A Short History of Talking Biotech

Fifteen years of iterative action research in institutionalising scientists' engagement in public communication

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Cover illustration: "*Reflections*" by Jimmy Lorenzi, Corsica (2006)
Jimmy Lorenzi is a self-styled "sculptor-juggler of colours" who was awarded *"L'Oscar de France"* for art and communication in 2002. He is an honoured and innovative artist who has organised, for example, painting courses for blind children. I met Jimmy on the beautiful island of Corsica where he was born and still lives and where the majority of this thesis was written. Together we selected this painting for the cover as to me it reflects the emotions and the colourful ups and downs of fifteen years talking biotech.

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door

Patricia Osseweijer

geboren te Dordrecht

promotor: prof.dr. J.T. de Cock Buning

“The time has come,” the Walrus said,
“To talk of many things:
Of shoes—and ships—and sealing wax—
Of cabbages—and kings—
And why the sea is boiling hot—
And whether pigs have wings.”

Lewis Carroll, “*The Walrus and The Carpenter*” in
Through the Looking-Glass and What Alice Found There, 1872

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INTRODUCTION

Aim and purpose of this thesis

Whether people recognise it or not, science (including social science) and the technologies which derive from its discoveries totally underpin every aspect of life for one-fifth of the world's population. In the developed, so-called "post-industrial" societies people count on science for their health, their wealth, their welfare, their living standards and life styles, and their very environment. This will also soon be the case for a further one-third living in China and India. For the remaining just under one-half in the developing economies, it is their aim beginning to be achieved. Science has been one of the most powerful, if not arguably the most powerful, of human enterprises. In developed societies we have come to depend totally upon it and all indications show that this will be ever-increasingly so throughout the whole world.

Yet in Europe at least, science has come under challenge while it has to compete with other pressing priorities and conflicting interests for its financing in the public, political, media and activist arena. One of the lessons, hard-learned, from the biotechnology debate of recent years is that the vast majority of European people generally are not really interested in science, do not understand it and do not want to unless they have a personal need to. Otherwise their interest in science and technology is as spectacle, entertainment or controversy. Scientists have a special position in this critical situation because, while innovation, specialisation and institutionalisation have made science ever more complex, distant from and less understood by the majority of people, scientists alone remain expert and knowledgeable about their science, its technological applications and our dependence upon them. Comparison of the European Commission's Eurobarometer surveys between 1992 and 2005 shows that people overall in Europe say they have become considerably less interested in science generally. Yet, notwithstanding, they also say that scientists working at a university or government laboratory are best qualified to explain to them the impacts of science and technology (Eurobarometer, 2005, Gaskell et al., 2005 and 2006).

In that sense, and as this thesis will argue, scientists have a responsibility to explain their science and its import for the general good. They also need to act for their own good as public sector scientists because via taxes and government they are paid to do it by the rest of the population to whom they therefore need to provide account. Most scientists see the need to communicate and engage with the public. Some do it very well but many are hesitant for reasons of priority of research, publication and career, lack of training and confidence, and lack of tangible rewards. The answer would seem to be to concentrate on a range of public communication and engagement activities which experience shows do have significant genuine effect and which are possible within the given circumstances[1]. This thesis explores and analyses why many scientists may find difficulty in taking up that responsibility and also the ways in which they do have options to act and how these relate to the institutional settings in which they do their science.

With the discovery of DNA by Watson and Crick in 1953 a new era started for the scientific exploration of the basis of life. Molecular biologists, geneticists, microbiologists and biochemists slowly unravelled the mechanisms of cellular processes until 25 years later in 1977 genetic engineering became a reality with the first human protein, somatostatin, made in a bacterium. Then, as Mark Cantley later wrote, "*public and political opinion was learning to see gene technology, genetic engineering, biotechnology and so on as a single, vague and disquieting phenomenon*" (Cantley, 1992).

It is an oft-repeated truism that biotechnology is set to make a progressively more significant impact on the lives of all citizens in countries rich and poor, and on their economies. This is especially so in the case of biotechnology compared with other fields of science and technology as it may change the very fundaments of human existence: what we are – our genetic composition, what we live on – our food, how we live – our health, and where we live – our environment. It already has the ability to change the course of evolution, the underlying principle of life on earth, and the potential with synthetic biology to create new forms of life.

This thesis deals with the relations of scientists in the field of biotechnology with society at large. As a case example it provides a critical analysis of the activities of the researchers in a Dutch university department of biotechnology over the last fifteen years in order to formulate more effective and sustainable ways of interacting and communicating with the broader public in the development of modern biotechnology. It further aims to provide insight into the competences of scientists in public communication activities and provides suggestions for improvement. At the level of management it identifies the critical constraints in the organisational settings of universities in synchronising the rapid innovations of science with society's perceptions of them.

The thesis follows and describes a case situated in a changing social context over the recent fifteen years. It begins in the late 1980s with the early rise of public concern with biotechnology in Europe, continues with the increasing controversy during the 1990s and then ends with the established debate around the turn of the century to the present time of writing. It argues that the institutionalisation of scientists' public communication will be a key determinant for the sustainable maintenance of science for, and in, society.

[1] In this thesis the terms "science communication" and "public communication" refer to both one-way, so-called "deficit model", and two-way communication while "interaction", "involvement" and "engagement" are used synonymously for activities using the two-way "dialogue" or "contextual model" of science communication.

The approach is multidisciplinary and will utilise and evaluate the relevant concepts from a number of disciplines such as science communication, fundamental epistemology, sociology, social psychology and organisation theory as well as biotechnology.

The public debate accompanying the development of biotechnology during the last fifteen years is well known from the media and there have been many studies of it. This thesis is the first study however that describes the internal discussions and activities of biotechnologists in Europe in relation to the debate and maps their search to give an adequate response to it.

This thesis addresses the following central research questions:

1. Why is an increased use of (bio)technology in everyday life and products not related (but contrarily) to an increased public support for research?
   - To what extent can the cause of this be found in the closed practices of scientists?
   - What competences (knowledge, skills, attitudes) would hamper or facilitate an open practice?
   - What institutional practice and structures would hamper or facilitate the required competences?
2. What institutional management is required to earn public support for scientific developments?
   - What is the relationship between personal competences and institutional practice, structures and constraints?
   - What kind of changes need to be made to adjust competences of scientists to their societal role?

The thesis takes conclusions from observations with ways of raising scientists' awareness, competences and attitudes for engagement and communication with the wider public. It concludes by proposing how this public interaction can be facilitated through institutional management structures and practices. Although it concerns a specific case in the biotechnology field both kinds of conclusions may be generalisable to a number of other scientific disciplines, both natural and social.

Outline of thesis

Chapter 1 starts with a general description of the social context of the recent fifteen years during which developments in science communication have taken place. This is followed by introductions to some of the disciplines in the social sciences which are relevant for the work described in this thesis.

The thesis is further divided into four parts.

Part I: Knowledge: Raising awareness describes the lessons learned from the involvement in a European network (Chapter 2), followed by the description of the results and conclusions of a European Commission-funded research project which showed the growing awareness amongst scientists of the importance of training in public perception of biotechnology issues. Some parts were already published in 1993 and 1994 in Dutch (Osseweijer, 1993; Osseweijer, 1994) (Chapter 3). Chapter 4 closes this part with the conclusions on activities to raise awareness amongst scientists in a number of European congresses. Some of the arguments have been already published elsewhere (Osseweijer, 1999; Osseweijer, 2001).

Part II: Skills: Development of training describes the development of international training courses in public perceptions of biotechnology and bioethics over the period from 1993 to 2006 (Chapter 5). It evaluates the objectives, approach, contents and value of the courses for science communication in biotechnology. A paper similar to the content of Chapter 5 has been submitted for the journal "Science and Engineering Ethics".

Part III: Attitude and behaviour: Willingness to act describes an approach of scientists to reflect and discuss the possible consequences for biotechnology developments in the context of legislation and communication (Chapter 6). It also analyses the attitudes and behaviour of scientists in public communication of two public activities organised by the Delft University of Technology Department of Biotechnology (Chapter 7). Parts of this chapter were published in 2004 (Osseweijer, 2004). In Chapter 8, the results of three international surveys into the views of scientists on issues in biotechnology and their involvement in communication are described and discussed. Their willingness to be involved in public communication is measured as well as their participation in past public activities related to science communication.

Part IV: Institutionalisation: a new model for science communication in a university explores the drivers, objectives and costs of science communication in a university setting and gives a synthesis of the activities' results and evaluations (Chapter 9). It analyses the drivers for a university to be active in public communication and introduces a model approach for science communication, the "Three-E" Model: Entertainment, Emotion and Education. An example of this approach has been recently published (Schuurbiers, Blomjous and Osseweijer, 2006). It finishes with a proposal for a sustainable implementation of science communication in a university with recommendations for the removal of identified restrictions that presently hinder further institutionalisation of science communication (Chapter 10). This expands on the concept for institutionalisation of science communication in a university setting as published in 2004 (Osseweijer & De Cock Buning, 2004).

Chapter 11 summarises the final conclusions in an overall reflection that may be relevant for the introduction and implementation of science communication by universities in different disciplines. It discusses some options for further research on the hypotheses made for the institutionalisation of science communication.

In relation to most of the previously published papers this thesis describes the original data in greater detail and analyses and presents these in an integrated analysis of fifteen years of science communication.

The thesis deals with topics and issues in the natural sciences in a social science context for the insights which the latter provides into the former. It is intended to be as readily accessible as possible to readers from both areas. The writing therefore is in non-technical language. Where technical terms and concepts in the natural and social sciences are necessary they are explained and discussed for readers to whom they may not be familiar. Those to whom they are well-known are asked to kindly bear with this. Hopefully therefore the thesis may be useful to those interested in both the natural and social sciences.

Delft, 2002

It was a nice day when we finally set down for the annual review discussion. With plenty of coffee we (Gijs (Kuenen), Sef (Heijnen) and me) went through all the activities I had been involved in during the past year. Then suddenly it happened. They posed the question straightforwardly. What would you really like to do in your career? I had already talked about my enthusiasm for public communication activities and how I thought this should be embedded in the organisation of the Department. So perhaps should I do a MBA or a PhD? Their advice was as straightforward as their question: I should look at the options to make a PhD thesis on science communication. Soon afterwards I met Joske (Bunders) and Tjard (de Cock Buning) and the venture started. I could not have hoped for a more stimulating group behind me!

CHAPTER 1

Theoretical background and research design

1.1. Societal context

Public perceptions of biotechnology and scientists' views on public communication from 1980 to 2005

Modern biotechnology[2] has long been viewed as a breakthrough technology promising better quality of life for all world citizens. Its development however has been accompanied by concern and criticism about the methods it uses. There were early technical concerns about, for example, the use of antibiotic markers in the development of transgenic crops and moral issues about the principles of genetic engineering leading to the charge of "*playing God*". Others were worried about the opportunities for consumer choice in GM-foods. Environmental and animal welfare groups tried to block development by generating media coverage focussing on possible, often vague and unspecified risks and the lack of benefits for consumers. Political opinion in Europe spread to the USA and elsewhere, including to the developing world. The concerns were taken seriously resulting in reduction of support for scientific development in the European Union, especially in the agricultural and food sector. It was in this context that realisation grew within the scientific community that it was necessary to involve themselves in public communication.

While a very few eminent researchers had realised and acted on this almost from the outset, an increasing number of scientists started to contribute to public events. These individual activities were often passive, the experts being asked by the event organisers or the media for information or comment. Many scientists felt that they could ill-afford time away from their research, publications and grant-seeking. Some colleagues still frowned on what they felt were unscientific and therefore inappropriate activities. During the 1990s the first leading biotechnology research institutions and companies developed a number of pro-active communication approaches. These first campaigns were pragmatic in trying to show the benefits of academic and applied research such as by publishing information materials, organising laboratory open days, providing educational kits and running buses with

[2] There have been many definitions, of which the most used and accepted, and the one which will be used for this thesis, is the Organisation for Economic Co-operation and Development (OECD) definition of 1990, which was updated in 2005: "*The application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services.*" Broadly defined, the word *"science"* encompasses any systematic field of study aimed at discovery and *"technology"* the use and application of discoveries. As in the OECD definition, *"biotechnology"* is used in this thesis to refer to both the sciences and technologies covered by the definition and *"biotechnologists"* to both the scientists and technologists engaged in them.

laboratories to bring the newest techniques to schools. The focus was predominantly on explaining the science.

In Europe, a number of surveys were carried out to investigate public attitudes to the introduction of products derived from genetically modified organisms. Eurobarometer surveys in biotechnology conducted by the European Commission held repeatedly in a similar format over a number of years (1991, 1993, 1996, 1999, 2002 and 2005) provided insights into public perceptions of biotechnology. These surveys showed a relationship between knowledge and attitudes towards new technologies: more highly educated people were more positive to the introduction of new technologies such as information technology and biotechnology. In general the European public approved the use of biotechnology for new medicines and therapies but showed a more reluctant attitude to the introduction of GM foods and drinks. Noteworthy were the results about trust in organisations as sources of information. With industry, political organisations and governments at the bottom of the trust list and the environmental and consumer organisations at the top, although, notably, with public sector scientists relatively high-rated, it became clear that acceptance of biotechnology could not simply be a matter left to government and industry to communicate.

All these Eurobarometer surveys showed that the general knowledge on biotechnology by the public throughout Europe was low. During the early 1990s scientists believed that if more information were to be made available then the public would understand the potential benefits and increase their support for biotechnology, the pejoratively-termed "deficit model" of science communication. However, public meetings organised with the intention to inform and achieve acceptance resulted in increasing awareness but not necessarily in support. It became clear that more information usually only tended to lead to further polarisation of opinion. From the later, 1999, Eurobarometer survey it emerged that the general level of knowledge had not increased and that the general level of support for biotechnology had actually declined in spite of science communication's best efforts. By then it had become widely recognised that acceptance could not be achieved by simply providing information alone. Scientists had to listen to, understand and respond to actual public concerns.

In preparation of the 1996 Eurobarometer study on biotechnology a group of science communication experts was involved in designing the questions and analysing the answers. With support of the European Commission the results were compared to similar studies in the United States and Canada. Perceived use, risk and moral acceptability were chosen as determinants of public support. People were asked whether they thought each of six biotechnology applications (see Figure 1.2.1) were useful, risky, morally acceptable and if they should be encouraged.

Six applications of modern biotechnology

- Using genetic testing to detect inheritable diseases such as cystic fibrosis (G)
- Introducing human genes into bacteria to produce medicines or vaccines, for example to produce insulin for diabetics (M)
- Taking genes from plant species and transferring them into crop plants to make them more resistant to insect pests (C)
- Using modern biotechnology in the production of foods, for example to make them higher in protein, keep longer or change in taste (F)
- Developing genetically modified animals for laboratory research studies, such as a mouse that has genes which causes it to develop cancer. (A)
- Introducing human genes into animals to produce organs for human transplants, such as into pigs for human heart transplants (T)

Figure 1.2.1: The six applications of modern biotechnology used in the study by Gaskell et al. (2000)

They concluded that usefulness is a precondition of support, in no case is a "not useful" application given support. For example, GM food products which are similar to "normal" food products but just have a lower production cost, are not likely to be accepted. People will accept some risk if the application is useful and morally acceptable. For instance, GM food containing an important vaccine or new medicines produced by yeast are likely to be accepted. Moral concerns acted as a veto regardless of views on risk and use. This is shown by the reluctance about the production of medicines by transgenic animals. A main lesson from the study was the conclusion that "*if risk is less significant than moral acceptability, then public concerns are unlikely to be alleviated by technically based reassurances and other policy initiatives dealing solely with risks*".

The Eurobarometer survey of 2002 showed similar results to the previous ones for level of knowledge, attitudes to sources of information etc, with a slightly higher public support to biotechnology.

While the Eurobarometer surveys have their value, it must be realised that they provide a picture of people's attitudes or, rather, what they say their attitudes are, and not their actual behaviours. Observational compared with attitudinal studies readily demonstrate the lack of correspondence. Other surveys therefore tried to qualify public opinion by using focus groups, which are reviewed by Gaskell (Gaskell et al., 2002) and Wynne (Marris et al., 2001).

Following the Eurobarometer findings in 1996, it was important for scientists to recognise that they should not focus on safety and risk but respond to the moral concerns. The role of scientists in the debate on the use of modern biotechnology was becoming clearer. Scientists needed to become more visible; they needed to be involved in the public debate on the purpose and use of their results and explain their views about the benefits, and risks, of biotechnology. "Patenting life", genetically modified (GM) food, GM crops and their possible effects on biodiversity and organic farming, "bio-piracy" of genetic material from developing countries, the production of tissues and organs from embryonic stem cells, invasion of privacy from DNA-profiling or the replacement of commodity materials originally provided by Third World countries, are just a few of the issues which concerned the public. It became important for scientists to recognise both scientific and moral issues if communication were to be effective.

During the early years the media had increasingly covered biotechnology in a more or less balanced way (Durant, 1992). This changed rapidly when environmental and animal welfare organisations such as Greenpeace focussed on biotechnology as a strategy to gain media attention, publicity and hence membership and subscription income (Nichols, 2001). Their claims that biotechnology was dangerous and their activities such as destroying GM-crop field trials and releasing laboratory animals delivered media-attractive news stories. Often these stories were no longer covered by science reporters but by general reporters with considerably less knowledge of biotechnology (Dixon, 1993). The general tendency in the press was negative although the tone varied quite considerably in different countries (Moses, 2002).

By this time other events such as the BSE affair and the birth of Dolly the cloned sheep all contributed to the negative perceptions of biotechnology (Gaskell & Bauer, 2001; 't Hoog and De Cock Buning, 2000), although others argue that this was due to a more general criticism of scientific developments (Kinderlerer, personal communication, 2006). Monsanto's earlier importation of GM-soya into Europe in 1996, not anticipating European media and consumers' reactions, had markedly escalated the antagonism to biotechnology. So when Pusztai claimed that GM-potatoes were capable of killing rats, this was readily picked up, even by the respected medical journal, The Lancet (Ewen & Pusztai 1999), as yet another proof of the undesirability of biotechnology. A group of twenty-five scientists backed Pusztai in his claims, however most did not have a background in biotechnology and some had links with environmental organisations, which supported the negative view of biotechnology. In the end, scientists of the UK Royal Society concluded that Pusztai's research findings were not properly reviewed and therefore his conclusions were not supportable (The House of Lords, 2000; The Lancet, 1999; Horton, 1999). The organic farming movement, especially in the UK, adopted an anti-GM stance in order to promote the "naturalness" of its products. Extensive media publicity about the Monarch butterfly, the withdrawal of Starlink's tortilla chips containing GM-starch approved for animal feed only, and GM-pollen flow into Mexican maize wild land races all contributed further to the controversy (Gaskell et al, 2003).

