, i.e. to move throughout the biosphere and to genetically interact with other organisms. Therefore, the impacts biotechnological applications might address not only the

local but also the global community. For the investigation of the relevance of the community aspect the general public has been included here.

Risk & uncertainty criterion

The community possibly faces the threat that risks being reduced within the company could be transferred to the outside, making risk management even more important[89] (Cf. section 2.5 (Biotechnology and Environmental Protection)). Possible impacts of operation can have global and maybe even uncontrollable effects. Social responsibility and information dissemination to the community can reduce fears and can decrease the likeliness of an incident happening (because of the link between CSR and the precautionary principle, Cf. chapter 3 (CSR and Social Responsibility)). The possible long-term impacts through the use of microorganisms for bioremediation purposes are another uncertainty[90].

Based on these reasons this aspect is **important** for the biotechnology industry.

Potential benefits criterion

The involvement of the community in the planning processes can lead to higher long-term success through cross-backgrounded information, thus providing high-quality jobs. Community (public) acceptance is needed to offer the biotechnology industry the possibility to explore its technical potentials and the public image is the most important competitive disadvantage for biotechnology (described in section 2.6 (Opinions about Biotechnology)).

Based on these reasons this aspect is **relevant** for the biotechnology industry.

Bribery and corruption (Policies and procedures to address bribery and corruption)

For a long-term perspective and with regard to the whole supply chain this aspect gains importance if not only the European but also the biotechnology sector worldwide is considered. Biotechnology companies might need resources, e.g. genetic resources from there and could influence the government to make decisions in favour for the company, by paying money. Through the need to tackle uncertainty with transparency of operational practices, the chance for bribery and corruption to occur decreases. This is explained by the fact that the company needs to disclose much of their business information, i.e. what they are doing and how and therefore would have more difficulties in "hiding" information.

Risk & uncertainty criterion

Based on the available information the relevance is **uncertain**.

Potential benefits criterion

Based on the available information the relevance is **uncertain**.

Political contributions (Policies, procedures and compliance mechanisms to manage political lobbying and contributions)

[89] Dobes, V. (2002, August 27). Personal interview.

[90] Academic expert 3. (2002, August 27). Personal interview. It was mentioned by this expert that for instance with regard to *in situ* soil bioremediation high uncertainties exist for people living on this ground many years later. Information is therefore needed about why and how the soil was treated and changes over time and possible impacts need to be investigated.

| Risk & uncertainty criterion | Potential benefits criterion |
|---|---|
| Based on the available information a **low relevance** could be determined. | Based on the available information a **low relevance** could be determined. |

Competition and pricing (Policies and their enforcement to prevent anti-competitive behaviour)

| Risk & uncertainty criterion | Potential benefits criterion |
|---|---|
| Based on the available information a **low relevance** could be determined. | Based on the available information a **low relevance** could be determined. |

Customer health & safety (Policies and their enforcement to preserve customer's health & safety during their use of the company's products and services)

Customer health & safety is a key topic of discussion with respect to genetically modified food. Rejection of consumers against this food has been realised by NGOs[91], which proves the issue of consumer choice to be important.

| Risk & uncertainty criterion | Potential benefits criterion |
|---|---|
| The ICFTU stresses the threat new technologies like biotechnology can pose to public health[92]. The customer's rejection of biotechnological products and its application are often based on the lack of information and the uncertainty about potential impacts. A sufficient investigation and test of the variety of rapidly developing biotechnological products regarding their safety is needed to avoid long-term impacts on customers (dynamic or unknown effects/changes of living things, described above in the characteristics).<br><br>Based on these reasons this aspect is **important** for the biotechnology industry. | Biotechnology can provide high quality and clean products, which might have fewer impacts on customer's health than conventional ones. The occurrence or non-occurrence of impacts on customers caused by products influences the reputation and success of a company. A benefit can be achieved if customers feel comfortable and secure with the products or services they buy.<br><br>Based on these reasons this aspect is **relevant** for the biotechnology industry. |

Products and services (Mechanisms related to product information and labelling, compliance with regulations)

For a company to act socially responsibly, it is important to respect preferences of society, for instance in the sense of supporting consumer choice by labelling products.

| Risk & uncertainty criterion | Potential benefits criterion |
|---|---|
| Complying with quality standards regarding the production and providing information about | Based on the available information a **low relevance** could be determined. |

[91] Friends of the Earth. (2002, August 27). Telephone interview.

[92] ICFTU. (2002). *Fashioning a new Deal. Workers and Trade Units at the World Summit for Sustainable Development. Assessing our Performance. The Workplace Perspective.* p.19

| | |
|---|---|
| the product according to the amount of knowledge available can reduce fears customers have connected with the product. Product labelling is especially relevant with respect to genetic modification. Still, this activity does not reduce the risk or uncertainty itself, only communicates it to the public. This results in a higher fairness towards the society, which supports the approach of social responsibility.<br><br>Based on the available information the relevance is **uncertain/relevant**. | **relevance** could be determined. |

Advertising (Adherence to standards and voluntary codes related to advertising)

| Risk & uncertainty criterion | Potential benefits criterion |
|---|---|
| Advertising and lobby work could influence people's minds about risks and uncertainties of biotechnology. It is a possible form of information dissemination and education of the public, clearing up about potential impacts and on this basis enabling rational discussions. On the other hand, this information should be reviewed to prevent the danger of biased information being distributed. A group of stakeholder representatives could take this task of reviewing, making the information more trustworthy.<br><br>Based on the available information the relevance is **uncertain**. | Based on the available information a **low relevance** could be determined. |

Respect for privacy (Policies, procedures and compliance mechanisms for customer privacy)

| Risk & uncertainty criterion | Potential benefits criterion |
|---|---|
| Based on the available information a **low relevance** could be determined. | Based on the available information a **low relevance** could be determined. |

The employment of the criteria to determine which social aspects are of significant importance for the biotechnology industry to behave socially responsible resulted in five crucial aspects: health & safety, training & education, diversity & opportunity, community, and customer health & safety.

Those aspects have to be given first priority in decision-making processes of biotechnology companies if they aim at a socially responsible behaviour. For the reasons explained above, a biotechnology company should utilise resources to improve their social performance regarding those aspects. Besides them there are further aspects identified of which relevance is uncertain but might be relevant for the biotechnology industry. The term "uncertain" refers to that fact that (even though this aspect is important by itself) there is no specific relevance of the aspect for the biotechnology industry, other that to other industries as well. These, as uncertain classified, aspects should be open to discussions to determine their relevance for a company case by case.

They are either not essential for the first-step short-term integration of social responsibility (but are still relevant in a mid- until long-term perspective) or have given a lower priority with respect to the criteria. Those aspects should not be completely neglected since they will be of increasing importance when the company develops. The uncertain aspects could be an issue of stakeholder discussions, helping to specify relevant aspects in each individual biotechnology company case. A growing company will become more powerful; hence can influence more parts of the system it operates in. Examples for this could be the commitment to require socially responsible behaviour from all business partners along the supply chain or its own dedication towards continuous improvement. Table 3 shows a summary of the findings of this section.

*Table 3: Specific relevance of social aspects for the European biotechnology industry.*

| | Criterion | |
|---|---|---|
| Aspect | "Risk & Uncertainty criterion" | "Potential benefits criterion" |
| Employment | - | ? |
| Labour/Management relations | - | ? |
| **Health & safety** | **++** | **+** |
| **Training and education** | **+** | **++** |
| **Diversity and opportunity** | **+** | **++** |
| Strategy and management | - | - |
| Non-discrimination | - | ? |
| Freedom of association and collective bargaining | - | - |
| Child labour | - | ? |
| Forced and compulsory labour | - | ? |
| Disciplinary practices | - | - |
| Security practices | - | - |
| Indigenous rights | - | ? |
| **Community** | **++** | **+** |
| Bribery and corruption | ? | ? |
| Political contributions | - | - |
| Competition and pricing | - | - |
| **Costumer health and safety** | **++** | **+** |
| Products and services | ?/+ | - |
| Advertising | ? | - |
| Respect for privacy | - | - |

++ important, + relevant, - hardly relevant, ? relevance uncertain (with respect to biotechnology companies)

### 4.1.3 Relevance of identified Social Aspects to the whole Biotechnology Industry

The identification of aspects for acting socially responsibly was aimed at being specifically established for companies applying biotechnological processes for substitution purposes of conventional processes or for the creation of new products for bioremediation. Besides that the research was based on developments in the European biotechnology sector.

As mentioned in section 2.4 (The Biotechnology Sector) biotechnology is a crossover technology, of which techniques can be applied in a variety of industries. As the variety of resources that could be used in the biotechnology industry is very large, it has potentials to be applied all over the world[93]. With respect to this fact, a company needs to widely scope its concept of social responsibility and implement it in all parts of the world, where it is operating. As the general conditions (e.g. in social or legal terms) change in different places, the importance of certain aspects could change too. The question to be reviewed is the relevance of the set of social aspects identified so far for assessing the social performance under different conditions. Examples have been given already such as the case of child labour or indigenous rights. Even though those aspects are not specifically relevant in the European context they might become very important if a company starts operating in or building up new business relationships with for instance developing countries (e.g. import of resources from there). This results in the challenge for business to continuously reflect on their performance and adjust it to the given conditions.

Since social issues, in general, are very much subjective the reason why certain aspects are seen to be significantly relevant while others are not, is not necessarily based on scientific evidence. People often base decisions on subjective judgements and values and this normative context also applies to industry operation and environmental problems. For example could people who always lived in a quiet village perceive the noise of a close new factory as unbearable whereas people from a bigger city would probably not even recognise it. One interviewee answered to the question if the selection of relevant aspects would be different if other applications of biotechnology are at issue, that intuitively decided it would differ greatly, even though this person thinks it should be the same[94]. This point already indicates the relevance of dialogues with different stakeholders to give companies the chance to get an impression of those personal perceptions.

### 4.1.4 Stakeholder Participation for continuous Improvement

To achieve social responsibility on a long-term basis, values and goals have to be reviewed continuously as they are changing with time in society too. The awareness of business of their operational impact on social issues and the commitment to review their social performance is a first step for companies to demonstrate social responsibility. The movement towards social responsibility is not a state-of-the-art business but rather very dynamic and needs continuous improvement. To achieve this, a company needs to permanently involve stakeholders and review the process. Their involvement is important to achieve a high quality and stability of the improvement process as well as for utilising as many social resources as possible. Hence the proposed activity is a multi-stakeholder process, also because there are many stakeholders and their relevance will probably change over time. The consultation of stakeholders is a strategic tool to discover the expectations they have towards the company, understand the complexity, and identify and even rank important areas for action. Being involved in stakeholder dialogue most likely also provides a company with information they would otherwise miss and therefore shows more business opportunities[95]. An open dialogue and transparency are essential to create trust and can help to assure that the company continuous to have the licence to operate.

A number of benefits of stakeholder involvement have been identified by several institutions, for instance by Business for Social Responsibility (BSR)[96]. This is a global organisation helping companies to achieve business objectives in ways that respect ethical values, people, communities, and the environment. Among other services, this organisation publishes white papers on different topics, one

---

[93] Academic expert 3. (2002, August 27). Personal interview

[94] Expert from the EFB. (2002, August). Response to questionnaire

[95] WBCSD. *Meeting Changing Expectations. Corporate Social Responsibility.* p.9

[96] BSR. (2001-2002). http://www.bsr.org/Meta/About/index.cfm [2002, September 03].

of them specifically dealing with the issue of stakeholder involvement. In this publication, several benefits of stakeholder engagement are listed[97], among others:

Reducing costs: through enhanced communication and increased trust.

Communicating with the community to identify potential areas of conflict can reduce costs compared to having to solve them afterwards. As outlined before, especially biotechnological applications contain risks and therefore, good, transparent communications are needed to prevent conflicts and to create trust in the operation of the company. In case an incident happens, the implications for the company's operations might not be as bad if trust was established before, compared to if there were no transparent interactions. In the latter case, to have "explanation-campaigns" for re-establishing acceptance for operation after something happened is much more expensive and time-consuming.

Building markets: Cooperation with customers can help companies to identify market niches and therefore, to facilitate the development of new products and services and their successful performance on the market.