The media attention during these years initiated numerous debates which further polarised opinions. The activist environmental organisations used biotechnology as a proxy for anti-globalisation, anti-multinationals, anti-science, anti-global warming, etc (Moore, presentation at BIO 2004, San Francisco). Consumer organisations promoted consumer choice between GM and non-GM products, which led to demands for labelling and traceability and hence regulations. On the other hand, the genetic disability organisations strongly supported the development of biotechnology as providing possible cures for their members.

During these years of controversy scientists were increasingly involved with the media but often reacted defensively to the allegations of environmentalists. Importantly, their reactions were directed to the scientific basis of the claims about the risks and safety of the technology as unfortunately these scientists did not understand the importance of, and need to respond to, the underlying ethical issues and concerns.

Around the turn of the century when the battle lines were drawn, media coverage again became more balanced. This was helped by the development of potentially more beneficial examples of biotechnology, such as Golden Rice, although contested at the time, and the growth in the commercial sector, backed by increasing numbers of investors. It was also clear from the Eurobarometer results in 2002 that people were losing trust in environmental organisations and especially animal welfare organisations as sources of information (Eurobarometer, 2002). This trend continued so that by 2005 environmental groups had sunk to third from the bottom of the list of trusted organisations while university scientists were almost on a par with medical doctors at the top. (Eurobarometer, 2006).

A more recent development is the growth of “anti-activist” organisations, especially in the United States, who take the fight to organisations such as Greenpeace and animal welfare organisations who they claim are “extremists“ (Moore, 2004; Driessen, 2005). They stress the costs and negative impact of **not** developing biotechnology, especially as it relates to population growth, starvation, illness and economic development in developing countries. In their presentations and discussions they acknowledge and respond to public moral concerns.

Currently in the USA and in rapidly developing and emerging economies, such as China, India, major South American countries and some in Sub-Saharan Africa, there is strong political support and economic investment in research in key areas of biotechnology and their commercial applications, especially in the health care and agricultural fields with growing interest and support for industrial biotechnology (Ernst and Young 2004/5), backed by a strong public support although some argue that opposition is rising (Hoban, 2000; Hornig Priest, 2000, Miller, 2004).

In their book “*Biotechnology 1996-1999: the years of controversy*” Gaskell and Bauer labelled these developments in time as “the early years”, “the years of controversy” and “the years of the established debate” (Gaskell & Bauer, 2001). Although public concerns vary greatly for different applications of biotechnology and in different countries, a very general representation for Europe can be drawn as is presented in Figure 1.2.1. (see also Bucchi and Neresini, 2002, 2004). The question now is whether we will experience a decline or an escalation in public concern and how will this influence the development of biotechnology (Gaskell, 2003, Miller, 2004).

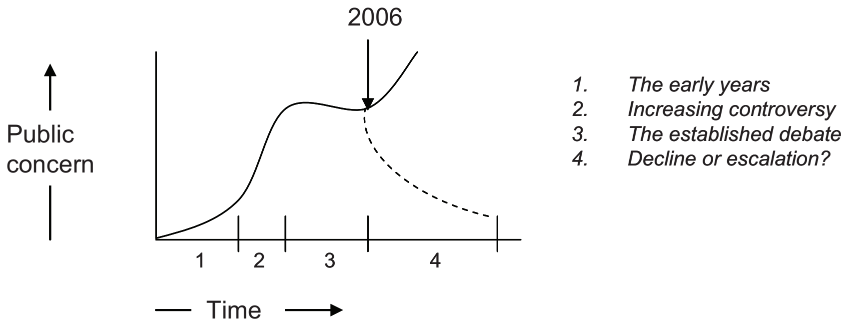

Figure 1.2.2: Public concern for biotechnology over time, after Gaskell and Bauer, 2001

Many have argued that scientists need to communicate with the public to increase public support for research and its applications (Willems, 2003, Bucchi, 2004, Osseweijer, 1999, 2001, 2004) This thesis will present and discuss how scientists may be empowered to undertake this task.

1.2. Theoretical background

Introduction

This chapter will set out the contributions made by different areas of practice and research which bear upon the role of biotechnology scientists in public communication. Because the thesis deals with a rather extensive period of fifteen years, a significant proportion of the theoretical insights described below became available only during the study. Similarly, a considerable number of the observations described in Chapters 2 to 8 reflect and support the development of these new insights. Parts of this chapter cover topics which will be familiar to social scientists and they are kindly asked to bear with this in the interest of making them accessible to readers who may not be. It also lists, in a short overview, the conceptual perspectives in the interaction between science and society.

1.2.1. Science communication and public participation in the decision-making process

Two models for science communication

Science is characterised by the cumulative discovery of knowledge about how nature works. Science communication is defined here as the exchange of information about science and technology and *in particular* the interaction between scientists and the publics (in all their capacities and interests)[3]. In science communication we can define two general model approaches; the so-called “deficit model” and the “contextual” or “dialogue model” or, with due respect to the importance of the many kinds of input in the process, the “transdisciplinary” or “Mode Two” model (Nowotny, 2001). The deficit model, based on an educational objective, starts from the expectation that people are relatively uninformed about science and that to achieve a more positive attitude towards science, it is sufficient to provide information about the scientific facts and benefits. The information is provided by the scientists to the receiver, the public. It is based on the presupposition that if people know more about the scientific details of a technology, they are more likely to support the development of this technology. It is characterised by the position of scientists as independent researchers, providing neutral information. As described in a study of the practice and theory of science communication by Hanssen et al. (2003) this model was often used with great expectations by government and other interested parties to increase public knowledge for society’s economic, democratic and cultural reasons.

However, a number of experts in the social and communication sciences questioned this linear model of communication. As reviewed by Hanssen, Bauer (1964) already pointed out that the model overlooks the different motives of receivers and senders to enter into the process and he argued for communication as a two-way process. In 1975 Carey distinguished two views about science communication: 1) a transmission process in which messages are made and distributed and 2) a ritual view in which communication is seen as a symbolic process which produces, maintains and transforms reality. Within the transmission process view and based on Miller (1983), several authors developed new theories for science communication around the notion of scientific literacy. Scientific literacy consists of three parts: 1) knowledge of scientific concepts, 2) understanding of the scientific process and 3) awareness of the impact of the science for the individual and for society. Although the building of scientific literacy amongst the public is still the subject of many science communication studies, later authors further built on the second vision of Carey and questioned the concept of knowledge as a set of verifiable scientific facts. Wynne stated in 1992 that the public does not view science *in abstracto* but always in a social context. He showed with his studies on farmers’ perceptions of science that the social context and trust issues are often more important than ‘facts’. These authors therefore argued that information will not necessarily lead to understanding and that it is questionable if understanding is a component necessary for support. Gross summarised at least three defects of the deficit model (Gross, 1994). Firstly he argued that the model gives a wrong vision of science; it puts the scientist informer in a higher, more faultless position than the receiver, which cannot be substantiated. Secondly, the deficit model isolates science from the context of public relevance and importance and, thirdly, the model does not discuss any ethical and political issues as the science is isolated from the societal context. The deficit

[3] The notion ‘science communication’ used in this thesis includes both one-way and two-way types of interaction. It specifically excludes marketing and PR activities. The essential difference is that the latter have a purpose to sell a product, either a (set of) biotechnology application(s) or an educational programme. However, it is recognised that to some extent this is an ideological distinction as marketing and PR motivations may influence those involved in the science communication activities, consciously or not.

model gives a passive role to the public and can be seen as a one-way traffic of information from the scientist to the public. Based on these observations, the contextual model was proposed as a better model for science communication. It views science communication as a successful collaboration between science and local, contextual knowledge[4]. The emphasis is on dialogue and two-way streams of information exchange. A necessary requirement therefore is mutual trust and understanding of concerns (Wynne, 1992). The model is based on the assumption that the social dimension is inherent to scientific knowledge and activity.

The contextual model became more generally recognised and accepted around the turn of the 21st century. This change from the deficit to the contextual model may be viewed as a paradigm shift in science communication in the Kuhnian sense which will be discussed later. This model is particularly relevant for biotechnology communication as biotechnology specifically relates to the use of increasing knowledge in society. If we wish that the developments of biotechnology are applied in a sustainable and responsible way, it is crucial that public information about biotechnology goes further than a simple explanation for those who are intrigued or interested out of curiosity or a direct need for information; it needs to be set in a social context for which the contextual model provides a means.

An overview of public involvement in decision-making about science

The proposition that greater levels of public participation would improve public decisions derives from two assumptions. The first is that the process would be improved by including people with perspectives and knowledge that would otherwise be missing. The second is that support for policies would be stronger if the public had better information and more access to the process. Renn et al (1995) distinguish between three broad classes of citizen participation: genuine deliberative methods which allow for fair and competent debate and discussion between all parties, such as consensus conferences, citizens' juries and planning cells; traditional consultation methods, including public meetings, surveys, focus groups, and mediation, where there is little or no extended debate; and referenda, in which people do have democratic power but which are not generally deliberative in nature. How should the effectiveness of available public participation techniques be evaluated and what principles should guide prospective choices from among them? Extending Habermas's critical theory, various authors have proposed evaluating public participation methods according to whether they are fair and competent. Competing values theory defines four perspectives: rational, empirical, consensual, and political for evaluating effectiveness. The International Association for Public Participation, and Resources for the Future, among others, have also proposed potential evaluative frameworks. (Mumpower, 2001). Experience with deliberative processes highlights several key requirements that any dialogue process must meet:

- Dialogue and engagement needs to occur early, and before critical decisions about the technology become irreversible or 'locked-in'.

[4] The model therefore also provides for a more prominent place for value orientation and its relation to opinion forming.

- Dialogue is not useful in and of itself, but has to be designed around specific objectives. Accordingly, clarity at an early stage about the objectives for dialogue is essential.
- At least some form of commitment from the sponsor (typically government or some other agency) to take account of outcomes is required when commissioning dialogue processes: otherwise why should organisers and participants bother?
- Stakeholder and public dialogue should be properly integrated with other processes of technology assessment for a new technology, as and when they occur.
- Any dialogue process should be properly resourced, including the means for systematic evaluation (Petts, 2004).

This approach is also reflected in the later UK Royal Society & The Royal Academy of Engineering report *"Nanoscience and nanotechnologies*" (2004) which lists the following approaches to increase public participation:
- Participatory and/or constructive technology assessment with stakeholders, particularly that which takes account of the dynamic interrelations between society and scientific developments (see, for example, Rip et al 1995).
- Scenario analysis with stakeholders to identify significant uncertainties that might emerge with a new technology.
- Direct public engagement such as citizen juries or panels for identifying at an early stage broad 'desired futures' for a new technology, significant ethical concerns, or the acceptability of key applications and options. The quality of scientific and other input to such public engagement activities is critical to their success.
- Decision analytic methods draw upon more formal approaches for framing problems, as well as for identifying preferred options and their attributes (see, for example, Stirling and Mayer 1999; Arvai et al 2001).
- Multi-stage methods, which combine different approaches to framing, option appraisal and final choice in a sequence of linked activities, often with different groups of stakeholders and the public at various stages (see, for example, Renn 1999).
- Research into public attitudes, both qualitative and quantitative, to generate good quality 'social intelligence' (Grove White et al 2000) about a new technology and public concerns.

Providing proper resources for dialogue processes however is not a trivial matter. The 1999 UK nuclear waste consensus conference costs were in the order of £100,000 (POST 2001), while the overall costs for the UK "*GM Nation?"* public debate in 2003 totalled £650,000 (Public Debate Steering Board 2003). Such costs, although at first sight large, must be viewed in relation to the far greater potential economic and social costs of getting decisions about investments in major areas of a technology wrong at this stage. Hence, important potential constraints on public participation include cost, time, political support, and feasibility. Additional issues include deciding whether to include public participation as part of the policy making process, balancing *a priori* versus *a posteriori* standards of fairness, giving weight to existing versus future preferences, managing the tension between democratic and representative processes, and resolving issues of standing in disputes. A further issue is that observation from public consultation activities such as consensus conferences and public debates has shown that they tend to select for those who are already interested and committed, whether positively or negatively, to the issue as participants and polarise them further in their views by the experience of the activity while not attracting and involving the majority of people who are not interested or prepared to give their time and attention against other competing interests. The selection and evaluation of public participation techniques need to take into account their virtues and potential drawbacks, circumstantial constraints, and the relative importance of the various competing objectives of public participation processes (Bucchi, 2004).

Different social contexts for public participation

Within Europe Denmark may be regarded as having led the way in public involvement in decision-making about science. In 1986 the Danish Parliament passed a law on gene technology and environment, probably the first in the world, that initially prohibited the deliberate release of GMOs but was later relaxed. It allocated US$1.5 million to disseminate information on modern biotechnology. More than 21,000 people participated in these educational activities and all the different points of view were represented in the debate. Already in the mid-1980s the Danish government had initiated 'lay panel discussions' and ‘consensus conferences’ as means to help decide on controversial subjects. In the panel discussion about thirty Danish citizens gathered for a weekend to receive information about the technical details of a controversial subject, for example genetic modification of animals, followed by discussion. The results of such lay panel discussions have been input for political decision-making. Nowadays, the Danes are recognised in the Eurobarometer research as critical to, but not afraid of, biotechnological developments.

Novo Nordisk, a Danish pharmaceutical multinational company, established a tradition of inviting environmentalists and other issue groups to their production plants and laboratories in the early 1990s. These visits are not intended only to show the technology, but chiefly to exchange opinions about issues that concern the visitors most. These discussions with issue groups are welcomed by employees of the company. Apparently the company and the members of the public look upon each other as partners in the discussion. Such open discussion of difficult bioethical topics by “lay panels” and through “consensus conferences” is characteristic as an embedded part of the Danish culture. However, experience has shown that they do not transpose readily into other cultures in other European countries.

Consensus conferences represent one among a number of responses to the perceived inadequacies of representative democracy. Together with “citizens’ juries”, “deliberative opinion polls” and other similar initiatives, they attempt to engage members of the public more closely in the political process. Such engagement is intended both to encourage habits of active citizenship and to improve the quality of public debate and decision-making. In Denmark, consensus conferences gained recognition within the national political culture. In

1993, the Danish model was taken up for the first time in the Netherlands; and in the same year, the then UK Agricultural and Food Research Council (now Biotechnology and Biological Sciences Research Council (BBSRC)) announced that it was to fund the Science Museum in London to organise the first UK National Consensus Conference on Plant Biotechnology which was held in the following year.

Faced with a massive amount of information and only a comparatively short time in which to digest it, the consensus conference lay panel in the UK produced a measured and balanced report (Joss and Durant, 1995). The panel concluded that, *"there is scope for people to intervene in controlled ways which have the potential to provide significant benefits, and at the same time to satisfy the requirements of those people who feel that matters are progressing too quickly with an implied lack of care"*. The lay panel advocated, *inter alia*, tightening up the regulations governing the release of genetically modified plants into the environment, establishing effective international controls over the commercial exploitation of plant varieties, and providing consumers with clear and comprehensible information about new biotechnological products. However while the conference did receive some coverage in the media it had little or no discernible effect on policy probably because no provision was made for government attention to its outcomes.

In the UK, the “Public Understanding of Science” movement dated from the mid-1980’s and was closely associated with the promotion of an informed, democratic society as much as it was with the promotion of science as a “public good”. More recent emphases on public consultation, particularly since the late 1990s, arose as declining public confidence in expert advice and authority more generally placed increasing strains upon traditional forms of science-related governance. Science policy and scientific advice to government, which had hitherto been constructed around expertise offered by a patriarchal and stable self-validating elite, began to face accelerating demands for more direct forms of democratic accountability and control.

The so-called “Bodmer report” (Bodmer, 1985) was very much a product of “Thatcherite” Britain, in which public expenditure of all kinds had to be justified in terms of its contribution to national prosperity. The Royal Society, the UK's prominent professional scientific society, responded to political pressures for public “accountability” by setting up the Committee on Public Understanding of Science (COPUS), with a mandate to examine the interface between scientific knowledge, the public, and the scientific enterprise (i.e. the creation of new knowledge). The “bottom line” of the Bodmer report was that there being few public issues without some scientific content, public understanding of science was essential to the proper functioning of Britain as a democracy. The call for relevance and accountability struck a chord with both the public and the scientific community. Whether reluctantly or enthusiastically, the scientific community responded, and public understanding of science activities began to flower. (J.A. Stein, unpublished paper).

The way in which the public debate was organised initially in The Netherlands was quite different (van Woerkom, 2003). Well before the introduction of GM-soya into Europe in 1996 and the beginning of the controversy following from it, an “informal consultation group” (Dr B. de Vet, personal communication) had been brought together with representatives of several non-governmental organisations, such as environmental and consumer groups, together with those from research institutions and biotechnology companies. This informal group set its own agenda and regularly met on a voluntary basis. The main result of the consultation group was a voluntary policy on labelling biotechnology food products. This intensive interaction between opponents in the public debate did not prevent each group from trying to directly influence the general public. The partners in the consultation group respected each other's position and their strategies on involving the public at large in their own way. Aggressive and major publicity campaigns took place. Although these campaigns were not always appreciated by other members, they did not influence the informal biotechnology consultation group significantly. Its focus on consensus in the bioethical debate gave the members opportunity to achieve results without losing face. It did however depend wholly on trust and mutual respect and understanding, which became clear when one of the environmentalist groups stepped out because of a felt lack of respect. The long-lasting consensus of the consultation group certainly influenced the subsequent general debate on ethical issues in biotechnology in The Netherlands.

Further similar public consultation exercises continued in The Netherlands culminating in 2001 with a public debate on biotechnology and food entitled *“Genes on the Menu”* overseen by a Temporary Committee on Biotechnology and Food, chaired by Dr J.C. Terlouw. This developed into a polarised conflict to the extent that, as the report stated: “*Environmental and development organisations in particular have reproached the Committee that they have evaded the fundamental question in the debate; whether or not the public considers the application of gene technology acceptable*.” (Terlouw, 2002). More public participation examples in The Netherlands have been described (Paula and De Cock Buning, 2004) as well as the role of trust in governance (Gutteling et al., 2006).