The awareness raising of the possibilities of biotechnology among stakeholders could lead to a discussion of specific opportunities in different industries. With the help of this external input, problem areas in current production of special products or services could be identified and the potential application of biotechnology to solve them could be fully explored. Hence, biotechnology can build markets as it has the potential to create products and services for which manufacturing was not feasible by other means.

Protecting against negative customer actions: Stakeholder engagement might prepare companies to better respond to customers concerns.

Through stakeholder dialogue, the usefulness of a product can be discussed and potential claims and fears already addressed in the development stage, thus facilitating the introduction of the product to the market and its success. For biotechnological products this process, could result in a significant increase in consumer acceptance.

Increasing organisational effectiveness: Creation of skills and competencies through dialogues and partnerships.

This is especially important for biotechnology companies with respect to their interdisciplinary approach. Partnerships between biotechnology companies can facilitate information input in and information exchange on R&D projects, resulting in a more efficient outcome compared to isolated research in different enterprises. Value can be added to the company if employees are allowed to gain experience, and thus, most probably, higher competency, by working with partner companies, for example in other countries.

Enhancing two-way communication: Direct discussions with a variety of outsiders can improve employee's ability to communicate and listen.

This social competency is relevant for biotechnology companies as it enhances their ability to seriously address concerns of outsiders. Recognising a company as one that carefully listens to the issues raised by outsiders can contribute to the creation of trust among those outsiders towards the company.

---

[97] BSR Staff. (2001-2002). http://www.bsr.org/BSRResources/WhitePaperDetail.cfm?DocumentID=399 [2002, September 03]

Bridging cultural gaps: Stakeholders with different cultural backgrounds can bring in diverse knowledge and facilitate operation in various countries, preparing the company to face different cultures, laws, and languages.

Because biotechnology companies may operate in different countries or draw their resources from there they are likely to profit from this input.

Despite all benefits a company can gain from involving stakeholders, it might also create difficulties. Many companies are not used to a high level of transparency and disclosure and might feel uncomfortable with it. Furthermore, it takes time and resources to engage in stakeholder dialogues. Consequently, companies have to make a rough cost-benefit analysis of potential relationships with stakeholders.

Nevertheless, the benefits seem to outweigh the costs in most cases, as the example of the Danish biotechnology company Novozymes shows.

> Novozymes has already realised the importance of stakeholder involvement. They are committed to a responsible behaviour not only in the environmental dimension but also established a new policy on social responsibility in 2001. To successfully address the issue of responsibility the company recognised the need to work together with their stakeholders. One of their strategies was to ask three of their stakeholders to look at the company's performance from the stakeholder's point of view. This approach added value to the company by displaying fields where further action was required.
>
> Source: Novozymes A/S. (2002). *Environmental and Social Report 2001*.

### 4.1.5 Potential Stakeholders for Biotechnology

For the biotechnology sector, a set of preliminary stakeholders has been identified. Based on the question which stakeholders are important from the perspective of an enterprise employees, NGOs, government, local authorities, and the local community are seen as essential. As mentioned in section 2.4.2 (Future Opportunities) the three stakeholders the public, the industry itself, and government were identified as important. The reasoning given by the OECD was based upon the argument that they relate to the three driving forces public demand, economic demand, and scientific and technological feasibility.

Employees are the workforce of all companies, building the basis for it to work. For the biotechnology industry they are of special importance because their skills strongly influence the success of the company. Their health, safety, and satisfaction are therefore crucial for the company.

NGOs have a strong power to influence the public opinion about the behaviour and position of companies towards social inequities and environmental affairs. As NGOs often reflect public concerns and the avoidance of bad reputation is critical for companies they have to be transparent regarding their activities, especially because the biotechnology sector deals with living organisms. One example of NGOs for the biotechnology sector is Friends of the Earth, who are dealing with the topic of genetically modified (GM) food and the lack of consumer choice[98]. Because NGO campaigns can affect companies very much, the latter should respect the standpoints of the former and guarantee friendly relationships and transparency to them.

[98] Friends of the Earth. (2002, August 27). Telephone interview.

Another important stakeholder is government for the simple reason of existence and sometimes – as in the biotechnology sector – for reasons of promotion. The development of the biotechnology sector in Europe still very much depends on governmental support, either legal or financial[99]. Companies also have to comply with legal requirements regarding operation and employment of people and governments can intervene in a company's business if those requirements are not met. Because local authorities have decision-making power regarding business plans, such as operation permits, expansions and the building permissions for new company sites they are also relevant.

The stakeholder group of 'investors' is very likely to be important as they might favour companies that consistently demonstrate responsible behaviour. This could be especially relevant for small enterprises as they generally have few resources and depend on investments from outside. As the NAI (described in section 3.1.3 (Social Responsibility and Economic Benefits)) proves responsible enterprises to be more successful in the market those enterprises are likely to attract investors, because the probability of making profits is higher in this case.

Last, but not least, the acceptance of the community at the company's location is important for operation as the neighbourhood is the first concerned about impacts of operation with biological systems and it is a source of employees and consumers. The community is likely to recognise problems first and can put pressure on the company e.g. through boycotts, strikes (of employees) and complaints to authorities. As discussed before, this stakeholder also includes the general public since impacts of the application of biotechnology are likely to not be restricted to certain regions but could affect people on a worldwide scale.

Since a stronger focus of this thesis is put on already mentioned bioremediation or substitution practices, consumers are so far not identified as being one of the first important stakeholders. The explanation for that lies in the nature of the product or service with which consumers do not come in direct contact with. This statement can be supported if one imagines a genetically modified plant growing on contaminated soil to clean it in comparison to another GM plant serving as food for dinner. Most likely, the latter case is a greater issue for discussion. As the example shows, biotechnology provides a wide range of products and services. Therefore, consumer's choices and values are important to companies in order to market their products successfully. Based on this, if a complete stakeholder dialogue is to be established, consumers are an important group that must be included.

[99] Financial support especially through increased science budgets. Cf. Ernst & Young (2001). *Integration. Ernst & Young's Eighth Annual European Life Sciences Report 2001*. p.67

# 5. Conclusions and Recommendations

## *5.1 Conclusions*

We now live in a better-informed world with people being increasingly interested in different issues. As high environmental standards for business operation are generally already expected, the focus has shifted, during recent years, towards the third dimension of sustainable development: social issues. With the help of modern communication technologies different people, cultures, and mindsets from all over the world are connected. High availability and incredibly fast dissemination of information pose a new challenge to business, requiring correct and responsible behaviour to sustain good reputation and for them to remain competitive.