In the USA, the institutional environment for governmental decision-making about issues involving science has long been much more transparent and open than in most European contexts. It was early formalised, for example, in administrative law governing how public agencies such as the Environmental Protection Agency (EPA) or the Food and Drug Administration (FDA) procure expert advice. Institutional mechanisms for expert advice are themselves conducted under intense public scrutiny, legally enforced through the courts on the basis of legislative mandates. Thus each of the many and diverse expert scientific fora is a social microcosm of public participation. This is because the experts involved are familiar with the kinds of public reactions which will ensue should they fail to consider any issue.

The USA's distinctive political culture is strengthened by an elaborate legal-constitutional structure of formal accountability, including the Freedom of Information Act, the Government in the Sunshine Act, the "right to know" laws, the Federal Advisory Committee Act, and the Shelby Amendment to the Appropriations Bill. These laws give rise to expert mechanisms and occasions of collective negotiation over risk assessments and regulations which are already more representative of diverse public concerns and values than equivalents in most of the European Union. This may well explain why in the USA there is much greater trust in governmental institutions than generally in Europe and little interest in the techniques of consultation such as consensus conferences, national consultations and the like (Hoban, 2000).

In the USA there is a far more genuinely institutionalised dialogue as part of the routine operating culture of government bodies which contributes to a greater degree of public confidence in science-based policy. Expert advisers understand themselves to be both hearing and representing popular concerns in ways that do not prevail in Europe.

Studies about the views and attitudes of scientists in science communication

As the thesis deals with the explicit involvement of scientists in public communication it is important to also review the results of studies on scientists' views and attitudes towards public communication. Willems and de Bruin found in a preliminary study interviewing twenty-three scientists in 1996 that most agreed that they should be involved in science communication (Willems & de Bruin, 1996). A more extensive study was commissioned by the Wellcome Trust in the UK and took place during December 1999 to March 2000 (Wellcome Trust/MORI (2000))[5]. The conclusions can be summarised as follows:

- Most scientists see benefits to the public having greater understanding of science.
- The vast majority believe it is their duty to communicate their research and its social and ethical implications to policy-makers, and the public.
- The overwhelming majority have not been trained to liaise with the media, or to communicate with the public.
- Half the scientists participated in one or more communication activities in the last year. Participation is related to scientists' skills and confidence.
- They think that the public primarily trusts the media, charities and campaigning groups.
- Most feel constrained by the day-to-day requirements of their job.
- Three-quarters feel responsible and equipped to communicate the scientific facts of their research but confidence declines about communicating its social and ethical implications.
- Scientists suggest incentives from funding authorities and scientific institutions to encourage time spent on science communication, followed by media training.

[5] During Autumn 2005 the Royal Society carried out a second study funded through its Science in Society programme, the UK Research Councils and the Wellcome Trust to examine the factors affecting science communication by scientists and provide evidence to support the development of strategies to encourage scientists and engineers to communicate with the stakeholders including the public, policy makers and media (Royal Society, 2006). The findings were similar to those in the earlier Wellcome Trust/MORI study although 18% more scientists said they had carried out public communication activities. It concludes by saying that although the study has been conducted with scientists and engineers, there are broader implications concerning the ways in which all academics engage and communicate with the public.

Chapter 8 will describe three similar smaller studies which were carried out among international biotechnology scientists in 2002, 2003 and 2005 by the author. The results are consistent with the findings of the Wellcome Trust/MORI (2002) and Royal Society (2006) studies but also reveal interesting observations about scientists' own opinions on biotechnology issues.

1.2.2. Risk perception

Risk perception is an important factor in public interaction because risk is a priority concern in our present day Western society, hence often referred to as a "Risk society" (Adams, 1992). Furthermore, it plays an important role in the argumentation of scientists, who are often more inclined to discuss scientific data, including scientific assessment of risks, than moral values related to their work. Many scholars have published very interesting papers on risk perception. The work of John Adams is briefly introduced here, firstly because he has discussed his findings with a broad audience including scientists over a considerable period of time, and secondly because he was involved in several of the activities described in this thesis. His views therefore influenced the approaches and conclusions of the activities described.

John Adams, in his book *"Risk"* of 1995, pointed out that it is important to be clear about the type of risk one is dealing with. He describes three possible kinds of risk[6]:

- Risks perceived through science such as cholera for which you need a microscope to see it and scientific training to understand it.
- Risks perceived directly, such as climbing a tree, riding a bike, etc.
- Virtual risks, or those risks about which scientists do not agree, such as global warming, BSE, low-level radiation, etc.

Adams argues that people use perceptual filters by which they weigh the rewards against the dangers and that if the science is less conclusive these filters through which risks and rewards

[6] Adams argued that directly perceptible risks are dealt with instinctively and intuitively. Virtual risks are culturally constructed – when the science is inconclusive people are free to argue from pre-established beliefs, convictions and prejudices. When virtual risks – sometimes called unconfirmed hypotheses – are mistaken for risks about which science has clear and useful advice to offer, much confusing results. An important factor is also the level to which one is in control of the risk. The more control people feel they have, the more they are able to take the risks because they clearly see the rewards and they trust their ability to control the act. This explains why people are less afraid to take their own car to fly in an aeroplane, while statistics clearly show that one is much more likely to be involved in a car accident than in a plane crash. With unknown (virtual) and vaguely defined risks the extent or probability of the risk is unclear, as is who has control over it, and therefore people call for strict regulation or even banning. People perform their own risk management as a balancing act, taking into account the propensity to risk, the perceived danger and likelihood of accident, and the rewards. Adams points out that institutional risk management commonly ignores such balancing behaviour. The job specification of most institutional risk managers obliges them to deal only with the perceived danger and likely accidents. Judgements about safety ought not, they insist, to be "corrupted" by concerns about rewards. An unbalanced concern for reducing accidents without considering the opportunity costs of doing so fosters excessive risk aversion, resulting in worthwhile activities with very small risks being inhibited or banned.

are perceived become more influential. He describes the filters in terms of four commonly used general typologies:

- The **egalitarian** is fearful and risk averse: *"If you can't prove it's safe assume it's dangerous"* and hence invokes the precautionary principle (as often by NGOs (non governmental organisations) such as Greenpeace, Friends of the Earth and consumer groups).
- The **individualist** is an optimist and pragmatist: *"If you can't prove it's dangerous assume it's safe"* – and tends to focus on the rewards of risk viewing it as opportunity.
- The **fatalist** believes that he cannot change events and ducks if he sees something about to hit him – otherwise *que sera sera*.
- The **hierarchist** likes to manage the risks. They commission more research to find the "right answer" and are very uncomfortable when dealing with virtual risk. This often represents the view of regulators, health and safety officers, and those responsible for regulating biotechnology.

The majority of the European public falls most of the time into the fatalist category, a most influencable group. That is another reason why trust is recognised to play such an important role in public communication. It is known from several public opinion survey studies including the Eurobarometer that family and friends are most trusted and that companies, governments and the media are considered low in trustworthiness. Scientists remain credible, but until more recently less so than consumer and environmental interest organisations.

1.2.3. Epistemology

Because this thesis deals with scientists, their closed practice, their perceptions and their competences, it is important to look at the principles in epistemology, the branch of philosophy that studies the nature of knowledge, which provides insight into the approaches used by most scientists in their research. It may help in understanding some of the difficulties in science communication by indicating how and why scientists may well have different belief systems from their publics. This section therefore provides a brief introduction of the most important epistemological theories relevant for this thesis[7].

The extent to which current scientific knowledge can provide evidence about what is actually 'true' is in itself a question. The acceptance of knowledge as if it were absolutely 'true' and unquestionable (in the sense of theology or ideology) is referred to as "*scientism*" or "*positivism*". The public often has opposite views of science and many believe that scientists are making claims of infallibility. Science contributes to the process of consensus decision making when people of varying moral and ethical views come to agree on 'what is real'. In secular and technological societies, without strong conceptions of reality based on other

[7] For these reasons parts (including the definitions used) of this Section were abstracted from the Free Dictionary and Wikipedia on 12 September 2004

shared moral or religious grounds, scientific dialogue has often been used to settle disputes. Concerns about the disparity between how scientists work and how their work is perceived have led to efforts to educate lay people about scientific scepticism and the scientific method.

Epistemology is the field of philosophy that deals with the nature, origin and scope of knowledge. Scientists make assumptions about the way the world is and the way in which theory relates to the world. Science is both a process of gaining knowledge and the organised body of knowledge gained by this process. The scientific process is the systematic acquisition of new knowledge about a system. This systematic acquisition is generally the scientific method, and the system is generally Nature. Science is also the scientific knowledge that has been systematically acquired by this scientific process. It can be viewed as an attempt to explain which actions are acceptable in science and how to best use science to our advantage.

A central concept in epistemology is empiricism or dependence on evidence. Empiricism views knowledge as derived from observations of the world. It holds therefore that scientific statements are subject to, and derived from, our experiences or observations. Scientific theories are developed and tested through experiments which are a set of actions and observations, performed to verify or falsify a hypothesis or research a causal relationship between phenomena. The experiment is the cornerstone in the empirical approach to knowledge. Biotechnology research is largely situated within this philosophical approach.

Opposite to empiricism is the approach that scientific observations are shaped by their social and political context. This approach is held by many historians, philosophers, and sociologists of science, and is usually known as "*constructivism*". Social scientists have claimed that many things are social constructions, or that they have been socially constructed (Berger and Luckmann, 1966). In its strongest form, it sees science as merely a discourse between scientists, with objective fact playing a small role, if any. A weaker form of the constructivist position holds that social factors play a large role in the acceptance of new scientific theories.

Reductionism describes various reductionist approaches within science. One type of reductionism is the belief that all fields of study are ultimately amenable to scientific explanation. A historical event explained in sociological and psychological terms can in turn be described in terms of human physiology, which in turn might be described in terms of chemistry and physics reducing the historical event to a physical event. Reductionists who view historical events as 'nothing but' physical events and who deny the existence of other phenomena were highly criticised by many. However these views are still firmly based in the approach of scientists in chemistry and physics.

Karl Popper conceived the term *critical rationalism* to describe his philosophy of falsifiability. This designation indicates his rejection of classical empiricism, and of the observationalist-inductivist account of science that had emerged from it. Popper argued strongly against the latter, holding that scientific theories are universal in nature, and can be tested only indirectly, by references to their implications. He also held that scientific theory, and human knowledge generally, is irreducibly conjectural or hypothetical, and is generated by the creative imagination in order to solve problems that have arisen in specific historic-cultural settings. Logically, no number of positive outcomes at the level of experimental testing can confirm a scientific theory, but a single genuine counter-instance is logically decisive: it shows the theory, from which the implication is derived, to be false. Popper's account of the logical asymmetry between verification and falsification is the basis of his philosophy of science. He took falsifiability as the criterion of demarcation between what is and is not genuinely scientific: a theory should be accounted scientific if, and only if, it is falsifiable.

Thomas Kuhn's influential book *The Structure of Scientific Revolutions* (SSR) (Kuhn, 1962) argued that scientists work in a series of paradigms, and found little evidence of scientists actually following a falsificationist methodology.

Kuhn postulated that the practice of science comes in three phases. The first phase, which is undergone only once, is the '*pre-scientific phase'*, in which there is no consensus on any theory. He described a theory as an idea formed by speculation and characterised this first phase by the existence of several incompatible and incomplete theories. When scientists begin to use one theory methodically and successfully it becomes accepted and starts to use a common terminology, common experimental methods and equipment leading to a common interpretation of scientific phenomena and it develops into a paradigm. After this occurs, Kuhn argues that '*normal science'* begins. According to Kuhn this is what scientists spend most of their careers doing. It can only be performed in a specific paradigm and its goal is to explain and expand the paradigm. Kuhn illustrated normal science as a process of puzzle solving, armed with knowledge provided by a paradigm, scientists can begin to make well-founded and trusted assumptions about what they are studying. This may seem to violate long held ideals about objectivity in science, but as he and others pointed out, it is extremely difficult to study anything without making at least a few basic assumptions. Kuhn (SSR, section XII) also argued that the probabilistic tools used by verificationists are therefore inadequate to the task of deciding between conflicting theories, since they were also derived from the very paradigms they seek to compare. Similarly, observations intended to falsify a statement are also inadequate to the task. Advocates of such paradigms are in a difficult position: *"Though each may hope to convert the other to his way of seeing science and its problems, neither may hope to prove his case. The competition between paradigms is not the sort of battle that can be resolved by proof."* (SSR, p. 148). The success of science, according to Kuhn, can be explained by the ability of scientists to use the principles of a paradigm, they do not need to work constantly from first principles. For Kuhn, it is this practice of scientists working within a particular kind of community that explains the astonishing success of science: *"The scientific community is a supremely efficient instrument for maximising the number and precision of the problems solved through paradigm change."* (SSR, p. 169).

Imre Lakatos, attempted to reconcile Kuhn's work with falsificationism by arguing that science progresses by the falsification of research programmes rather than the more specific universal statements of naïve falsificationism. Paul Feyerabend ultimately rejected any prescriptive methodology, replacing method with the aphorism *"Anything goes"* stating "*this is not a "principle" I hold... but the terrified exclamation of a rationalist who takes a closer look at history"* (Feyerabend, 1975).

Postmodernists in line with Feyerabend have criticised Kuhn for not going far enough, although also many find Kuhn's "humanising" of the scientific process going too far. SSR is also embraced by those wishing to discredit or attack the authority of science, such as Creationists and radical environmentalists. It also coincided with changing national attitudes about science (exemplified by Rachel Carson's *Silent Spring* which was published in the same year). Also outside the history and philosophy of science, the book's basic tenets have been adopted and co-opted by a variety of fields and disciplines, as for example has been already mentioned in relation to the "deficit" and "dialogue" or "contextual" models of science communication. Changes in politics, society, and business are often expressed in Kuhnian terms and the terms "paradigm" and "paradigm shift" have become such notorious buzzwords that they are often considered as hollow and empty and bare no strong relation to Kuhn's text.

The differential impact of these philosophical developments between the social and natural sciences may provide insight into the difficulties for integration between the two. The experiences in public acceptance of biotechnology have contributed to the present drive for addressing societal and public communication issues within scientific programmes from their outset. This is demonstrated by the inclusion of requirements to this effect for example in European Commission projects and in the guidelines for the establishment of the Netherlands and Canadian Centres of Excellence in genomics research. It is also emerging in the relatively new field of nanotechnology as a consequence of the experiences from the public debates about various biotechnology issues and with the development of science communication activities. Another trend is the desire for increased participation of all stakeholders in decision-making about science research. Both developments have encouraged the collaboration of scientists and social scientists in designing new ways of public interaction. However, many natural scientists and social scientists still tend to use different approaches based on their differing epistemologies and practices and they need to reconcile their differences as far as possible for each to be effective in this much-needed collaboration.

1.2.4. Psychological drivers: Consistency Theory and Social Psychology

When one wishes to understand the reasons for the ways in which scientists communicate it is not only interesting to consider their epistemological mindset as we have above, it is also interesting to see if psychology provides any general insights that may be relevant in this respect.

Psychology is the practice of studying, teaching or applying an understanding of the mind, thought and behaviour. Two relevant topics in social psychology are shortly described here: Consistency Theory and Social Psychology, the latter with a focus on new social trends in cultures. The first is important for understanding the individual contribution a scientist can make in interacting with the public, the second gives insight in the options scientists may use for their communication[8].

Cognitive dissonance

The theory of cognitive dissonance was first proposed and published by the psychologist Leon Festinger in 1957 and later discussed by Sherman and Gorkin (1980), Knox and Inkster (1968). In common with other theories of cognitive consistency, Festinger's cognitive dissonance theory suggests that we have an inner drive to hold all our attitudes and beliefs in harmony and avoid disharmony (or dissonance). He described cognitive dissonance as a state that an individual reaches once he/she has an imbalance between cognitions. An example is an individual purchasing organic apples, initially believing that this was the best product to buy. The cognition held is that good apples have been bought. If the individual is then exposed to information questioning the quality of organic food, this provides another cognition. The imbalance between these cognitions will lead the individual to seek consonance between the two cognitions. Cognitive dissonance is therefore a psychological phenomenon which refers to the discomfort felt at a discrepancy between what you already know or believe (your "Gestallt"), and new information or interpretation.

There are various ways to reduce cognitive dissonance. Changing a cognition gives some discomfort, it requires a reflection and admittance that a wrong cognition was held. Therefore, rather than adapt to these cognitions, the new information on quality of organic food may be devalued, and the report about it may be perceived as untrue. This is another way of allowing one's cognitions to be in a balance again. Another example is through selecting information after the purchase. It might be that a person would purposely avoid other information on organic food knowing that the decision had been made and finding out about other information about organic products could lead to some discomfort. Reduction of cognitive dissonance is good, it gives a person a better feeling and can provide a closer consonance by eliminating contradictions. However, when the reduction of cognitive dissonance involves a distortion of the truth, wrong decisions may be taken. When somebody is confronted by ideas

[8] For these reasons parts (including the definitions used) of this Section related to cognitive dissonance were abstracted from the Free Dictionary and Wikipedia on 12 September 2004

or facts that are contrary with his pre-existing belief, this results in cognitive dissonance which has the power to distort or even block perceptions. When the information is disturbing, a person may not feel compelled to cope with it, even if it is true. This can also occur subconsciously and can block the adoption of new ideas. Cognitive dissonance is described as a very powerful 'self-preservation' mechanism which can completely override the human desire for truth.

Festinger identified four types of cognitive dissonance:

1. ***Self persuasion*** *or post-decision making dissonance occurs when one is forced to choose between two attractive choices. No matter which way you choose, at some point you will wish you could go back and change your mind.*
2. ***Forced compliance*** *dissonance results from being forced to behave in a manner contrary to ones beliefs, but the external inducement is not enough to justify the counter-attitudinal act.*
3. ***Exposure to new information*** *causes dissonance in needing to change one's belief system to be compatible with this new information. Dissonance comes from prejudice, not just prejudice of people, but prejudice of ideas as well. Our belief systems are systems of prejudices. Everyone believes in things that are false. We just do not know it yet. If a truth enters our minds that contradicts this false belief that we have, we are initially inclined to throw out the truth and keep the false belief. When we are aware of contradictory beliefs, we need to examine both as objectively as possible. If both have merit, then we need to resolve the contradiction.*
4. ***Social support*** *dissonance is caused when new information enters a belief system shared by a group. Dissonance is generated as group members disagree, as continued membership in the group requires acceptance of new ideas, or when an external event invalidates a belief central to the group.*

Festinger (1957) predicted that if we behave in a way which is counter to our attitudes ('attitude-discrepant' behaviour), then the dissonance which is created will produce pressure to change our attitudes. It is argued that in situations involving attitude-discrepant behaviour, the dissonance produced, and therefore the amount of attitude-shift, will be at its maximum where the reward offered is just sufficient to justify the behaviour. This is illustrated by social experiments in which people were asked to defend a statement. Those who were offered a small amount of money were more reluctant to change their statement than those who did not receive any money and those who received a considerable sum. He also argued that we value most highly those goals or items which have required considerable effort to achieve. This method of reducing dissonance is known as 'effort justification'. The desire to maintain one's self-image is also argued to be important. If experience conflicts with one's self-image, then that will set up dissonance. There are two options for dealing with this, either to adjust one's self-image or to re-interpret the experience itself, i.e. to neglect it or give other explanations to the conflicting information. For example when people are confronted with negative feed-back on their presentation of a lecture then they may choose to justify the negative feed-back by saying that these people have not sufficiently appreciated the importance of it. There is much evidence that people tend to go for the second option so as to try to maintain their self-image.

These explanations about reducing conflicting ideas are relevant for scientists when they interact with members of the public or other stakeholders. They relate to the trustworthiness of scientists in the eyes of the public when the public recognises a conflict of interest. They also have important implications for scientists' own behaviour when they are confronted with a dissonance in advancing a scientific approach against their own internal values. An example is illustrated in a questionnaire amongst scientists described in detail in Chapter 8.

Social Psychology: Emerging emotional markets

In relation to the changing societal context of the fifteen years described in this thesis it is also relevant to view the more recent developments in social psychology. This is especially relevant for the way it provides insight on strategies for reaching the majority of the general public, described by Adams as non-interested 'fatalists', and involving them in interaction on biotechnology, and relates to the approach of the model discussed in Chapter 10.

The last decade has been recognised as the period of the risk-averse economy, referred to as the "industrial and post-industrial society" (Bell, 1975). However, several psychologists (Pine and Gilmore, 1999 and Piët, 2003) recognise the emergence of what they term an "emotion market" which may lead to novel approaches to public understanding and public interaction. The concept of the "emotion market" is based on the observation that people in such "post-industrial societies" increasingly give priority to happiness over money and materials. Some social psychologists argue that we presently live in an "everything can be made and bought" society, the "new economy", where we expect as a matter of right to be healthy, well fed, housed and protected. People are reasonably wealthy and all our fundamental needs, as in Maslow's hierarchy of needs [9], are satisfied, leading to fear of losing these acquisitions and boredom. This has led to a wish for entertainment which has developed into a huge industry. However, this "bought" and instant entertainment (examples include Disney-land, games industry, etc) does not provide "happiness".

In the move towards an "experience economy", people look for emotions to fulfil the need for happiness and to give reason and satisfaction to life. For many this replaces the earlier, but now eroded, religious moral values searching for a new goal in life. This shift is demonstrated by an increase in emotional and a decrease in rational messages. Marketing which appeals to emotion predominates, with much advertising linked or based on "feel-good" life-style scenarios. Other messages appeal to our moral actions, such as choices for products without

[9] Maslow's Hierarchy of Needs is a theory in psychology that Abraham Maslow proposed in his 1943 paper *A Theory of Human Motivation*, which he subsequently extended. His theory contends that as humans meet 'basic needs', they seek to satisfy successively 'higher needs' that occupy a set hierarchy. The hierarchy of needs is often depicted as a pyramid consisting of five levels from physiological or biological needs at the bottom, then safety, love or belonging, status or esteem and self-actualisation at the top.

animal testing or from “ethically correct companies”; “fair traders”, or “organic farms”. The risk adversity which was so dominant in the “new-economies” is slowly being replaced by a tendency for courage and personal investments in ideals. This is also illustrated by the establishment of new “heros”, persons who are seen and promoted as exemplary for society.

In Piët’s book *“The Emotion Market”* she suggests that in order to discuss the potentials of new technologies it is important to recognise that consumers can be divided into two clusters according to their “comfort zone" :

1. Sensation, stimulations, adventure, excitement, growth, being unique
2. Rest, safety, security, acknowledgement, confirmation, belonging

The characteristics of the first “comfort zone” are positive about scientific advancement, while the second combine more conservative and reluctance to change characteristics. The two sets of clustered characteristics may mingle within the personalities of individuals but organisational cultures are generally placed in either cluster (1) or (2). Piët argues that people within the new emotion market need to find reconciliation within these comfort zones. The intersecting point of the clusters may provide a potential concept for a strategy in reaching consumers in marketing and for raising the interest of the public in public communication. Five needs can be addressed in these strategies for:

- comfort / contact / binding / belonging;
- acknowledgement of being: identity and significance;
- fundamental safety;
- inspiration, the power to create and personal growth;
- sensation of vitality.

These can be translated into separate “markets’, each with its own identity:

- safety market (psychological, social and physical);
- Rousseau market (the natural, original, authentic);
- romantic market (symbols, rituals, stories, myths);
- individual identity market(consumer behaviour, fashion, lifestyle);
- market of significance and meaning.

The specific characteristics of the “New Rousseau market” are originality, novelty and challenge (for example, “a hot club where the food sucks but you need to look good to get in” or garden furniture looking like wood but made of plastic). The “Romantic market” stands for the success of such as the Harry Potter and the Lord of the Ring movies, and although this market is still in a defensive, conservative mood it creates possibilities that should be explored such as an approach appealing to the "Magic of Science".

The general trend is that emotions are becoming more important than content in communication. This gives an enormous potential for new communication and interaction, but equally a challenge to better understand the role of emotions and the role they play in interaction and communication about science.

1.2.5. Professional socialisation

Professional socialisation is the term used by sociologists to refer to the complex of influences to which a member of a profession is subjected during their training for, and practise of, the profession throughout their career. A scientist, whether a natural or social scientist, throughout his or her training, beginning at school, continuing through undergraduate and postgraduate study and training, and then as a practising scientist, learns not only the established “facts” and experimental techniques in their specific area of science but also the beliefs, values and behaviours of its established practitioners. The parentheses about the word “facts” are relevant as they are subject to social construction and can create cognitive dissonance for the scientist when confronted with alternative constructions from beyond his or her area of science.

Science, proverbially, can be viewed as one of the most competitive of human activities. Candidate science students are in competition with each other for university places at the best universities. University study is a continuing competitive struggle with the student’s peers for the grades required to gain the class of degree needed to allow him or her to continue to postgraduate study and for the finance necessary to support it. Having gained the PhD, almost mandatory now for a career in virtually all areas of science, the aspiring researcher must again compete with peers for a postdoctoral post (or posts, for serial postdoctoral-type positions are not uncommon) for the further research training required before being deemed qualified for a position in a university, research institution or in the research division of a company. Competition does not end there but continues throughout the practising scientist’s professional career.

As with all professions, entry into, and continuation within, the profession is mediated and controlled by those already established within the profession. The technical skills required to practice in the specific field of science and the beliefs and values which they hold about their science are the criteria by which the appellant professional scientist is judged according to their competence in the former and conformity with the latter. Codes of conduct may help in guiding scientists as discussed by De Cock Buning (2004). Established scientists act as “gatekeepers” to every succeeding stage in the progression through training and career, whether as members of appointment committees to positions, editors of journals which provide the main means of attaining scientific status by publication or as members of evaluation panels for grants and awards which provide the necessary financial support for research. Not only are they the gatekeepers, they are also the role models as lecturers, supervisors and senior colleagues presented to every young scientist during their training to emulate, and expected to be emulated by them. Social control among laboratory, seminar and conference peer groups of the scientific speciality provides further reinforcement.

In short, this is therefore how scientists come to be socialised into their profession as scientists and into what has been characterised by Kuhn as their "paradigmatic science" with its empiricist and reductionist approaches. It is not surprising therefore that when scientists are confronted with beliefs, values and behaviours which differ from those into which they have been so strongly socialised that they have difficulty in reconciling their own value positions with those of others, and hence experience the cognitive dissonance which was discussed and which is addressed in this thesis as to its relevance for the scientist as communicator.

1.2.6. Organisation and management of a research department

This thesis is concerned with the institutionalisation of science communication in academia therefore a brief discussion on organisational management in this context is provided here about the setting and developments in the field.

According to the typology of Mintzberg (1979), academia are composed of institutions with little formalised planning and control coupled with advanced professionalism. Coordination is carried out by standardising the input (selection of professionals) and facilitating the output (research and teaching). This implies that options for change have to be positioned within the existing management style focussed on selection of professionals and facilitation of output. However, Pascale and Waters (1981) and Peters and Waterman (1982) warned about the interdependence of the components of the management structure of an organisation. Together they developed the so-called "7-S" model which was taken up as a basic tool by the global management consultancy McKinsey and can serve here as a model to analyse existing situations and formulate the desired organisation. The model proposes that structural implementation needs to be addressed as seven components of management (Superordinate goals or Shared Values, Strategy, Skills, Staff, Style, Structure and Systems) with ample attention being given to the "soft" S's: Skills, Staff, Style and Shared Values. The "7-S" model has since been recognised as a valuable tool to initiate change processes and to give them direction, including within university contexts.

The management organisation of the context of the case studies: Department of Biotechnology, Delft University of Technology

The university management system of the Delft University of Technology is based on a flat model with delegated responsibilities to the Faculties. The University Board consists of three people, the Chairman (who has the overall responsibility), the Rector and a third member. Each has their own portfolios of responsibility: the Rector mainly in relation to research, the third member in relation to education and the Chairman for the overall and general management. The University Board has a small supporting staff unit. Decisions are taken by the Board after discussion in the monthly Management Group ("Groepsraad"), in which all the Deans take part.

TU Delft has 14,000 students and 4,500 employees of which over 2,300 are scientific staff members divided over eight Faculties. Since the end of the 1990s each Faculty has a professional Dean responsible for the financial and personnel management together with the education and research of the Faculty. The Dean of the Faculty of Applied Sciences is assisted by three education directors, a personnel and a financial manager and a management team consisting of the chairmen of the six departments.

The Department of Biotechnology has eight research groups, led by a professor and on average consisting of four scientific staff members, two to three analytical staff members and 10 to 20 PhD students and postdoctoral researchers. The Chairman of the Department is assisted by the Department Executive Secretary, who also directs the Department's Project Bureau. At the time of writing the Department is running about one hundred and eighty scientific projects, is involved in three BSc and MSc degree programmes, and coordinates the management of two large Netherlands national research programmes, the "Kluyver Centre for Genomics of Industrial Fermentation" Centre of Excellence and the "Biobased Sustainable Industrial Chemistry" public-private partnership programme. Currently the total number of people in the Department is one hundred and ninety and the annual turnover was just over €17 million in 2005 of which about 50% came from university (or government) funding.

The organisation works with the "bottom up" provision of annual SMART[10] goals by individual research teams. The Dean of the Faculty defines the major goals with his team and annually agrees the priority of ambitions with the Board of the University. Simultaneously, the University Board decides on major aims in achievement which it discusses with the assembly of Deans who have to implement the agreed procedures and business objectives. The University Board is governed by a Council with external peers which meets quarterly. The University is largely decentralised, although the financial allocation model provides a major drive in setting the rules for receiving the main government income.

In 2004 Delft University of Technology decided to carry out a reorganisation to centralise the supporting staff aiming to reduce the number of support staff members in favour of temporary scientific staff. Although this obviously has a diminishing effect on the responsibility of the deans and chairmen of the departments, in theory at least it will not influence the primary processes of research and education.

[10] SMART: Specific, Measurable, Attainable, Result-focused, Time-oriented

1.3. Research design

1.3.1. Research questions and objectives

The objective of this study is to analyse the ways in which biotechnology scientists interact and communicate with the public, aiming to derive lessons on the optimal approach and content of the communication activities as well as on the desirable level of responsibility for these activities. It further aims to determine criteria for effective biotechnology communication and its institutionalisation by academic institutions to help them address public concerns in a sustainable way. The main research questions are:

1. Why is an increased use of (bio)technology in everyday life and products not related (but contrarily) to an increased public support for research?

and

2. What institutional management is required to earn public support for scientific developments?

In order to answer these questions the study investigates:
What can we learn about the role of the biotechnologist researcher in public communication from a series of strategies developed to increase public communication in biotechnology carried out by a university department in The Netherlands.

Further questions are:
Can we identify criteria for improved communication involvement by biotechnology scientists in the content of the communication and in the involvement of scientists? Can we recommend how this improvement can be realised? What lessons can be learned from this study which are relevant for other areas of science?

The study analyses the main constraints in encouraging public communication activities and how these activities can be institutionalised in a university context. The results may well be useful for academic institutions in other scientific fields or universities, providing an example for the institutionalisation of public communication by scientists.

Do biotechnologists need to communicate?
The study starts from the premise that biotechnologists do need to communicate, the argumentation for this being set out shortly below.

As was stressed in the Introduction, biotechnology is set to make a progressively greater impact on the life of every individual throughout the world both in developed and in developing countries, and on their economies. Its significance is greater probably than any other field of science and technology because it has the ability to change the very bases of human existence: our genetic composition, our food, our health and our environment, and the course of the evolution.

Every aspect of life in developed post-industrial societies is dependent on science and technology. Modern society has institutionalised science and technology in its university and research institutes, in effect as a contract with society with the aim of providing the knowledge needed for its future by research and discovery, and of educating future scientists and technologists to continue the contract. Scientists are the experts but this does not *per se* necessarily mean that they also need to communicate what they do.

Many from both academia and from industry have concluded that biotechnology scientists need to increase their involvement in public communication if they wish to achieve greater support from society at large for the implementation of biotechnology. However, independently from the wish to achieve greater public support, there are also reasons derived directly from the principles of a democratic society for scientists' involvement in communication. Public involvement in decision making processes requires public information and the social contract between society and scientific institutes demands accountability. Based on these arguments posed by present developments in society and biotechnology with its important potential impact, a set of evaluation criteria for public communication may be derived.

There are two main reasons for scientists to communicate with the public at large: democratic, with underlying social and economic components, and moral.

It is axiomatic that democratic societies depend on informed decision making. Political agendas and decisions, including those about choices for science policy, research funding, regulation of the science and its applications, support for its industrial development, etc. are subject to voters' opinions. It is necessary therefore that scientists are accountable to the public about their science and their reasons for doing it so that informed decisions can be made. This is a general responsibility following from the democratic principle for all researchers from whatever discipline to explain their science and its findings as they see them. However there is a special responsibility for those involved with biotechnology to do so because of its potential pervasive and major impact on society.

The moral imperative for scientists to communicate with the public is that only they have understanding at an early stage of the possible impacts of their science for society, which they need to provide for the joint decision making process. As is argued, biotechnology especially has the potential ability for such large impact on people's lives that it is a moral obligation on scientists to inform the public about possible issues surrounding these matters. An example of course was the decision of the early biotechnologists during their 1973 conference at Asilomar in California for a moratorium on their recombinant DNA research until its hypothetical risks became clearer. (Berg, Nature 1973). A similar call has recently been made by nanotechnology scientists for a moratorium on using nanotechnology to tackle environmental problems such as pollution because of possible toxicity of very small particles, but not for a broader ban or moratorium. (report of Committee of Royal Society and the Royal

Academy of Engineering in the UK in The Times, 30 July 2004, "*Minuscule machines, towering hopes, big dangers*"). This moral requirement for public communication is explicitly discussed and imposed by the Code of Ethics for biologists, to which a large number of biotechnologists subscribe.

There are two social reasons for scientists to engage in public communication which underlie the democratic reason. The first follows from the general observation that societies tend to oppose new technologies. Until about one hundred and fifty years ago, before electricity became commonplace, most people had a fair understanding of the technologies among which they lived. However, with the advent of electrical devices, technology became more complex and often threatening; electric equipment is concealed and in many cases there is little if anything to see. Some people feel that modern genetics, at the very centre of life, is the latest in a long line of malign developments which include nuclear energy, novel weaponry and a host of others. Von Wartburg and Liew (1999) have noted that *"...the introduction of a new technology marks a turning point for society...Among other consequences, (it) leads to a redistribution of resources...new skills and knowledge become more in demand, old skills and knowledge become obsolete..."* It is not surprising that novelty, biotechnology included, is often misunderstood, misinterpreted and resisted. Durant called this the "Yuk factor" - *"I don't understand it, I don't want to understand it and I don't like it"* (Durant, personal communication). It is because people tend to reject new technologies, but need in a democratic system to be able to weigh their pros and cons, that there is a social obligation on scientists to provide this understanding in public communication.

The second underlying social reason follows and relates to accountability and trust. If scientists are contracted by society to develop the solutions for tomorrows' challenges, then society needs to be able to trust them[11]. Trust acts as a summing device when full understanding is not possible. This is the general situation for modern technologies, and especially for the complexities of biotechnology. Trust is based on confidence and knowledge which is claimed to be maintained by inclusivity, transparency and information. This relates to both factual information and emotional feelings. A component of the contract and trust is accountability[12]. Scientists are contracted and paid for their work via taxation and government by society. They are accountable to society for the uses and outcomes of that payment. The social need for scientists to be accountable, and thereby maintain trust, is an imperative which follows from the contract between society and science.

The first and second economic reasons for scientists to communicate with the public at large also underlie the democratic reason. The first relates to the fact that the generation of wealth for the functioning of modern societies wholly depends on science and technology.

[11] 'them' is used here referring to the professional group and not to the individual

[12] as Munnich (2004) points out: the process of accountability is more important than the individual excellence. In science this is done by debating research results and conclusions between experts and counter-experts in the public domain of published journals, books and conferences

Biotechnology has been promoted as a major generator of wealth. In order to allow society to make informed decisions about the contribution which biotechnology may make to wealth generation scientists need to explain its economic impact, i.e. its benefits, and its costs, to society. This also includes explanation of the costs and benefits to society if a technology which is scientifically feasible is not pursued.