This thesis aimed at presenting a starting point for biotechnology companies to actively take social responsibility. Based on the analysis of available information THE MAIN OUTCOME are five social aspects of specific relevance to the European biotechnology industry. Those aspects are as follows:

1. **Health & Safety**
2. **Training & Education**
3. **Diversity & Opportunity**
4. **Community (Public)**
5. **Customer Health & Safety**

THE FIRST CONCLUSION of this thesis is that for the time being the topic of social responsibility in this industry has been largely neglected and information or data are scarcely available. Hence, there is a difficulty of getting relevant information about the social dimension of the biotechnology industry. Interviews with experts from different fields did not succeed to fill this information gap. Nevertheless, biotechnology's unique characteristics and the increasing global pressure on companies to commit to social responsibility displays the urgency for this industry to actively review and demonstrate their social performance. It is important to mention that there is growing interest especially in ethical questions, regarding the applications of biotechnology, supporting the urgent need to address responsibilities of companies with respect to social issues. Furthermore, the attempted focus on biotechnology for environmental protection could not be realised during this research. Due to the lack of specific information for analysis, the importance of the five identified aspects is not specific for companies applying biotechnology for environmental protection. The relevance might differ for other biotechnology applications and for different regions.

THE SECOND CONCLUSION refers to the differences of understandings related to biotechnology among different groups, such as academia, the public, industry etc. There is hardly any common knowledge about the variety of applications of this technology. A big problem is that opinions and discussions about biotechnology are often focussed on gene technology and its potential risks, and no distinction is made between those two. Those discussions often leave a negative impression about gene technology among people and ignore the number of benefits it brings to society (e.g. the production of food like cheese or beverages and medicines with the help of genetically modified microorganisms), which are commonly not discussed in public. Hence, this narrower point of view has the potential to

limit development capacities of biotechnology, in general. A focus on information dissemination and education of all stakeholders – not only by companies, but also by governments and academia – is needed to address those differences of understandings.

THE THIRD CONCLUSION relates to the distinctive, double-sided nature of biotechnology. Considered on the one hand as a key technology to successfully contribute to sustainable development and feared on the other hand for its potential risks and uncertainties a huge gap of perceptions exists. The use of living organisms (genetically modified or not) possibly has a strong power to impact our lives in ways we do not understand and probably cannot imagine yet. To explore the opportunities of biotechnology for sustainable development at the same time an understanding and good management of social responsibility is crucial. Because of the sensitivity of this issue to achieve this understanding and good management, the involvement of stakeholders on the one hand and interdisciplinary teams on the other hand are important. Their different perspectives, claims, and experiences will add value to a company and allow it to make well-funded decisions.

## 5.2 Recommendations

This section provides information to address the research question number *4. Which recommendations can be given to the biotechnology industry with respect to social responsibility?*

The resistance towards biotechnological applications and non-acceptance of products are considerably caused by the lack of information, knowledge, understanding, as well as lack of trust and confidence. Fears of the public are often caused by unknown potential and unpredictable risks. Those two facts act as a limitation for companies to explore and to capitalise upon the potentials of biotechnology. To address this limitation and take first steps to act socially responsibly the following recommendations are given to biotechnology companies:

1. **Be active**: This thesis provides a set of five crucial aspects to be considered to move towards a socially responsible behaviour. Biotechnology companies should use those aspects to review their social performance and take measures to improve them. Taking this action and communicating achievements to outsiders is a first step towards corporate social responsibility.

2. **Information & Transparency**: Biotechnology companies (and their associations) should launch information campaigns, e.g. by using product descriptions, brochures, the internet etc. Performing open-house-days in companies or by having representatives who actively engage in academic activities such as giving lectures in universities (or even in schools) are important possibilities to spread information. Demonstrating transparency by providing information creates the basis for companies to gain trust from society and to secure their business success.

3. **Clarification**: The diversity of biotechnological applications and their potential impacts needs to be discussed and clarified to avoid resistance and allow well-founded discussions. This is of special importance with respect to the existing but often neglected differences of traditional and modern biotechnology, including their benefits, utilisation possibilities, and impacts.

4. **Investigation**: Since companies very often perform R&D projects, they should investigate reactions of society in advance, in order to test their acceptance concerning the introduction of new biotechnological products to the market. According to the precautionary principle, companies should additionally perform risk analyses to prove the safety and quality of their products prior to launching them on the market.

5. **Stakeholder involvement**: The importance of stakeholder engagement was clearly demonstrated in section 4.1.4 (Stakeholder Participation for continuous Improvement). Companies should consider possibilities to involve them into the evaluation of their social

performance. One option could be the creation of an independent advisory group, including representatives from different stakeholders to critically review the company's performance and provide suggestions for improvement. An advisory group could be useful to discuss and review the five important aspects highlighted in this thesis with respect to the individual case of a company. Furthermore, this group could help to review the aspects classified as uncertain to determine if there is a relevance of them for the company or not.

6. **Broaden your mind**: Since all companies are a part of a bigger system, effects that go beyond the boundaries of a company need to be considered. This applies, for instance, for impacts caused along the product line in different regions and countries (space dimension). It also includes looking at the potential impacts a product or service can cause during its whole life (time dimension, life cycle approach).

## *5.3 Further Suggestions & Comments of the Author*

The core research question of this thesis was *What is the relevance of social performance issues for companies operating in the European biotechnology sector?*

The information given about the field of biotechnology on the one hand and of the concept of social responsibility and social performance on the other hand were combined, discussed and analysed to display the relevance of social performance issues for companies operating in the European biotechnology sector. Besides the results gained from the research, there are nevertheless open questions to further investigate in this field in the future.

### 5.3.1 Future Research Questions

During this research many interesting questions were raised. Because of lack of available information and due to time constraints, not all of them could be answered. The topicality of this topic of biotechnology and corporate social responsibility calls for a more detailed investigation. To address this and based on the results and findings of the research, a set of questions for further research is presented:

1. How can the five identified aspects be implemented into business operations?

2. How can a complete stakeholder dialogue about CSR in the biotechnology industry be achieved?

3. How can the public be effectively informed and educated?

4. What are the specific characteristics of the different applications of biotechnology and their actual potentials to contribute to sustainable development?