The second economic reason is that scientists have to explain why society must return some of the wealth generated by science to science if science and wealth generation is to continue. As society pays for the publicly funded universities and research institutes, it is in the interest of all academics to communicate about their work. Society decides on the amount and distribution of public funding based on this information. However, with competing calls on limited public funds it is in the biotechnologists' own interest, as with the members of all academic disciplines, to communicate effectively.

The foregoing discussion is based on an idealised view of democracy with full public involvement in the decision making process. However, the reality in democratic societies is that the majority of the public is simply not interested in participating in decision making which is left to the elected representative ministers and their staff. They in turn tend to be influenced by communicated opinions and perceived public perceptions while subjected to often intense lobbying by special interest groups although they are finally answerable to the electorate[13]. Therefore the need remains that the "silent majority" of the public at large is informed. This could possibly be achieved by specially established institutions, however the efficacy of such systems is highly questionable as the responsibility for their tasks is unclear, as is the manner by which they may carry them out, and therefore their effectiveness. If the responsibility remains within the government, than the accountability of scientists is diminished. Equally, if the responsibility remains within the organisation of the (independent) public information institution, than the accountability of scientists is also diminished and furthermore, the drivers for the institutional organisation will depend on its financial incentives. As the public trust in scientists is related to their accountability, in both cases the public trust in science can be affected by the performance of these institutions.

In order to prevent this shift and decline in accountability scientists need to perform the task of public information themselves. But how can scientists reach this "silent majority"? People are overloaded with information and are not interested in science unless there is a direct personal need or unless it is brought to their attention by the media as novelty, for entertainment or because of controversy. A common approach is to define a range of audiences and use different methods to arouse the interest of each: those that have a specific need (e.g. genetic disability patients and their carers); those that have professional interest (e.g. pharmacists, doctors, farmers); those who represent the public (politicians); those who

[13] Taking the view that government is an intermediary between scientists as a sectoral interest group and the rest of society, which places the responsibility of informing the public on the scientists themselves

report news and provide entertainment (media); those who have a financial interest (shareholders); etc. The efforts of scientists to inform the decision making process can be directed in this way.

In order to reach the "silent majority", public communication activities need to stimulate the interest of the public. Because different groups of people have different interests and concerns it is also necessary therefore to know and understand their differing interests and concerns. These are not only related to the scientific and technological information, but also importantly relate to (bio)ethical, safety, social and legal issues. Scientists need to be able to understand and respond to these issues.

Following from the democratic contract of science with society, the social, moral and economic reasons dictate that scientists inform and participate in the democratic decision making process, which includes interaction with the public. As in any contract, good performance is in the interest of the performer. It is argued that communication is an implicit task for scientists, therefore it is in their own interest to do this effectively and it is in the interest of academic institutions to facilitate and organise this process.

Up till now, such interaction has not been performed in a structured way. Reasons for this lack of scientists' involvement can be found in the technocratic, empiricist views of many scientists and science managers; that science is objective and scientists account for their efforts to the government, whose task it is to act on these 'objective' findings. The responsibility to communicate with society was therefore left to the government. In turn governments established institutions, such as in The Netherlands "Stichting voor Publieksvoorlichting over Wetenschap en Techniek" ("Public Information, Science and Technique" (PWT), later renamed as "Stichting Weten" (foundation for science communication) and the Rathenau Institute to carry out these tasks. However such intermediaries do not suffice as it is scientists as experts on their research that government officials and journalists wish to speak with in person and that members of the public wish to see on TV, read about in newspapers and magazines, and listen to at public events and on the radio.

At the same time, scientists are not encouraged to interact with society as these activities do not form part of their job descriptions and are not credited in performance and career assessments nor by funding agencies. Furthermore, the general lack of skill of the majority of scientists to interact and communicate with the public has made them uncertain and on occasion has generated negative attitudes to scientists who try. This is now changing. The following chapters will describe and analyse a series of strategies which have been implemented in a Department of Biotechnology of a Dutch university, the Delft University of Technology (TU Delft), to institutionalise public communication within an academic institution.

The following sub-questions will be addressed in Chapters 2-10:

Part I: Knowledge: Raising awareness

Chapter 2:

1. Which problems can be identified for organisation, management and responsibility of a macro (European) approach to biotechnology public communication?
2. Which lessons can be learned from European collaborations for institutionalisation of science communication?

Chapter 3:

3. Which training needs have been prioritised by biotechnology companies in 1992?
4. Which elements were chosen to be included in training on public communication?
5. How did the development of industrial training courses for public communication influence the strategy for science communication of a university department?

Chapter 4:

6. Can biotechnology scientists be informed on public perception issues and be encouraged to be active in science communication through dedicated sessions in scientific conferences?
7. What are the strong and weak aspects of these sessions in relation to the objectives of the approach?

Part II: Skills: Development of training

Chapter 5:

8. Can we improve skills for public communication by training?
9. Which elements need to be included in training on public communication?
10. What problems did we encounter in developing courses on public communication and what can we learn from doing so?
11. Can we encourage biotechnology scientists to increase their involvement in science communication by providing them with courses to improve their skills?

Part III: Attitude and behaviour: Willingness to act

Chapter 6:

12. How can biotechnology scientists identify future societal issues related to their work?

Chapter 7:

13. What problems can be identified in organising public events?
14. Which lessons can be learned from public events that are relevant for science communication?

Chapter 8:

15. How do biotechnology scientists view their own role in public communication?

Part IV: Institutionalisation: a new model for science communication

Chapter 9:

16. What lessons can be learned from a series of communication activities within a Department of Biotechnology over a period of fifteen years?
17. What drivers exist within the university organisation for a department to be active in public communication?

Chapter 10:

18. What model (strategy) can be proposed to optimise public communication by scientists?
19. What can be suggested to remove the present constraints for public communication in the university setting?

1.3.2. Research design

With the introduction of a new technology, the societal context for its perception by the public at large and its acceptance changes rapidly over time. In order to understand these changes a number of strategies that were used by the Department of Biotechnology of the Delft University of Technology (TU Delft) to increase public communication over a period of fifteen years from 1991 to 2005 are analysed for their objectives, content and delivery; and for the lessons they provided. Both the management composition and the management structure of the Department remained largely constant over this period. Throughout, the Department has had full responsibility for its finance and organisation, under the supervision of the Dean of the Faculty of Applied Sciences. The Department Management Team consisting of the Chairman, Vice-chairman, Facility Manager and Executive Secretary has been responsible for all communication activities. The author, first in the role of policy advisor and since 1999 as Executive Secretary, was involved in the initiation, organisation and evaluation of these activities and carried out this study as a participant observer (author's personal resumé, Appendix 1). As the lessons from each public communication activity of TU Delft are integrated into the subsequent activity, together with the conclusions from other national and international biotechnology communication activities, a continually accumulative and iterative learning approach has been created.

The analysis of the strategies and instruments for public communication in biotechnology used by the TU Delft are carried out by the analysis of the objectives, problems encountered and results of each activity in terms of its objectives and of the general goal of public communication. It gives reference to appropriate theoretical frameworks such as didactics and those briefly described in Chapter 1.3.

The analysis does not involve a general quantitative evaluation of the communication activities for their value in public information or input in the decision-making process of the audiences as such is not possible because no direct causal linkage can be established.

Therefore the decisions to carry out the activities are evaluated on the basis of judgments made in relation to a series of boundary conditions such as availability of funds, time and personnel with the required skills.

The research is based on the premise of the democratic principle, which involves a reciprocal contract of society with academic institutions. Public communication is viewed in this context as a necessary activity for scientists as a responsibility of accountability to society and not as a means to increase public support for biotechnology. The thesis evaluates as many aspects as possible relating to this accountability, including the reasons for the judgments made (including the decisions not to communicate) and how these affected further policies and strategies. With this aim the thesis therefore also evaluates which criteria for public communication activities were used and argues what criteria can be added based on the problems encountered and the general aims derived from the democratic contract of scientific institutions with society.

From the argumentation in Chapter 1.3.1. it can be concluded that public communication by scientists needs to address:

A. Availability of knowledge:

1. Provision of information on the scientific data
2. Provision of information on the potential impact of implementation of the technology on society, including explanation of the benefits and costs, and including a cost-benefit estimation if the technology were not to be introduced
3. Provision of transparency on how judgments are made, including explanation of the procedures in place to verify scientific findings

B. Availability of skills:

4. The involvement of scientists who wish to be involved and who are skilled to perform the interaction

C. Availability of attitude:

5. An attitude to encourage public interest to raise awareness and provoke involvement in the decision-making process
6. An attitude strategy that shows understanding and guarantee responding to public interests and concerns, including ethical, social, safety and legal issues.

All science communication strategies ideally need to fulfil these criteria and strategies or otherwise provide explicit argumentation for specifically excluding one or more.

Institutionalisation of science communication needs to facilitate the implementation and continuous development of these criteria plus the availability of resources in finances and staff time.

The activities described in Chapters 2 to 8 are evaluated for the way in which these criteria are met. Chapters 9 and 10 discuss the important drivers and constraints relevant for institutionalising science communication and provide a model for institutionalisation.

1.3.3. Research methodology

The activities and strategies used by the Department of Biotechnology at TU Delft are viewed as a series of case studies[14]. Each case is evaluated for the reasons and objectives of the activity determining the bottlenecks encountered and the way in which they were addressed. This is done using the oral and written evaluations by participants, results of specially designed questionnaires, interviews and discussion groups. The way in which the lessons provided by each activity are addressed in the following activity or strategy are discussed. The case studies together therefore form an iterative process of action research[15]. Furthermore, each activity and strategy is evaluated for the criteria derived from the accountability of scientists in society.

[14] A case is defined here as a self-standing activity in which biotechnology scientists were involved in communication

[15] Action Research (AR) is defined as social research carried out by a team of professional researchers and stakeholders who together define the problems to be examined and the proposed actions for study. It promotes a broad participation and is directed to social change. It is based on a social constructivist view and considers all information (scientific as well as tacit information) brought to the process as equally relevant (after Greenwood and Levin, 1998).

Part I: Knowledge: Raising awareness

Hydra, 1994

The little town hall was packed with as many Task Group members per square meter as the streets with cats. John (Durant), Martin (Bauer) and George (Gaskell) attempted to show their results and conclusions from public survey results in spite of the lack of an overhead projector or beamer. The atmosphere was jolly, resulting in many late-night discussions aided by retsina's. It would be the beginning of the "survey of surveys", compiling public opinion studies in an easy approachable way.

CHAPTER 2

The European Federation of Biotechnology as an instrument in institutionalising public communication in biotechnology

2.1. Introduction

This chapter addresses the lessons that can be learned from European collaboration in science communication. It describes the case of the TU Delft Department of Biotechnology involvement in a network of a scientific federation over a period of fifteen years and the involvement in a European Commission-funded project from 1991-1993. The analysis of the activities and their impact provide insight into the effectiveness and boundaries for continuing public communication at a macro level.

The European Federation of Biotechnology (EFB) was established in 1978 to advance the use of biotechnology in Europe. It consisted of a federation of national biotechnology societies throughout Western and Central/Eastern Europe. The Federation established a number of "Working Parties", each addressing a separate field of interest in biotechnology, such as Bioreactor Performance, Downstream Processing, Education, etc. National society members were invited to delegate two national representatives from academia or industry for each of the Working Parties. Because this system proved to result in only marginal change in membership and did not allow for the involvement of more young biotechnology scientists, some Board members pushed for a more open system. In 1995 the EFB Board decided to reorganise its Working Parties and national delegate system to facilitate increased involvement from biotechnologists throughout Europe. The Working Parties were transformed into "Sections", addressing a broader field of interest, while horizontal activities common to all sectors of biotechnology were organised in "Task Groups". The Section on Biochemical Engineering Science (ESBES), for example, comprised the previous Working Parties on "Downstream Processing", "Bioreactor Performance", and "Measurement and Control". Individual membership was now possible, which extended the Sections from around fifty members in the original Working Parties to over three hundred members in each Section. The Working Party on Education became the Task Group on Education & Mobility.

The event which probably marked the beginning of science communication specifically to do with biotechnology was the European Federation of Biotechnology's prescient decision in 1989 to set up an *ad hoc* group to recommend how the Federation should deal with public education and communication. Its report by Houwink in 1990 recommended the establishment of a Task Group. In 1991 the EFB decided to follow this recommendation by establishing the EFB Task Group on Public Perceptions of Biotechnology with the aim of building expertise to advise the Federation on how to deal with the public's growing concerns about biotechnology and to carry out activities with the aim of responding to these concerns. This was the beginning of collaboration in biotechnology science communication in Europe. The Group has continued its activities from then to the time of writing with the Delft University of Technology Department of Biotechnology being represented in the Task Group on Public Perceptions of Biotechnology by the author from the very beginning of its activities.

2.2. Method of evaluation

This chapter explores the following research questions:

1. What problems can be identified for organisation, management and responsibility of a macro approach to biotechnology public communication?
2. What lessons can be learned from European collaborations for institutionalisation of science communication?

In the role of participant observer, the activities of the EFB network groups were critically reviewed by means of the analysis of the groups' results by assessing their objectives and by means of an evaluation of the usefulness of the involvement in the networks for a Departmental institutionalisation of public communication.

2.3. Results

2.3.1. Objectives and achievements of the activities of the EFB Task Group on Public Perceptions of Biotechnology

In 1991 the report of the EFB *Ad Hoc* Group led to the bringing together of some fifty multidisciplinary experts (from scientific research, industry, government, consumer and environmental organisations, the media and communications researchers and practitioners) from almost all the European countries to establish the European Federation of Biotechnology Task Group on Public Perception of Biotechnology (EFB-TGPPB) under the chairmanship of Professor John Durant, then Professor of Public Understanding of Science at Imperial College London and Assistant Director of the Science Museum London. In 1998 Professor Richard Braun, Professor of Microbiology, at Bern University took over the chairmanship until December 2005 when he passed it to Professor Julian Kinderlerer, Assistant Director of the Sheffield Institute of Biotechnological Law and Ethics of the University of Sheffield. Dr David Bennett, a member of the original *Ad Hoc* Group, has served as Secretary to the Task Group throughout.

The *Ad Hoc* group invited members using the following criteria:

- their affiliation with an area of biotechnology (healthcare, agriculture and food, and environmental biotechnology)
- their affiliation with a type of organisation (industry, academia in biotechnology research, academia in social research, non-governmental organisations, patient and consumer organisations, media, politics)
- their membership of other networks of relevance (European or world alliances of patient groups, biotechnology industry networks, academia networks, journalist organisations, national organisations)
- their representation of a European country
- their interest, experience and commitment in public communication

The Task Group's general aim was, and still is, to increase public awareness and understanding of biotechnology and the life sciences throughout Europe. The objectives to advance the public debate on biotechnology and to facilitate dialogue between interested parties were based on the mutual expertise of the Group's members. The choices for activities were made on the basis of experience, scientific insight, social context and other constraints such as availability of funds and opportunities.

By adopting the policy of maintaining an independent position between science, industry, government, public interest groups and the media, they aimed to position themselves as a trustworthy partner to become a source of information and advice for all parties, and to be a neutral organiser of public events. The chairman and secretary of the Task Group developed close working relations with the European Commission, which resulted in the membership of European Commission representatives from both the Research Directorate-General and the unit responsible for the Eurobarometer biotechnology surveys. The group submitted and consequently received funding for a series of projects which enabled the organisation of the proposed activities. During the early period of the Task Group separate European Commission contracts covered the Task Group meeting costs and activities. From 1994 to 1999 the Task Group was funded by two large European Commission coordination action projects supplemented by a number of European Commission-funded projects for specific activities in which several Task Group members participated, all coordinated by Dr David Bennett and his staff. From 2000 onwards Task Group members have proposed, coordinated and participated in numerous European Commission projects on a wide variety of topics and activities in the public communication field.

As the number of the Task Group's activities grew it established six sub-groups for the main areas of its work:

1. Biotechnology Research and Higher Education
2. Healthcare Biotechnology
3. Agro/food Biotechnology
4. Environmental and Consumer Organisations
5. Journalists and the Media

6. Research on Public Perceptions (public opinion surveys)

Each sub-group was responsible for the organisation of activities in its area while the groups would report to each other for the sharing of experience and, where appropriate, the organisation of joint activities.

Through its members the Task Group was able to monitor developments in European national and international policy, legislation, research and commercialisation and activities in public communication. These observations were shared and reviewed twice a year during two-day meetings. In addition the meetings discussed the planning and evaluation of communication activities funded by the European Commission projects. Those activities were addressed to key opinion leaders as the group considered this the best strategy to achieve impact of their messages. They included:

- publication of a book on public perception consisting of articles contributed by Task Group members (Durant, 1992);
- publication of a large series of concise, authoritative briefing papers on a wide range of key topics in biotechnology (in English and translated into eight other major European languages) for (European Parliament and national) politicians and other interested key opinion leaders, university and biotechnology company staff members, lecturers and teachers, journalists, patient, consumer and environmental public interest groups and other interested individuals (http://www.efbpublic.org);
- publication of a loose-leaf, updated handbook of information sources for non-specialists (later superseded by the Task Group's and other websites);
- publication of a survey of public opinion surveys (Hamstra, 1998);
- organisation of major international conferences on public perceptions of biotechnology;
- organisation of a large number of stakeholder workshops on a wide range of key topics (often in collaboration with other institutions, such as the European Molecular Biology Organisation (EMBO));
- publication of reports from these conferences and workshops (www.efbpublic.org, Braun, 1999);
- web-based international *"Ask-the scientist"* email enquiry initiative for the general public with responses from volunteer scientists in almost all European languages.

The TU Delft Department of Biotechnology was involved in the "Biotechnology Research and Higher Education" group of the Task Group with the author as its representative. This group aimed to raise awareness of the importance of paying attention to public perception of biotechnology amongst scientists and to stimulate and organise training on public perception issues to increase the level of skills of scientists to interact and communicate with the public. The decision of the Department to join the EFB Task Group on Public Perceptions of Biotechnology in 1991 was influenced by:

1. The Department played a coordinating role in stimulating biotechnology research in The Netherlands as coordinator of the Netherlands Association of Biotechnology Research Schools and by providing members to the Board of the Netherlands Biotechnology

Society and the Netherlands Foundation of Biotechnology. There were early indications that the public perception of biotechnology was not particularly positive in The Netherlands and the Department wished to influence this situation so as to be able to help advancing biotechnology and hence maintaining the positions of the Association and the Society. Participation in the Task Group could well enhance its capacities or knowledge to do this.

2. The then chairman of the TU Delft Department of Biotechnology was at the time President of the European Federation of Biotechnology and had been involved in the recommendation to set up the EFB Task Group on Public Perceptions of Biotechnology. He therefore encouraged the Department to be involved in the activities of the Task Group.
3. The Department was in charge of the provision for the teaching on ethics, public perception and sustainability for the TU Delft MSc curriculum on chemical technology. This may have contributed to the decision to join the Task Group although the lecturers involved in this course were not directly involved in the further activities of the Group.

The Working Group on Biotechnology Research and Higher Education dealt with the involvement of scientists in public communication and education. However at that time little was known about the views of scientists to public communication so the Working Group decided to investigate the needs and opinions of biotechnologists in matters related to public perceptions. What do scientists want to know and how do they wish to receive this information? The Group was also interested in the views of scientists on their own roles in public communication. Three web-based questionnaires were developed; one exploring the need for knowledge about public perception issues by biotechnology researchers and lecturers; the second gathering their responses on how they as biotechnology scientists viewed their role in public perceptions of biotechnology and the third investigating what biotechnology industry employers wished their future employees as present biotechnology students to know about public perception and related matters. A statistical counter was added to the introductory page to compare the visits to the actual return of the questionnaires.

A total of 1,500 people selected from the Task Group database were approached by letter to complete the questionnaire, complemented with announcements in the EFB newsletter and linking the website to internet search engines. As the industrialists' response turned out to be low, a specific request was sent to 58 biotechnology company members. The results were collected in the period from 27 March to 31 October 1997. A total of 1,094 home page visits were recorded, 306 people visited the introductory page and 63 completed the questionnaires. Another 32 completed questionnaires were received on paper providing a total of 95 completed questionnaires (which equals a return of 6% or less as it was not possible to distinguish between the respondents who answered the letter request and who found the questionnaire independently via the internet). A total of 43 responded to the questionnaire related to the need for information; 35 to scientists' role in public perception and 17 to what industrialists wished to see in training for future employees. The origin of the visitors was mainly European complemented with some from the USA, Canada, Israel, Tunesia, Turkey and China.

Results of 1997 questionnaire determining the need for information on public perception by biotechnology researchers

Of the 43 respondents to the questionnaire on the need for knowledge on public perception by biotechnology researchers, 70% were involved in research and 53% involved in education in a variety of biotechnology areas. The questions were multiple choice with a possibility to choose more than one answer per question. Figures 2.3.1.1 and 2.3.1.2 show the answers for the specific topics on which the biotechnologists wished to receive more information.

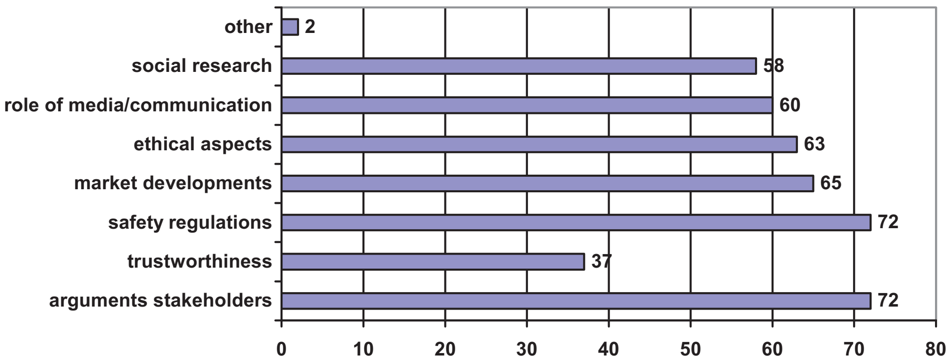

Figure 2.3.1.1: Needs of biotechnologists for general information related to public perceptions in percentages (n=43). Osseweijer and Corbett, 1997

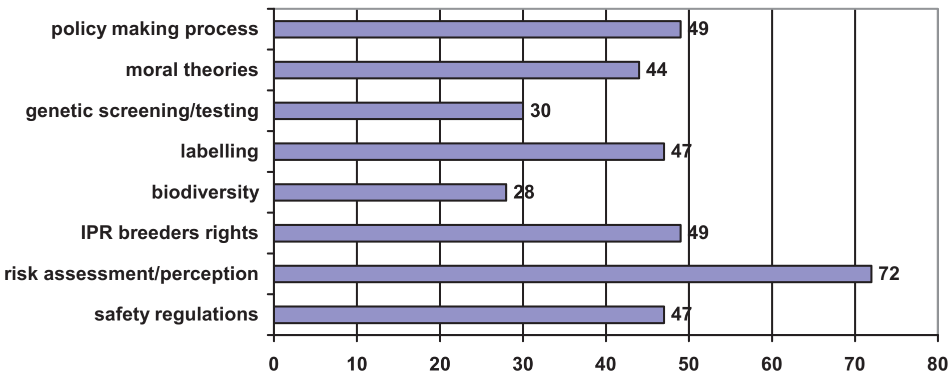

Figure 2.3.1.2: Needs of biotechnologists for information on legislation aspects in percentages (n=43). Osseweijer and Corbett, 1997

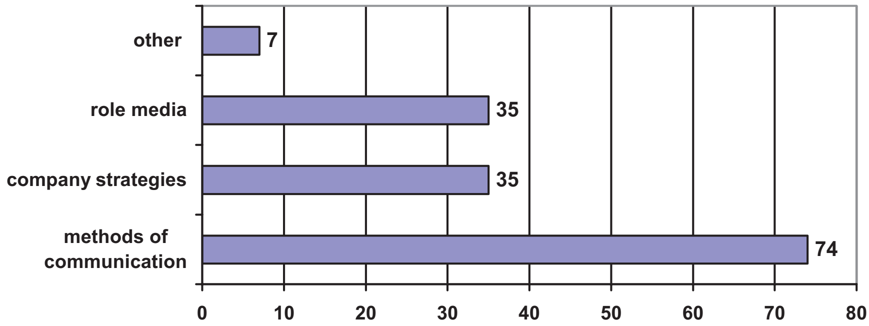

Figure 2.3.1.3: Needs of biotechnologists for information on communication aspects in percentages (n=43). Osseweijer and Corbett, 1997

The preferred way to receive this information was through briefing papers (72%) and information on the web (67%), only 12 % opted for a course or workshop.

Results of 1997 questionnaire determining the view of biotechnology scientists on their own role in public perception of biotechnology

A total of 35 completed web questionnaires was received on the survey into the views of scientists on their own role in communication. The respondents were equally divided over different areas of biotechnology with the majority working in research and teaching. Half of the respondents had at some point been actively involved in discussions on public perception issues. The combined results in Figure 2.3.1.4 show that all respondents felt that scientists needed to be involved in discussions about public perceptions of biotechnology.

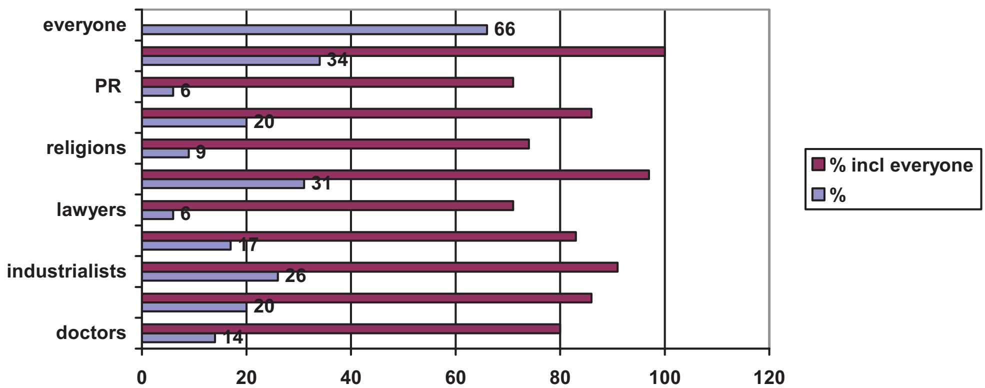

Figure 2.3.1.4: Views of biotechnologists on who should participate in discussions on public perceptions of biotechnology in percentages (n=35). The percentages indicated "including everyone" add the total for the specific category with the total given for "everyone". Osseweijer and Corbett, 1997

When asked who should be involved in determining governmental policies, legislation and safety regulations of biotechnology, all biotechnologists responded that scientists should be involved (Figure 2.3.1.5).

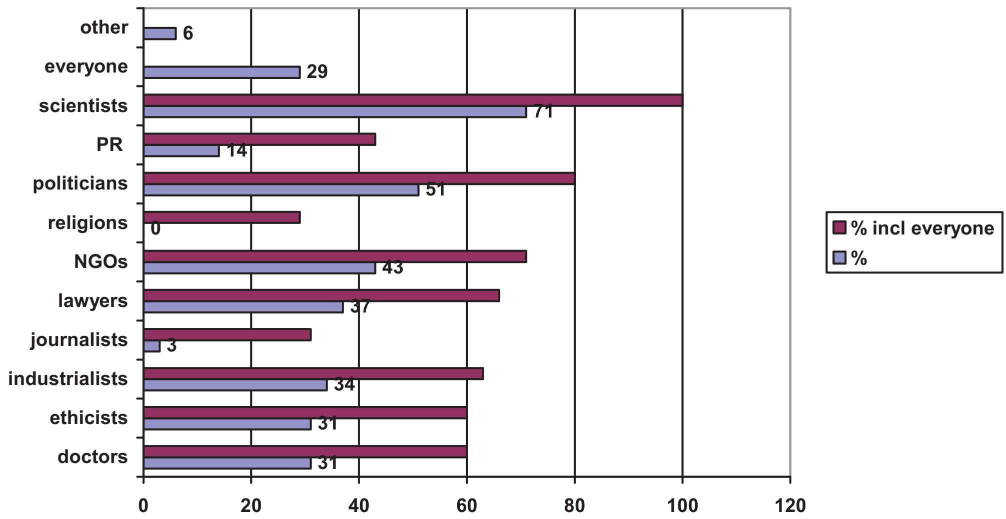

Figure 2.3.1.5: Views of biotechnologists on who should be involved in determining governmental policies, .legislation and safety regulations of biotechnology in percentages (n=35). The percentages indicated "including everyone" add the total for the specific category with the total given for "everyone". Osseweijer and Corbett, 1997

The above specified questions were directed to determining the ideal involvement of scientists compared with other groups. In contrast, the following question aimed to analyse in which specific activities related to public perceptions scientists felt they should be involved. They could choose on a scale from 1 to 4 from no involvement to some, substantial and large involvement. The mean is therefore 2.5. On average all activities scored 2.83 indicating that scientists felt they should be involved substantially in these suggested activities (Figure 2.3.1.6).

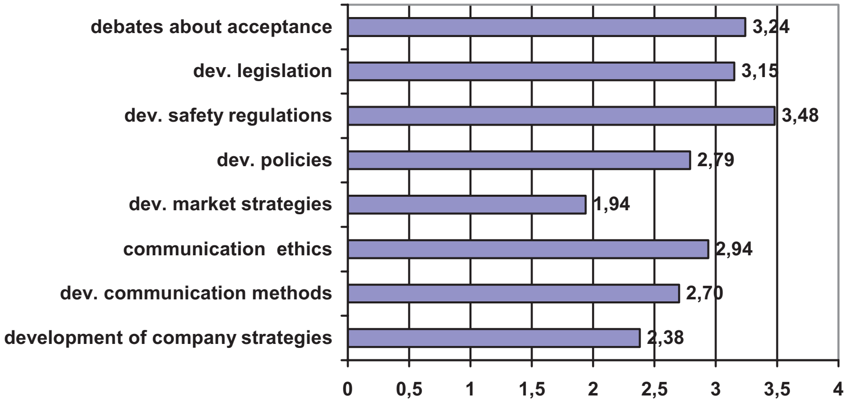

Figure 2.3.1.6: Views of biotechnologists on the activities they should be involved in on a scale from 1-4 (no involvement to large involvement) (n=35). Osseweijer and Corbett, 1997

The respondents were also asked about how much influence they felt they had as scientists on public opinion forming in relation to other groups. They generally felt the media (journalists etc.) had most influence, followed by consumer organisations and environmentalists. They scored "the scientists" on a value of 2,2 somewhat above "some influence".

Results of 1997 questionnaire determining the wish of industrial leaders for education of students in topics concerning public perceptions

The third questionnaire was especially aimed at industrialists to obtain an indication of the topics to be included desirably in MSc education programmes. The results only reflect the opinions of 17 industrial leaders, mostly representing the biotechnology food and drink industry and the bioprocess technology field (generally related to chemical production). 71% indicated that teaching needed to address the viewpoints and arguments of all stakeholders and 76% had the opinion that safety regulations and development of policies and legislation should be part of student education. Education on the role of the media and communication scored 59%. Education about product liability was felt very important (82%), while the process of policy making (35%) and information on genetic screening and testing and patient rights was felt least important (18%). The majority felt it important to teach methods of communication about biotechnology (76%) but addressing writing and presentation skills was felt less important (59%). Education on how the media works scored lowest (29%).

The industrialist respondents shared the opinion that this training should be provided in the form of workshops for post-graduate students in biotechnology either compulsorily (50%) or optionally.

2.3.2. Objectives and results of the activities of the EFB Task Group on Education & Mobility

The Task Group on Education & Mobility was established soon after the setting up of the European Federation of Biotechnology in 1978 to enhance the level of post-graduate biotechnology education. Unlike the Task Group on Public Perceptions whose members were selected by the original core group, the members of the Task Group on Education & Mobility were initially represented through the European Federation of Biotechnology by the European national societies on biotechnology and after 1995 by voluntary membership. The Group was chaired from the early 1990s onwards by Professor Gijs Kuenen, Professor of Microbiology of the TU Delft Department of Biotechnology, until 2000 after which Professor Charles Bryce of Napier College Edinburgh took over the chairmanship.

In 1996 and 1998 the Group received funding for two projects from the European Commission Socrates programme. The Task Group formed six “Working Groups”, dealing with core curricula and harmonisation of qualifications, the establishment of European masters and doctorate degrees in biotechnology, the establishment of a code of conduct, the availability of advanced short courses, the analysis of industrial training needs and the quality assessment of courses. The TU Delft Department of Biotechnology agreed to lead the Working Group on Advanced Short Courses represented by the author. The Department’s involvement in the EFB Task Group on Education & Mobility was driven by the view that education is crucial for developing science and that international collaboration could provide better education for more students. The Department had hosted a joint foundation with Leiden University, “Biotechnologie Opleidingen Delft Leiden, BODL” (“Biotechnology Studies Delft Leiden”), since 1984 which was responsible for the training of postgraduate students. Amongst other activities BODL had organised a continuing series of specialised international advanced short courses on various topics in the biotechnology field since its establishment. The involvement in the EFB Task Group on Education reflected the importance and ideology which the Department brought to professional training. It also provided an opportunity to increase the Department’s network and keep it updated on new training needs.

The objectives of the Working Group for 1996 to 1999 were to provide a forum for course organisers and course participants, in particular to:

- analyse demand and stimulate supply on advanced short courses in biotechnology;
- coordinate information on course availability;
- provide advice and information to course organisers;
- promote the European Doctorate in Biotechnology and the European degree accreditation transfer system.

The Working Group recognised that many young biotechnologists did not have the ability to follow advanced training courses due to constraints in finances or time. That is why the Group decided to focus on converting existing courses into modular formats which could easily be given in different countries or through the then newly developing internet systems. The trend in Europe was also to focus on continuing education to enable employees to keep up with new demands and new techniques. Novel educational approaches such as question-based learning were also taken into account as well as the priorities identified for colleagues in Central and Eastern Europe.

The results of the Working Group activities were disseminated through conference presentations to colleagues in the field and through a website. An analysis carried out in 1998 on the demand for training of biotechnology scientists indicated a priority request for training about the social and ethical aspects of biotechnology. A second priority indicated was training on entrepreneurship and technology transfer.

2.3.3. Involvement in a European study on availability and provision of biotechnology information

Introduction

In 1999, the Department of Biotechnology agreed to participate in a project initiated by Professor Vivian Moses of King's College London. The project was funded by the European Commission, with the objective to compare the information available about biotechnology for the public in the various European countries. The partnership included an expert in biotechnology from each country with the Department of Biotechnology at TU Delft representing The Netherlands in the person of the author. The Department agreed to participate with the hope that such a study would provide insight into the provision of biotechnology information available and into the possible contributions the Department could make in that field based on examples in other countries. The project also provided access to a further network of colleagues interested in public communication. The project was designed on the premise that providing biotechnology information would increase understanding and hence acceptance of biotechnology, addressing the questions:

- What is being done in EU Member States to inform the public?
- Are there lessons for one country to learn from another?
- What happened to public information in Switzerland in advance of voting in the 1998 Gene Protection Initiative referendum? Did people who otherwise would not have done so then take an interest because they were called upon to vote, although only some 40% actually went to the polling stations? Were they more willing under such circumstances to inform themselves? How did they go about it? What was accessible for them? Are any detailed analyses available?
- How relevant to European countries is the American experience where biotechnological products first came to the retail marketplace more than ten years ago?

In summary, the project aimed to clarify the range of opportunities for public education about biotechnology for citizens in European Member States; which opportunities were organised by governments and their agencies; which by educational establishments, and which by other organisations and institutions interested in influencing public attitudes. Furthermore it aimed to explore what materials were made available by publishers, booksellers and broadcasters.