5. Would the relevance of social aspects differ for people in developed and developing countries? If yes, why?

6. What is the state-of-the-art of social responsibility in the biotechnology sector in other places of the world?

### 5.3.2 Limitations of the Thesis

The central impression when doing this research was the topicality and innovativeness of the topic discussed. During literature research but also interviews with experts, the difficulty to gather relevant and sufficient data was apparent and sometimes information on posed questions was not available at all. An inquiry addressed to experts all over the world (the IIIEE-network) also resulted in very little information, supporting the impression that there is not much done in this field yet. The attempt was made to focus on biotechnology for environmental improvement, but during research it became clear that discussions so far are carried out mainly about gene technology and ethical questions and that further applications of biotechnology are not well known. Social aspects of biotechnology have been very much focused on ethical issues, such as human rights questions.

Social issues are characterised by a high complexity and subjectivity of people looking at them and are therefore difficult to deal with. In contrast to environmental and economic issues, social values are very much influenced by culture and individuals, hence, they are highly subjective. Social concerns are not materialistic (not bound to property) and therefore hard to grasp. Additionally, the social dimension is active, i.e. it is not only about reacting to certain situations but also about actively creating new conditions.[100]

The last limitation influencing this thesis work is the attitude of the author herself and the available information. The author's opinion about biotechnology is rather more positive than sceptical, which might occasionally be reflected within the text. In addition to that, several sources cited are published from institutions and organisations that favour the use of biotechnology and can also generate a quite positive image of biotechnology.

[100] Empacher, C. (2002). *Die sozialen Dimensionen der Nachhaltigkeit – Vorschläge zur Konkretisierung und Operationalisierung.*

# Bibliography

Becher, G., Schüler, J. & Schuppenhauer, M. Perspektiven der kommerziellen Bio- und Gentechnologie in Nordrhein-Westfalen. in: Kaiser, G. (ed.) (1997). *Wirtschaftsfaktor Bio- und Gentechnologie*. Wissenschaftszentrum Nordrhein-Westfalen. Düsseldorf

B.I.C.S. (Biotechnology Information and Communication Switzerland of the Priority Programme Biotechnology of the Swiss National Science Foundation). (2002). Weshalb nicht mehr Biotechnologie?. [Online]. Available: http://www.bioweb.ch/de/forum/1999/1/08 [2002, August 11]

Biotechnology Industry Organisation (BIO). (2002). *Editors' and Reporters' Guide to Biotechnology 2002-2003*. BIO. Washington DC

Bundesministerium für Bildung und Forschung (BMBF). (2001). *Rahmenprogramm Biotechnologie – Chancen nutzen und gestalten*. BMBF. Bonn

Business for Social Responsibility. (2001-2002). *About BSR*. [Online]. Available: http://www.bsr.org/Meta/About/index.cfm [2002, September 03].

Business for Social Responsibility Staff. (2001-2002). *Stakeholder Engagement*. [Online]. Available: http://www.bsr.org/BSRResources/WhitePaperDetail.cfm?DocumentID=399 [2002, September 03]

Business in the Community's Business Impact Task Force. (2000a). *Winning with Integrity. Summary*. UK

Business in the Community's Business Impact Task Force. (2000b). *Winning with Integrity. Chapter 01. Putting your heart into it. Purpose and values*. UK

Business in the Community's Business Impact Task Force. (2000c). *Winning with Integrity. Workforce*. UK

Büro für Technikfolgenabschätzung beim deutschen Bundestag (TAB). [Office for the estimation of consequences of technologies of the German Bundestag]. (1993). *TA-Monitoring Bericht II. Technikfolgen-Abschätzung zu neuen Biotechnologien. Auswertung ausgewählter Studien ausländischer parlamentarischer TA-Einrichtungen*. TAB-Arbeitsbereicht Nr.19.

Commission of the European Communities. (2001). *Towards a Strategic Vision of Life Sciences and Biotechnology: Consultation Document*. COM (2001)454 final. Brussels.

Commonwealth Scientific & Industrial Research Organisation (CSIRO) Australia (2000). *Gene Technology in Australia. Biotechnology: What is it?*. [Online]. Available: http://genetech.csiro.au/whatisgt.htm [2002, July 13]

Convention on Biological Diversity. (1992). Article 2: Use of terms

Deutsche Industrievereinigung Biotechnologie (DIB) im Verband der chemischen Industrie e.V. (2001). *Biotech 2001. Die wirtschaftliche Bedeutung von Biotechnologie und Gentechnik in Deutschland*. Frotscher Druck GmbH. Darmstadt

Dormann, J. & Holliday, C. (2002). *Innovation, Technology, Sustainability & Society. A World Business Council for Sustainable Development Project*. WBCSD. Switzerland

Empacher, C. (2002). *Die sozialen Dimensionen der Nachhaltigkeit – Vorschläge zur Konkretisierung und Operationalisierung*. Institut für Sozial-ökologische Forschung (ISOE) GmbH.

Ernst & Young (2000). *Evolution. Ernst & Young's Seventh Annual European Life Sciences Report 2000*. Ernst & Young International Ltd. UK

Ernst & Young (2001). *Integration. Ernst & Young's Eighth Annual European Life Sciences Report 2001*. Ernst & Young International Ltd. UK

Environmental Biotechnology Institute (EBI). *Our focus*. [Online]. Available. http://www.bio.calpoly.edu/EBI/ebi.html [2002, August 9]

European Agency for Safety and Health at Work. (last modified 06.08.2002). [Online]. Available: http://europe.osha.eu.int/ [2002, August 21]

European Commission (May 1994). *Ethics and Biotechnology*. Information Dossier of the Group of Advisors on Ethical Implications of Biotechnology.

European Commission. (2001). *Promoting a European framework for corporate social responsibility*. COM (2001)366 final. European Commission. Directorate-General for Employment and Social Affairs. Belgium

European Commission. (2002). *Biotechnology Programme (1994-1998) Project reports (volume 3 – 2001)*. European Communities 2002. Belgium

European Initiative for Biotechnology Education (EIBE). (1999). *Unit 17 Biotechnology: Past and Present*. Institut für die Pädagogik der Naturwissenschaften an der Universität Kiel. Kiel.

European Initiative for Biotechnology Education (EIBE). (2000). *Unit 16 Biotechnology and the Environment*. Institut für die Pädagogik der Naturwissenschaften an der Universität Kiel. Kiel

Global Reporting Initiative (GRI). (2000). *Sustainability Reporting Guidelines on Economic, Environmental and Social Performance*. GRI

Global Reporting Initiative (GRI). (2002). *2002 Sustainability Reporting Guidelines. Pre-Publication Release*. GRI

GreenEffects. *Die Kriterien*. [Online]. Available: http://www.greeneffects.de/seiten/index/index2.htm [2002, August 31]

GreenEffects (a). *GreenEffects im Vergleich zu DAX und S&P 500*. [Online]. Available: http://www.greeneffects.de/seiten/fonds/fonds2c.htm [2002, August 31

Hamstra, I. A. (1998). *Public Opinion about Biotechnology: a Survey of Surveys*. European Federation of Biotechnology. Task Group on Public Perceptions of Biotechnology. The Netherlands

Hansson, M.G. (2002). *Swedish Biotechnology and Bioethics go Hand in Hand*. In: The Swedish Institute. Current Sweden No. 438. June 2002. Stockholm

Heiden, St., Burschel, C. & Erb, R. (ed.) (2001). *Biotechnologie als interdisziplinäre Herausforderung*. Deutsche Bundesstiftung Umwelt (DBU). Spektrum Akademischer Verlag GmbH. Heidelberg. Berlin.

International Confederation of Free Trade Unions (ICFTU) (2002). *Fashioning a new Deal. Workers and Trade Units at the World Summit for Sustainable Development. Assessing our Performance. The Workplace Perspective*. Global Unions.

International Labour Organisation C87. (1948) *Freedom of Association and Protection of the Right to Organise Convention*. San Francisco

International Labour Organisation C98. (1949) *Right to Organise and Collective Bargaining Convention*. Geneva

Kestens, M. (2002). *Biotechnology in Europe. The Way forward*. In: Corporate Seeds. March 2002 – Issue 10. Hill and Knowlton. Brussels

Marlier. E. Eurobarometer 35.1: Opinions of Europeans on Biotechnology in 1991. In: Durant, J. (1992). *Biotechnology in Public. A Review of Recent Research*. Science Museum of the European Federation of Biotechnology. London

National Science and Technology Council (NSTC) (July 1995). [Online]. Available. http://www.wabio.com/definition_biotech.htm [2002, August 11]

National Science and Technology Council (NSTC). Biotechnology Research Subcommittee. *Biotechnology for the 21st Century: New Horizons. 3. Opportunities in Environmental Biotechnology*. [Online]. Available: http://www.nal.usda.gov/bic/bio21/environ.html [2002, July 10]

Novozymes A/S. (2002). *Environmental and Social Report 2001*. Novozymes A/S. Denmark

Organisation for Economic Co-operation and Development (OECD) (1994). *Biotechnology for a clean environment. Prevention, Detection, Remediation*. OECD. France

Organisation for Economic Co-operation and Development (OECD) (1998). *Biotechnology for clean industrial products and processes. Towards industrial sustainability*. OECD. France

Organisation for Economic Co-operation and Development (OECD). (2001). *The Application of Biotechnology to Industrial Sustainability. Sustainable Development*. OECD. France

OECD Observer. (1999, March 01). Biotechnology and Industry: A Union of Promise. [Online]. Available: http://www.oecdobserver.org/news/fullstory.php/aid/2/Biotechnology_and_industry:_a_union_of_promise.html [2002, August 12]

Raphael, T. (1997). *Umweltbiotechnologie. Grundlagen, Anwendungen und Perspektiven*. Springer-Verlag. Berlin Heidelberg

Stakeholder Forum. *Towards Earth Summit 2002. A Definition.* [Online]. Available: http://www.earthsummit2002.org/ic/process/stakeholders.htm [2002, July 26]

United Nations Division for Sustainable Development. Agenda 21. Chapter 16. *Environmental Sound Management of Biotechnology*

World Business Council for Sustainable Development. (WBCSD a). Council Projects. *Corporate Social Responsibility*. [Online]. Available: http://www.wbcsd.org/projects/pr_csr.htm [2002, September 01]

World Business Council for Sustainable Development. (WBCSD b). Council Projects. *Innovation and Technology*. [Online]. Available: http://www.wbcsd.ch/projects/pr_innovation.htm [2002, September 1]

World Business Council of Sustainable Development. *Meeting Changing Expectations. Corporate Social Responsibility*. Red Letter Design. London

World Business Council for Sustainable Development (WBCSD) Scenario Unit (2000). *Biotechnology Scenarios. 2000-2050 Using the future to explore the present*. Conches-Geneva

Xue, D. & Tisdell, C. (2000). *Safety and Socio-economic issues raised by modern Biotechnology*. In: International Journal of Social Economics. Vol. 27. pp. 699-708.

Zentralkomitee der deutschen Katholiken. [Online]. Available: http://www.zdk.de/aktuelles/ [2002, September 02]

List of interviews:

Academic expert 1. (2002, August 21). Personal interview.

Academic expert 2. (2002, August 21). Personal interview.

Academic expert 3. (2002, August 27). Personal interview.

Dobes, V. (2002, August 27) Personal interview.

Dobes, V. (2002, September 01) Personal interview.

Friends of the Earth. (2002, August 27). Telephone interview.

Representative from the Biotechnology Industry. (2002, August 08). Telephone interview.

Expert from the EFB. (2002, August). Response to questionnaire.