Methodology

A country-by-country survey of educational material and activity in the European Union and Switzerland together with California as an exemplar of the United States explored how their populations were being “educated”, or informed, to understand the technical, economic and ethical facts and significance of biotechnology in 1999. Each country member investigated qualitatively using interviews, literature and media studies and available policy reports:

1. (a) what actions and policies national, regional and local governments and their agencies advocated for assisting education for biotechnology among the general population;
   (b) what educational policies they promoted for schools, universities and the public; and
   (c) how they supported those policies;
2. how and to what extent schools, universities and other broad educational bodies incorporated biotechnology issues into their instructional activities;
3. how other organisations, public and private, made their contribution to public understanding (including academies of science, scientific societies, commercial companies (manufacturing, retailing, advertising, other), trade associations, consumer organisations, environmental and other interest groups, and political parties);
4. the role played by the media: the compass of press articles (serious and tabloid newspapers, weeklies, monthlies, locals, etc.) dealing with biotechnology problems; how radio and television dealt with the issues; how members of the public responded in their letters and comments;
5. the range of books, magazines and other material either free or on sale to the general public: what was easily obtainable and from which sources (libraries, bookshops, news-stands, by mail, etc.); the intended readership; the size of the print runs; the cost to prospective readers; promotional activity by the publishers;
6. an overview comparison with the situation in the US as exemplified by northern California;
7. the availability and distribution of information during preparations for the 1998 Swiss *Gene Protection Initiative* referendum;
8. correlation of the data collected in items 1-7 with existing and forthcoming surveys of public attitudes and opinion as, for example, in the Eurobarometer findings.

In each case, the project participants laid the groundwork within their own countries, identifying relevant bodies, collecting published and other material, and in some cases considering making use of questionnaires. At some time during the duration of the project, the coordinator visited each country for up to one week to work with the national project partner in collecting, assembling and reviewing information. Where possible, arrangements were made to interview a limited number of people involved with government and educational policy, with industry, consumer bodies, teachers, museums, and with journalists and editors in the press, radio and television. Such interviews explored in detail views on education and the presentation of biotechnological information in the national context.

After an introductory meeting to determine the methodology and compare the basic knowledge available, an interim one-and-a-half day workshop of participants was held mid-way through the two-year project to review progress and identify bottlenecks. The project closed with a final one-and-a-half day workshop of representatives from all the participating countries reviewing the draft final report, discussing possible routes for publication and deciding on the recommendations to specific European Member States and to the European Commission.

Results

The qualitative gathering of information materials provided within each country showed a considerable difference in each country. Overall though, it was observed that little attention was paid to biotechnology education to the under-16 year olds, that biotechnology books for a lay audience in the local language were hard to find and that the media paid little attention to biotechnology science. On the basis of these findings the partnership recommended in 2002 that the European Council should put education about biotechnology on its agenda. They further recommended that biotechnology education should be treated in a multidisciplinary manner which includes the social science perspective to reflect the situation in which decision-making takes place within our society. A system for rewarding scientists for communication activities should be implemented to increase their active participation in the dialogue on biotechnology. Coupled with that objective, scientists should be trained to communicate effectively with the media and the general public. Opportunities on the internet and television as effective sources of information should be better used to increase the dialogue on biotechnology issues.

The report of the study (Moses, 2002) included a number of inspirational examples of educational activities which were successful in most EU countries such as hands-on biotechnology laboratories. It provided a general overview of information available on biotechnology in each of the European Union Member States, Switzerland and the USA. It also listed a number of activities that engaged specific target groups. The report made ten recommendations to the European Commission. The group emphasised the importance of continuous funding for educational activities, recognising that many good materials are not properly distributed and quickly lose value because of the lack of resources to update them.

The following suggestions were directed primarily to public sector activities since the group recognised that commercial organisations will make their own decisions based upon their own perceived commercial needs. The project participants argued that many private companies involved with biotechnology already have extensive and high quality educational material and outreach programmes - activities they strongly commended and encouraged.

Recommendations quoted from the report *Biotechnology: Educating the public* (V. Moses, 2002):

1. *As an integral part of formal education, the relevant authorities in each country should ensure an adequate level of biotechnology instruction in an ethical, economic and social context.*
2. *Teachers should be encouraged to maintain and update their understanding of biotechnology.*
3. *Educational and research institutions should institute, extend and reinforce their outreach activities in biotechnology to all sectors of society.*
4. *Researchers in biotechnological areas should be afforded credit for outreach activities, just as they are for publications; outreach should be regarded as an essential component of career development.*
5. *Interdisciplinary activities and approaches should be encouraged in biotechnological applications and implications. Teachers should be specifically encouraged to offer lessons relating biotechnology to economics, ethics and social issues.*
6. *Researchers and their institutions, academic as well as industrial, should proactively cultivate a network of contacts: for journalists and others to have access to the relevant scientists, and for scientists to know which journalists to call.*
7. *Scientific academies and associations should be encouraged to address major issues of science and technology in the context of the local culture and in language which the general public can readily understand.*

8 *Professional organisations on whose activities biotechnology impinges should be encouraged to develop educational programmes focused on emerging topics of potential interest to their members.*

9. *Biotechnology education is a long-term issue requiring a long-term view; it should not be constrained by short-term funding.*
10. *The updating and marketing of EU-sponsored educational material needs to be undertaken on an ongoing basis.*

The recommendations were disseminated to national and EU politicians and to the media by a press release in June 2002.

2.4. Discussion of the problems encountered and the constraints of these strategies for institutionalisation of science communication in a university department

Initially the knowledge acquired by participation in the EFB Task Group on Public Perceptions of Biotechnology was restricted to the few people in the Department of Biotechnology at TU Delft involved in the activities and was not shared systematically with the Department staff generally. In the first years the experiences were mainly discussed within a national group of interested scientists in the Netherlands Biotechnology Society which was formed shortly after the EFB Task Group on Public Perceptions of Biotechnology was established. Through this national group the results were reported to biotechnology academics and industrialists during the bi-annual national symposia of the Society.

The problem was that the suggestions for activities and recommendation for improved public engagement from the EFB Task Group were without any commitment and were left to each individual member's own interest to take up. This situation was similar for most members of the Task Group. So while the Task Group had an impressive involvement of key opinion leaders, their activities were not structurally embedded in any organisation.

Furthermore during its early years many of the novel suggestions for public communication activities on a European scale by members of the Task Group could not be carried out due to the restricted resources in availability of funds for both administrative support personnel and activities. This is the reason why the Group secured funding from European organisations, in particular the European Commission. Reliance on this funding made the Group dependent on the successful submission and evaluation of project proposals. The responsibility of the organisation and for the results of each activity lay solely within the membership. The desired take up and implementation of their outcomes and conclusions was dependent on the motivation of their members to successfully apply this in their respective institutions. The membership varied from experts who were especially supported by their employers to invest time and participate in the Task Groups' activities to members who were self-employed, such as journalists. These limitations were recognised and accounted for in the strategy of the Task Group which therefore focussed on:

- a two-step communication and implementation process with results, conclusions and recommendations directed to key opinion formers and leaders who could act as amplifiers to their audiences;
- the value of the various disciplines and of the representation of recognised experts from different European countries represented in the membership;
- its independence as a group of experts from industry, academia, the media, government, and patient, environmental and consumer organisations supported by the European Commission as an independent source of finance;
- exchange of information from different disciplines such as surveys on public attitudes, novel developments in research and education, media attention and national activities and trends;

- organisation of pan-European activities of which the results were expected to be of value for all countries.

This strategy together with the fact that the members themselves were positioned in the forefront of activities in public communication and represented the majority of stakeholders involved in biotechnology in Europe made the EFB Task Group on Public Perceptions of Biotechnology a desired party for other organisations for the organisation of, or involvement in, their events such as conferences, consensus conferences, etc. It also provided a rapid mutual learning curve for its members. Although the financial constraints meant that the implementation of its recommendations and suggestions was not as effective as it could have been at the beginning, the strategy to provide an independent group of experts did provide a window of opportunities to develop dialogue with all recognised stakeholders and provide a serious discussion partner for the European Commission. When more funds for activities became available from 1994 onwards, a whole series of events were organised, including two international conferences on public perceptions and biotechnology in 1994 and 1998, dialogue workshops with NGOs[16], many other workshops and meetings on specific issues and topics, and the web survey described earlier. The Task Group also played a major role in making EFB members and other scientists aware of the importance of public perception for biotechnology development and as the initiator and exemplar for many other groups and activities.

The TU Delft has used its membership in the Task Group to enhance its knowledge on biotechnology communication and stakeholder relationships. The major benefit of the Department's involvement over this long period of time was the ready access to the results of the many, often highly innovative activities organised in the different European countries. This not only provided a very early insight in the development and results of the various approaches in science communication which otherwise would not have been available or only much later in publications but it also provided a forum for critical evaluation of these activities which made the information of a quality equivalent to peer reviewed publications. One example is the discussion about the consensus conferences. People involved in the organisation of the first one in Denmark (1987) as well as the organisers of the first one held in The Netherlands (1993) and of the one held in the United Kingdom (1994) were represented in the Task Group. The discussions not only gave insight into the organisational bottlenecks but also greatly gained from the representation and viewpoints of the different disciplines and backgrounds such as social research, media studies, policy makers, industrial public affairs and NGOs. The discussions led to the very early recognition of the constraints of the deficit model (Durant, 1992) and the importance of the understanding of ethical and moral issues long before Gaskell published his conclusions on the basis of his Eurobarometer study (Gaskell et al., 2000).

[16] NGO: Non-governmental organisation representing citizen interest groups such as Greenpeace, Friends of the Earth, Green Alliance, the Genetic Interest Group, etc.

The knowledge gained from this European collaboration was important for the choices about the content of the postgraduate courses which the Department organised (Chapter 3) to educate future biotechnology industry employees in this area. Later, this knowledge was also used to improve the TU Delft Masters degree courses and to improve the dissemination of results of European Commission research projects. The network function of the Task Group proved equally important for the selection of leading lecturers for the training courses and ready access to information on practicalities for the organisation of events and to a large variety of stakeholders in different countries for their involvement in stakeholder workshops, etc. The discussions on the approach chosen, organisational constraints and possible effects of activities in The Netherlands triggered the Department to organise public events and gave important input for these activities which are described in Chapter 7.

The Department investment in the EFB Task Group Working Group on Biotechnology Research and Higher Education gave the Department a clear voice in the decisions for projects to be carried out with the available funding. It provided the basis for a number of trial activities that later proved to be effective for further national and institutional implementation, such as the workshops on future issues of biotechnology described in Chapter 6.

Unfortunately, the internet questionnaire-based studies carried out by the Working Group led by the Department in 1997 did not yield enough respondents to be statistically representative. The limited funds of the Task Group prevented further manpower input. As the Department was interested in the indication which was provided, the study was not taken further. The results indicated that:

- in 1997 the internet could be useful for dissemination of information as it attracted a large number of viewings but could not be used reliably as a medium for a questionnaire with limited resources to address people to fill it in. Hence it would be expected that only people who were already interested in the topic completed the questions which limited the value of the answers;
- biotechnology scientists are most interested in information on methods of communication; risk assessment and risk perceptions which they wish to receive through internet and briefing documents;
- although biotechnology scientists felt that they should take part extensively in a variety of activities related to public perceptions, and in particular related to the development of safety regulations and legislation, they also felt they had little influence in the opinions of the public on biotechnology
- workshop courses for postgraduate students should focus on the views of stakeholders, safety regulations and product liability and methods of communication

The results were used by the Task Group to define novel topics for briefing documents to specific target audiences and to highlight the discrepancy between the wish to take part in discussions and the actual situation with few biotechnologists participating in public engagement. It was decided to do this by organising sessions in biotechnology conferences (see also Chapters 4 and 8). The findings about course topics were taken into account by the course organisers (see Chapter 5). The results of the study were also discussed with the members of the EFB Task Group's Working Group on Social Research (with members including Gaskell, Durant and Wynne) and compared with the results of other surveys and the Eurobarometer findings. Later similar results were also found in the extensive surveys carried out in the UK by Wellcome Trust/MORI study in 2000 and the Royal Society in 2006. Although the outcomes of the small internet survey could not be used for scientific comparison, the intensive discussions in the full Task Group of the results explored the value of the then available survey results and their implications, and provided ideas for further studies into public perception and training needs in that area to the members.

Perhaps most importantly, the participation of the Department in the EFB Task Group was instrumental in the provision of an expert network which provided key expert members for a number of the Department's activities (see Chapter 4, 5 and 6). Because fifteen years after its establishment the Task Group members continue to maintain active contact through joint activities, email and occasional meetings, it is probable that this is its most important role for all members.

The international EFB Task Group on Education & Mobility suffered from a lack of institutional support. Because the funding received through the European Commission's Socrates programme was limited, the Group remained even more dependent on its institutional members than the EFB Task Group on Public Perceptions of Biotechnology to continue any of the activities developed with finance from the European Commission after the funding ended. None of the employers of the members involved took the financial responsibility for carrying forward the proposed biotechnology education and training in Europe. This may have been due in part to the increasing competition for biotechnology students resulting from the reduction in numbers of students interested in science and technology throughout Europe. The members involved in the Task Group were often also involved in marketing for their university's study programmes and could not spare the time. Furthermore, a significant number of initiatives working to collaborate in Europe for more or better students and graduates unfortunately failed because of the limited time that their individual members could devote and/or the lack of their institution's agreement and support for these activities.

Involvement in the European Commission project on the public availability of biotechnology information very much reflected the period during which the deficit model of science communication was being progressively replaced by the dialogue model (1999 to 2002). It is interesting to observe that the EFB Task Group on Public Perceptions of Biotechnology was already long convinced about the value and need for a more open and two-way communication effort. This European Commission project however started from the premise of the deficit model and grew through intensive discussion between the members towards a series of recommendations related to a more dialogue-oriented approach. The TU Delft

Department gained greater knowledge and new contacts especially through the interviews organised with media representatives as part of the project's actions which provided useful contacts for the organisation of later events. It is not known if and how the various Member States involved have responded to the recommendations. Both in The Netherlands and at the European level we have not seen any significant changes. The willingness and availability of the project members to further lobby for the support and recognition of the recommendations therefore remained a key factor to the success of its implementation and hence the further institutionalisation of science communication.

2.5. Concluding remarks

Driven by the wish to address negative perceptions of biotechnology, the TU Delft Department of Biotechnology has used its international scientific networks to institutionalise science communication.

If institutionalisation of a novel task such as public communication of science in a department is seen as an educational process it needs to encompass the domains of Bloom's taxonomy: knowledge, skills and attitudes[17]. The EFB Task Group on Public Perceptions of Biotechnology was used as a means of providing knowledge on all of these through its meetings and publications, its contributions to the training of lecturers and young scientists of the Department and through the Department's increased involvement in activities. This is also reflected in the contribution towards the adaptation of the education modules on "*Biotechnology and Society*" developed for and implemented in the BSc and MSc teaching programmes at TU Delft, the attention given to public relations activities by the Department described in this thesis and the recent establishment of a research group on "Biotechnology and Society" in the Department responsible for education and research in this field.

Membership of this European expert group has been a highly useful strategy in providing a resource for:
- a rapid learning base for public communication in biotechnology;
- a network of experts to be included in educational activities and conferences;
- a network of experts for advice on public communication activities;
- a provider of early and extensive knowledge through its meetings, reports, briefing papers and reference databases;
- standing and reputation for the Department of Biotechnology especially in (inter)national project coordination.

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[17] Bloom created this taxonomy for categorising objectives that commonly occur in educational settings. B.S.Bloom (1984) *Taxonomy of educational objectives*: Pearson Education, New Jersey.

Membership of the EFB Task Group on Education & Mobility was not aimed at providing input for the institutionalisation process of public communication and hence made a limited contribution. It did provide an insight into European training provisions and needs however which were helpful for the Department's Graduate Research School Biotechnological Sciences Delft Leiden (BODL) foundation. The EFB Task Group on Education & Mobility's activities were not followed up and the network has not met after the European Commission funding stopped.

The involvement in a European project to analyse public availability of biotechnology information was useful to gain more knowledge and further contacts, and provided standing to the Department in giving attention to these questions. It also provided insight and agreed recommendations for institutionalisation of science communication. However, these recommendations were directed to the Member States' governments and not their institutions which may well be the reason why they were not taken up.

The experiences in the Task Group on Public Perceptions of Biotechnology as well as within the European project show that a macro-level approach can be extremely useful in testing new methods of communication, exchange of good practices etc, but lack the implementation and hence lack continuity. The responsibility and management of the events on a European level is not a problem as the organisers are accountable to the funding organisation. However, the organisation of public communication events on this macro-level may exclude explicit ownership and is therefore vulnerable for erosion of responsibility, a situation which is often referred to as "the tragedy of the commons"[18]. It is for the institutions themselves to implement the expert knowledge and skills for a sustainable result.

Table 4.1 in Chapter 4 gives an overview of the activities described in this chapter comparing the objectives, target groups, approaches taken, conclusions, constraints and benefits and their relation to the criteria for communication set out in Chapter 1.

[18] "*Tragedy of the Commons*" i.e. everybody owns it so nobody is responsible for it. Garrett Hardin (1968), "*The Tragedy of the Commons*", Science 162, 1243-1248.

Poland, 1991

It is cold, freezing cold, and white. The snow covers everything. We visit the first university that day, arranged for 9.30 in the morning. We are welcomed with vodka, gherkins and wurst. I learned quickly that day that my upbringing to nicely finish what you are offered may give you a severe head ache as in Poland they just politely fill it up again...

CHAPTER 3

Emerging awareness of the importance of public acceptance and public communication in biotechnology (1991-1994)

Based on the experiences with the European Commission-funded FORCE Programme project *"Pilot Models for Continuing Vocational Training in Biotechnology"*.

3.1. Introduction

During the late 1980s to early 1990s the emerging awareness of needs for continuing education and training was supported by the European Commission (EC) by its funding of projects on vocational training accompanied by some projects analysing industrial training needs. Universities were keen to enter this potential market at a time of ever-increasing cuts in research budgets. The project *"Pilot models for Continuing Vocational Training in Biotechnology"* was funded under the EC FORCE Programme of the Task Force Human Resources Education, Training & Youth in 1991. The Institute for Biotechnology Studies Delft Leiden under the auspices of the TU Delft Department of Biotechnology in the person of the author proposed and coordinated the project with a number of participating biotechnology companies and other appropriate organisations, i.e. British Biotechnology Ltd (a pharmaceutical company in the UK); Gist-brocades BV (a fermentation company in The Netherlands, now part of DSM); Unilever Research Laboratory (a multinational food company based in The Netherlands and UK), Zeltia Group (a biotechnology company in Spain) and the British Library Biotechnology Information Service in London.