# Abbreviations

| | |
|---|---|
| BSR | Business for Social Responsibility |
| CSIRO | Commonwealth Scientific & Industrial Research Organisation |
| CSR | Corporate Social Responsibility |
| DNA | Desoxyribonucleic Acid |
| EBI | Environmental Biotechnology Institute |
| EFB | European Federation of Biotechnology |
| EIBE | European Initiative for Biotechnology Education |
| GM | Genetically Modified |
| GMO | Genetically Modified Organism |
| GRI | Global Reporting Initiative |
| ICFTU | International Confederation of Free Trade Unions |
| ICT | Information and Communication Technology |
| IIIEE | International Institute for Industrial Environmental Economics |
| ILO | International Labour Organisation |
| NAI | Natur-Aktien-Index (Nature-Share-Index) |
| NGO | Non-Governmental Organisation |
| OECD | Organisation for Economic Co-operation and Development |
| R&D | Research and Development |
| SME | Small and Medium sized Enterprise |
| WBCSD | World Business Council for Sustainable Development |

# Appendix 1: Structure of biotechnology companies

Heiden et al.[101] state that the biotechnology industry can be divided into three different sectors, i.e. "Entrepreneurial Life Science Companies" (ELISCOs), "Extended Core Biotech Companies", and "Big Pharma" (big pharmaceutical companies). According to Ernst & Young ELISCOs are "Companies that use modern biological techniques to develop products or services to serve the needs of human healthcare or animal health, agricultural productivity, food processing, renewable resources or environmental affairs"[102]. ELISCOs generally employ less that 500 people and their main activity is the development of products and technologies in the Life-Science-Sector. Extended Core Biotech Companies – as the name says – have an extended core of operation and under 500 employees as well, whereas Big Pharma enterprises have normally more that 500 people working for the company[103]. Becher et al. on the other hand mention Core-Biotechnology Enterprises as one and Service provider and Supplier as other types of enterprises[104]. Core-Biotechnology Enterprises add economic value by producing and selling products and services. The latter work for the former by giving advice, selling specific materials and equipment for laboratories or production, and doing remittance work. Besides this description, another source stated that biotechnology companies are often very small enterprises established out of bigger companies or attached to universities[105]. Especially academics are a vital basis for this sector as it is people-centred and strongly dependent on highly-skilled biotechnology graduates.

[101] Heiden, St., Burschel, C. & Erb, R. (ed.) (2001). *Biotechnologie als interdisziplinäre Herausforderung.* p.60

[102] Ernst & Young (2000). *Evolution. Ernst & Young's Seventh Annual European Life Sciences Report 2000.*

[103] Heiden, St., Burschel, C. & Erb, R. (ed.) (2001). *Biotechnologie als interdisziplinäre Herausforderung.* p.60

[104] Becher, G., Schüler, J. & Schuppenhauer, M. In: Kaiser, G. (ed.) (1997). *Wirtschaftsfaktor Bio- und Gentechnologie.* p.13

[105] Hansson, M.G. (2002). *Swedish Biotechnology and Bioethics go Hand in Hand.*

# Appendix 2: Nano-Biotechnology

One interesting field of application is Nano-biotechnology, which means that nano-scaled tools (nano = $10^{-9}$m, atomic or molecular level) are applied to biological materials for production[106]. It is an interesting, interdisciplinary cooperation of several fields such as nanotechnology, biotechnology, medical technology, biochemistry, pharmaceuticals, physics, and material engineering. This technology has the potential to be applied in different sectors such as diagnostics, therapeutics, cosmetics, and medical technology. Biological molecules and structures work as models for potential applications of nano-technology. One examples for this is the DNA, which not only can serve as a type of electrical wire in nano-machines but its enormous storage capacity of information might additionally work as a basis for computers of the next generation. Another prospective application is the use of light absorbing molecules (like those which occur in the retina of human eyes) as a means to increase the storage capacity of CDs. Further promising applications of nano-biotechnology include improved timing and specificity of drug delivery, advanced disease diagnostics and the production of miniaturised biosensors.[107]

[106] Ernst & Young (2001). *Integration. Ernst & Young's Eighth Annual European Life Sciences Report 2001*. p.60

[107] Biotechnology Industry Organisation (BIO). (2002). *Editors' and Reporters' Guide to Biotechnology 2002-2003*. p.21/22

# Appendix 3: Description of the GRI social aspects[108]

| Aspect | Description/Meaning |
|---|---|
| Employment | Employment type (full or part time), employment contract (permanent or temporary), employment net creation, average turnover |
| Labour/Management relations | Percentage of employees being members of independent trade union organisations, or other bona fide employee representatives, procedures regarding information, consultation and negotiation with employees (regarding changes in operations) |
| Health & safety | Recording and notification of occupational accidents and diseases, existence of health & safety committees formed by management and worker representatives |
| Training and education | Hours of training per employee, skills management, lifelong learning, support continued employability of employees |
| Diversity and opportunity | Equal opportunity policies and programmes, monitoring systems to ensure compliance, composition of senior management |
| Strategy and management | Policies, procedures and monitoring systems to deal with all human rights relevant to the operation, e.g. addressing human rights issues throughout the whole supply chain (selection on suppliers/contractors) |
| Non-discrimination | Policies and programmes to prevent all types of discrimination |
| Freedom of association and collective bargaining | Existence and extent of application of a freedom of association policy (independent from local laws) |
| Child labour | Policy excluding child labour, their visible statement and enforcement, programmes to address this issue |
| Forced and compulsory labour | Policy preventing forced and compulsory labour, their visible statement and enforcement, programmes to address this issue |
| Disciplinary practices | Description of appeal practices and non-retaliation policies, confidential employee grievance system |
| Security practices | Human rights training for security personnel |
| Indigenous rights | Policies, guidelines and procedures to address needs of indigenous people, share of redistributed operation revenues to local communities |
| Community | Involvement in or contributions to the community (e.g. humanitarian projects, support of education), existence and enforcement of a community impact policy, dialogue with community in areas where community is affected by activities, benefits to society |
| Bribery and corruption | Policies, procedures/management systems and compliance mechanisms addressing bribery and corruption |
| Political contributions | Policies, procedures and compliance mechanisms to manage political lobbying and contributions, amount of money paid to political parties and institutions |
| Competition and pricing | Policies and their enforcement to prevent anti-competitive behaviour |

[108] The description of the aspects is based on the indicators displayed in the GRI (2002) guidelines pp.55-58

| | |
|---|---|
| Costumer health and safety | Visible statement and enforcement of a policy to preserve customers health & safety during their use of the company's products and services, instances of non-compliance, number of complaints |
| Products and services | Mechanisms in place related to product information and labelling, compliance with regulations, addressing and measuring customer satisfaction |
| Advertising | Adherence to standards and voluntary codes related to advertising |
| Respect for privacy | Policies, procedures and compliance mechanisms for customer privacy |

# Appendix 4: List of People approached

In general there does not seem to be much information available. Often the author was passed on to somebody else. The tendency is that biotechnology is mentioned with regard to agriculture and renewable biomass. On the other hand institutes deal with research on sustainability in general. The following people/institutions were contacted to gain information and support/undermine the picture of biotechnology and social aspects drawn from the literature. The outcome of this was very low; there was only one answer to the questionnaire.

| People/group approached and how | Outcome |
|---|---|
| Platform of European Social NGOs (questionnaire) | They do not deal with biotechnology. |
| Greenpeace (questionnaire) | No answer. |
| ICLEI (The International Council for Local Environmental Initiatives) (questionnaire) | No answer. |
| European Federation of Biotechnology, Task Group of Public Perceptions (questionnaire) | One person filled in the questionnaire and is referred to in the text as expert from EFB. |
| ICFTU (questionnaire) | No answer. |
| Vladimir Dobes (expert on cleaner production) (personal interviews, open questions) | Referred to in the text. |
| Expert from the Degussa AG (biotechnology company) (telephone interview, open questions and questionnaire) | Expert stressed importance of economic aspects, but they are closely linked with environmental and social ones. No answer to questionnaire. |
| IIIEE-Network (email, open questions on new technologies and CSR) | Very few answers. |
| Büro für Technologiefolgenabschätzung (TAB), Berlin (telephone interview, open questions) | They sent a report about implications of biotechnology from 1993. |
| Representative from the Vereinigung deutscher Biotech-Unternehmen (Association of German Biotechnology Companies) (telephone interview, open questions) | For the application of biotechnological processes economic considerations are most important, no social aspects are considered so far. Public relations start slowly now (but are mainly done by associations, not really by the companies themselves), SMEs don't have resources for stakeholder relations. |
| BMBF (German Ministry for Education and Research) (telephone interview, open questions) | Nothing really about social aspects on biotech available. Passed on for further questions to the Wuppertal Institute. |
| Institut für Technikfolgenabschätzung und Systemanalyse (ITAS) (telephone interview, open questions) | Nothing known in this direction, they look at sustainability (criteria) in general. |
| Koordinierungsstelle EG der Wissenschaftsorganisationen (KoWi) (telephone interview, open questions) | They provided some help with literature. |
| Experts of different issues at the Wuppertal Institute (personal interviews, open questions) | They are referred to in the text (Academic expert 1, 2 and 3) |

# Appendix 5: Questionnaire

This questionnaire was sent to a variety of stakeholders (Greenpeace, Platform of European Social NGOs, ICLEI, ICFTU, EFB, Degussa AG) to get an impression of their perceptions. Unfortunately it could not be used in the end since the response rate was close to zero.

**Questionnaire on "Biotechnology and Social Implications of its Application"**

Background

My name is Antje Simon and I am writing my thesis (diploma work) on social implications of the application of biotechnology in Europe. I am trying to create a guideline for companies in the European biotechnology sector to act and operate in a socially responsible manner. This includes listening to their stakeholders and improving their social performance, which can be described by several aspects.

I would like to ask you to go through this questionnaire and with this state your expectations towards biotechnology companies what you think is important if they want to behave socially responsible. Please make your opinion heard through this channel.

Biotechnology and Environment

The use of biotechnological processes for environmental protection can have two dimensions. First the creation of "new products", i.e. bioremediation (for instance microorganisms able to break down persistent pollutants and clean up contaminated sites, e.g. heavy metals or oil spills) and second the substitution of conventional (e.g. chemical) processes in industry. The applications of biotechnological processes not only have economic and environmental but also social implications.

The following table shows aspects to evaluate these social implications. It aims at giving stakeholders the chance to decide which of them are important for the biotechnology sector, especially for decision making processes about the application for environmental protection as mentioned above.

Please answer the following questions with regard to the aspects given in the table below.

1. Which of the following aspects would you like to be considered when a decision about applying biotechnological processes or not is made? (The application embraces "new products" as well as substitutions; do you think there are differences?)

2. Are the same aspects identified by you important for assessing the social performance of companies operating in the (environmental) biotechnology sector?

3. Are there any aspects missing you think are important to consider? If yes which?

4. Are some of the aspects legally binding already (national standards required by law)?

| Social aspect | Implies for instance: |
|---|---|
| Employment (Labour practice and decent work) | Employment type (full or part time), employment contract (permanent or temporary), employment net creation, average turnover |
| Health & Safety (Labour practices and decent work) | Recording and notification of occupational accidents and diseases, existence of health & safety committees formed by management and worker representatives |
| Training and Education (Labour practices and decent work) | Hours of training per employee, skills management, lifelong learning, support continued employability of employees |
| Diversity, Opportunity and Non-discrimination (Labour practices and decent work & Human rights) | Equal opportunity policies and programmes, policies and programmes to exclude discrimination, monitoring systems to ensure compliance, composition of senior management |
| Freedom of associations & Collective bargaining, Labour/Management relations (Human rights & Labour practices and decent work) | Existence and extent of application of a freedom of association policy, employees being members of independent trade union organisations, bona fide employee representatives, procedures regarding information, consultation and negotiation with employees (regarding changes in operations) |
| Strategy and management (Human rights) | Policies, procedures and monitoring systems to deal with all human rights relevant to the operation, e.g. addressing human rights issues throughout the whole supply chain (selection on suppliers/contractors) |
| Child, forced and compulsory labour (Human rights) | Policy excluding child labour, forced and compulsory labour, their visible statement and enforcement |
| Customer health & safety, Product and service declaration (Product responsibility) | Visible statement and enforcement of a policy to preserve customers health & safety during their use of the company's products and services, mechanisms in place related to product information and labelling, compliance with regulations |
| Community (Society) | Involvement in or contributions to the community (e.g. humanitarian projects, support of education), existence and enforcement of a community impact policy, dialogue with community in areas where community is affected by activities, benefits to society |

**Further questions**

1. In you opinion: Is the considerations of topics like social responsibility or social sustainability important for enterprises? Why/why not?

2. Do you have any specific expectations regarding social implications towards companies when biotechnological processes are applied for environmental protection?

3. Would your list of relevant social aspects look different for other biotechnological applications, such as in pharmacy, agriculture, medicine, bio-computers etc.? What would the difference be?

---

Thank you very much for your effort! Please respond to: antje.simon@student.iiiee.lu.se