The aim of the project was to achieve a better understanding of training needs in biotechnology companies in Europe and to contribute to the development of models for continuing vocational training in small, medium-sized and large biotechnology companies in Northern and Southern Europe. Its relevance for this thesis is that during the project the biotechnology industry members indicated the need for training in public perception issues, including public communication. It therefore provides insight into the early institutionalisation of science communication in the biotechnology industry in Europe.

This chapter analyses how the emerging awareness in the biotechnology industry of the importance of skills (training) and behaviour (communication strategies) in science communication for economic reasons contributed to the institutionalisation of science communication in the industry and how this influenced its institutionalisation in academic settings. It will address what training needs were prioritised by the European biotechnology industry, how training for public communication was developed, which elements were chosen to be included in this training and, finally, how the author's observation as coordinator of this

European project influenced the strategy on science communication in the TU Delft Department of Biotechnology.

3.2. Approach and results of EC funded project *"Pilot models for Continuing Vocational Training in Biotechnology"*

The project addressed the following questions:

- Which continuing training schemes already exist in biotechnology companies?
- Which sources of information are available and how can they be used in continuous training in biotechnology?
- What are the priorities for training needs in the biotechnology industry?
- Which employees need to be trained and how can the training be implemented in companies' human resource training activities?

The method used was to address these questions in workshops with presentations and discussions to determine the methodology and focus. Literature analysis and interviews were used to determine the available information sources. Interviews and structured questionnaires aimed to determine the priorities for training needs and the way to best institutionalise the continuing training in the company were followed by in-depth interviews for the design of specific training elements.

Results

In order to determine the methodology to be adopted for the project, an international two-day workshop was organised in 1991 with the partners and invited experts from two European biotechnology companies with an established practice of staff development, Novo Nordisk, a multinational fermentation company in Denmark and Ciba Geigy, a Swiss multinational pharmaceutical company. Presentations were made by experts with knowledge of existing European and Japanese training schemes on current and novel practices of staff training, motivation and career development together with introductions by personnel managers of European biotechnology companies on their human resource policies. The discussions led to a thorough analysis of companies' training needs as intended.

It emerged from the workshop that companies were looking for training in the fields of "*Public Perceptions of Biotechnology*" and "*Relations between Marketing and R&D*". These topics were completely novel for training as so far no such courses were available. The workshop members voiced the need for competence of their staff in dealing with different public perceptions of biotechnology and in addressing the different attitudes of R&D and marketing staff in developing products in biotechnology. Most workshop members already had some negative experiences with NGOs and the media and with the transfer of R&D ideas to marketing. It was recognised that staff needed competence to address these issues and some participant companies already had some experience in providing in-house training for their staff on these problem situations.

As the FORCE project intended to provide new training where it was most needed, it was decided to focus on these novel subjects. It was further decided to clarify the specific needs with respect to the contents and teaching methods for the appropriate implementation of such training courses for company personnel so as to match the needs of the biotechnology industry and thus provide viable training courses that would be popular. This was carried out by detailed written questionnaires to both R&D and personnel department managers accompanied by an internet questionnaire addressed to R&D employees in European biotechnology companies (see Appendix 2). The questionnaires also aimed to confirm the priorities of training topics voiced by the participants of the first workshop and to collect suggestions for the subjects that needed to be included in these courses. The questionnaires confirmed the chosen priorities although the demand for training in public perceptions of biotechnology proved more popular than the demand for courses addressing the interface between management and R&D.

The questionnaires also produced a number of suggestions for the contents of the courses which were analysed and prioritised with the project partners and external experts on an individual basis. These suggestions and the results of a literature study on communication methods and their effectiveness were used to develop a first draft for the training module on '*Public perceptions of biotechnology'*. The course programme was based on an open learning approach and presentations on public perception surveys, legal matters and case studies were followed by group work to make a communication strategy for dealing with public perception issues. It also included hands-on media training. The draft was discussed with managers of British Biotechnology, Unilever, Zeneca Seeds, a UK seed company, Van der Have, a seed company in The Netherlands, and Novo Nordisk. The seed company members advised including the development of an emergency plan in the programme based on their experience with field trial disturbances. Further advice was offered by the group of European experts from the European Federation of Biotechnology Task Group on Public Perceptions of Biotechnology (see also Chapter 2).

The first course entitled "*Workshop Course on Public Perceptions of Biotechnology, Communication and Company Strategy"* was held in October 1993 in London (Osseweijer, 1993) (see for the course programme Appendix 3). The workshop course aimed to train the industrial participants in the development of a communication strategy for a fictitious company. It started with the arguments for the need for science communication based on the social context of the increasing aversion of the public towards science and technology. The 1991 Eurobarometer public opinion survey results were discussed and the importance of public trust in biotechnology was stressed. The differences in public support for medical, agricultural and environmental applications of biotechnology together with the differing social contexts in Europe were taken as determinants for the development of a company's communication strategy. The use and trustworthiness of information sources by the public were evaluated to define the activities and targets of the strategy's activities. As the Eurobarometer survey revealed that industry was not seen as a trustworthy source of information, participation in networks to inform stakeholders on biotechnology applications was considered. The collected knowledge of the EFB Task Group on Public Perceptions of Biotechnology was provided through lectures and skills training by a number of its members experienced in science communication, the Eurobarometer public opinion surveys, industry practices and media relations by role-played presentations and interviews (see also Chapter 2). They emphasised their shared view about the importance of being pro-active and taking the public's concerns seriously. Examples on company experiences in public communication and how this had led to integrated company strategies were given by senior public affairs staff members of two large international biotechnology companies. Participants in groups of four to five applied the overall knowledge provided during the course in practical exercises by designing and presenting a company communication strategy and were challenged by simulated "nasty situations" to which they had to respond.

The participants and lecturers of the workshop course concluded that:

- it is important to define whether there is a real market for the development of each biotechnology product (constraint 1);
- biotechnology products need to have a substantial added value (such a lower price or better quality) to be acceptable to the public (constraint 2);
- target groups to which a company wishes to direct its communication and product information need to be chosen carefully as budgets are limited (strategy 1);
- an open and pro-active approach is necessary to prevent the development of myths about products (attitude 1);
- durable contacts with key figures in society such as politicians, key opinion makers, consumer or patient groups are important because they can provide a company with trust relations with these contacts (strategy 2);
- it is important for a company to be transparent and to take concerns seriously in order to create trustworthiness (attitude 2);
- it is important for a company to prepare an emergency scenario which is ready to be used in challenging situations when they occur (strategy 3 and skills 1).

In order to develop the "*Workshop Course on Innovation in Biotechnology: Management of the interfaces between Research, Development and Marketing"*, the Institute for Biotechnology Studies Delft Leiden organisation needed more expertise. For the public perceptions course it could rely on the expertise within the network provided by its membership in the EFB Task Group but for this subject professional expertise was not available. Therefore it was decided to collaborate with the professional management consultancy provided by Createch. Together with this professional expertise this workshop course was developed in a similar way to the public perception workshop course. The course was organised in December 1993 and targeted to industrial managers (Osseweijer, 1994). It used a similar open learning approach as the other course: expert lecturers presenting case studies were interchanged with exercises on the basis of the participants' own experiences and desired applications. The programme focussed on the way internal communication was organised in a company and how this reflected on the relationship between R&D and Marketing. It stressed that public acceptance issues should be addressed in the management strategy at the very beginning of product development within an R&D group. The lecturers and participants concluded that:

- effective innovation is dependent on the interaction of fundamental research, applied research, experimental development and market research (constraint 1);
- the learning and experimenting experiences of all research staff need to be shared to achieve a quicker understanding of each others practices (attitude 1);
- increased communication between R&D managers and marketing managers helps in the mutual understanding of problems in each other's field and hence in the more efficient production and market introduction of biotechnology products (attitude 2).

Along with the development of the course programmes the FORCE project also aimed to analyse their appropriateness for different European countries. As the development of biotechnology was more advanced in Northern European than in Southern European countries at that time, Spain was chosen as an example to assess the appropriateness of the course programmes for Southern Europe. The project partners in Spain warned however that the culture and infrastructural organisation was quite different between Barcelona with a reasonably well developed biotechnology industry and its capital, Madrid. Therefore the Spanish partners opted for the organisation of two separate workshops. The first workshop was held in January 1993 in Madrid attended by R&D managers and technology transfer officers from a variety of biotechnology companies from throughout Spain. The developed training models were presented together with presentations by Spanish industrial managers on the specific needs of SMEs (Small and Medium-Sized companies) and larger companies in the Spanish context. These presentations on the status of Spanish biotechnology were helpful in creating a reference and concluded that the difficulties in the development of biotechnology in Spain mainly related to a lack of university collaboration in company research and to financial problems for new start-up companies.

The general conclusions and recommendations of the Madrid workshop were:

1. There is a clear heterogeneity between the different European countries in their publics' perceptions and in the focus of their biotechnology research and commercialisation. The problem of public perception of biotechnology can be considered a novelty in Spain in 1993 as Spanish companies due to their situation, size and future prospects have not yet reached the same level of preoccupation with the issue as companies in other European countries as most companies in Spain are dealing with more important problems such as finances. When a Spanish company shows interest in strategies to deal with public perception issues, it is always a multinational firm.

2. Unfortunately there is as yet no efficient connection between the world of research and the commercial field in biotechnology in Spain.
3. Any European action must keep in mind that the Spanish situation is not unique, and that it is therefore necessary to carry out activities specifically designed to help bring such countries closer to that of the more advanced Northern European countries. That includes providing advice from their experiences so as to avoid unwelcome situations.

In accordance with these conclusions the participants in the Madrid workshop therefore did not give priority to the need for training on public perception issues.

The second Spanish workshop was organised a year later in January 1994 in Barcelona which for historical reasons had a more active biotechnology industry at that time than elsewhere in Spain with greater university involvement. The local organisers wished to involve a broader group of stakeholders, i.e. politicians, members of the Spanish Biotechnology Industry Association, journalists, university teachers, biotechnology company managers and technology and training transfer managers from Catalonia and Spain, Greece, Germany, Belgium, The Netherlands, Finland and the United Kingdom. The reason was to show the Catalonian development to these participants and to emphasise to local institutions that biotechnology was an important field of development. Contrary to the Madrid workshop a year earlier, the participants of this second Spanish workshop did endorse the priorities for the training models on "*Public Perceptions of Biotechnology"* and on "*Relations between Marketing and R&D"* and strongly supported the thematic choice of these training models and their detailed programmes.

3.3. Concluding remarks

During this time in the early years of the development of biotechnology, the number of biotechnology companies was growing rapidly in the USA and in the UK, with small numbers in most of the other Northern European countries and few or none in Southern Europe and in Germany. In Southern Europe the development of the technology lagged behind added to by financial constraints for start-up companies as was reflected in the results of the Spanish workshops in this project. Meanwhile strong public and political resistance to biotechnology was experienced in Germany influenced by the "green movement". Ernst & Young documented the growth of small and medium-sized biotechnology companies in Europe with their annual series of reports on biotechnology commencing in 1995 (Ernst & Young, 1995-2006).

The European Commission emphasised the development of continuing training to establish a strong knowledge infrastructure in Europe. The FORCE project aimed to determine and to define the needs of biotechnology companies for continuing training of their staff. In spite of competing priorities such as company financing, regulatory affairs and intellectual property protection, public perception was selected as the priority for training. Part of the reason was also because no such training was available at that time. The development of the detailed course content was carried out in close consultation with the large and experienced biotechnology company personnel and R&D managers. These senior managers had already developed the view that it was important to deal with the public perception issues for the development of their businesses.

This resulted in a course programme which treated public perception issues as an integral part of the company management approach. The programme consequently included coverage of public opinion surveys, strategies and training for media relations, preparation of scenarios on handling of emergency situations and linking planning for product launches with communication activities. When this draft programme was circulated to a number of European biotechnology companies for their comments and suggestions it was well received.

The participants' evaluations of the courses were very positive but it was not possible to assess the impact of the courses on their companies' actual practices in dealing with public perception issues. The project showed though that companies recognised that public perception issues were important topics to address for biotechnology business development in 1993. The companies' endorsement of the proposed course programmes also showed that the institutionalisation of public communication was taken up by biotechnology companies by that time. This is also supported by the increase in reporting of social responsibilities or key indicators in the companies' annual reports. The recommendations for the course programme also demonstrated the desired strategy for institutionalisation with an embedding of such approaches within the senior management accompanied by close interaction through internal communication between all departments.

The evaluation of identified constraints, necessary attitudes and skills for both courses (see Table 3.3.1) shows the early institutionalisation of public communication in biotechnology industry. These conclusions were used in the lectures on public perception issues to make biotechnologists aware of the need to address public communication (see Chapter 4).

- Course	- Constraint	- Attitude	- Strategy	- Skills
- Public perceptions of biotechnology	- Define real market before development of product - Biotechnology product needs added value	- Have open and active approach to prevent myths - Be transparent, take concerns seriously to create trust	- Carefully chose target group for communication (limited budget) - Maintain network for trust relations - Prepare for challenging situations	- Make emergency scenario
- Management of interface R&D and Marketing	- Effective innovation depends on interaction R&D and market research	-	- Share learning experiences to establish understanding of each others practices - Increase communication between R&D and marketing to better introduce new products	-

Table 3.3.1: Identified constraints, attitudes and skills for public acceptance of biotechnology and for improved innovation in biotechnology, suggested by course lecturers and participants in 1993. Delft University of Technology

The coordinator of the project, the TU Delft University Department of Biotechnology, achieved much knowledge and experience through this project about the way in which biotechnology companies wished to address public perception issues through pro-active communication strategies. This knowledge was incorporated in its Master curriculum and Postgraduate training programmes and used to make colleagues aware of the need to engage in public communication. Moreover, the course programme on public perception issues was further developed and later integrated into a course for its own academic members. The development of this course is further described in Chapter 5.

Brussels, 1998

It is cold and windy in Brussels. Ana (Bravo-Angel) and I are now quietly cursing the whole idea as we cross uphill the open square of the Palais des Congrès, both carrying a fully decorated Christmas tree. At 11 at night, in our best dresses. David (Bennett) laughs behind us, picking up the odd tinsel ball we lose. The plenary lecture hall will look beautifully in style though on the 15th of December, our second Task Group conference day…

CHAPTER 4

Raising scientists' awareness of the importance of public perception for the development of biotechnology (1994-2002)

4.1. Introduction

In the previous chapters it was argued that the implementation of biotechnology innovations would benefit from the involvement of biotechnology scientists in the public debate. The conclusions from activities described in the previous chapters indicated however that scientists were not very aware of public opinion issues. The majority lacked knowledge about the content of the issues and of the topics, the skills to address them and, most importantly, a sense of urgency about the public perception situation about biotechnology in Europe and motivation to actively engage in public communication activities. This chapter describes an approach aimed at making scientists aware of public opinions about biotechnology, their importance to biotechnology development and the possible roles scientists can play in communication activities. Sessions or lectures on public perception issues were included in a number of scientific conferences and evaluated. This chapter addresses the questions *"Can biotechnology scientists be informed about public perception issues through dedicated sessions in scientific conferences?"*; *"Can biotechnology scientists be encouraged to be active in public communication through dedicated sessions in scientific conferences?"* and *"What are the strong and weak aspects of these sessions in relation to the objective of this approach?"*. Chapter 4.2 describes a number of dedicated conference sessions organised during the period 1998 to 2002, the problems encountered and the results achieved. Chapter 4.3 describes an extended approach where a number of coordinated activities formed an integral part of the conference while Chapter 4.4 analyses the results and draws conclusions.

4.2. Activities stimulating inclusions of public perception issues in scientific congress programmes, 1998-2002

In 1996 the European Federation of Biotechnology (EFB) Section on Biochemical Engineering Science (ESBES) started to organise three-and-a-half day, bi-annual, international symposia targeted for two hundred and fifty to three hundred and fifty scientists and industrialists in the broad field of biochemical engineering. The first Symposium was held in Dublin in September 1996. At that time scientific conferences in the biotechnology field did not address issues of public perception or ethics in spite of the fact that the Federation had established a Task Group on Public Perceptions of Biotechnology dealing with these issues earlier in 1991. However, in 1998, on the suggestion of the then vice-chairman of the EFB Task Group, Professor Richard Braun, the organisers of the second ESBES

Symposium in Porto, Portugal agreed to include an opening plenary lecture by him with the title of "*Biotechnology for the improvement of the quality of life: yesterday, today and tomorrow*". This lecture emphasised the importance of public opinion in policy making and the need for scientists to involve themselves in the public debate. During the third and last day of the programme, a plenary lecture by Professor Wolfgang Schuch of Zeneca Agrochemicals summarised the industry's views on the use of biotechnology for food production, emphasising the difficulties raised by public fear for transgenic food products. Both contributions were also published in the Symposium Proceedings (Feyo de Azevedo et al., 1998). The session raised a great deal of discussion, which was reported in the EFB Newsletter (see Figure 4.2.1) which was targeted to all c.4,500 members of the EFB.

During that week of a "bright" September, 235 researchers from 31 countries of Europe, America and Asia converged on Porto. In the secluded environment of Seminário de Vilar Conference Centre, overlooking the River Douro, there has been the time and mood for discussion and relaxation, for exchange of views, for making friends and for strengthening friendships.

The opening session on the evening of Wednesday the 16th has been available to a wider public (invited personalities from Industry, from the Administration and from the University). Professor Richard Braun delivered a most interesting inaugural lecture, addressing the contribution biotechnology can make to the quality of life: *Biotechnology for the Improvement of the Quality of Life - Yesterday, Today, Tomorrow*.

Figure 4.2.1: Excerpt from the ESBES-2 article published in the EFB Newsletter, 1998

Both the positive evaluation of these contributions in the second ESBES Symposium and the attention public perception issues had received in the general and scientific press, led to the decision of the scientific committee of the third ESBES Symposium to increase the emphasis on public communication by planning a dedicated plenary session in ESBES-3 held in Denmark in 2000. This session dealt with the importance of ethics and risk perception in two lectures published in the Symposium Proceedings which aimed to increase the participants' level of understanding of these underlying issues in public opinion about biotechnology. The lectures were delivered by Professor Peter Sandøe of the Royal Veterinary and Agricultural University in Denmark (on `*Ethical Perspectives on Biotechnology*`), and by Lise Kingo, then Director of Environmental Issues of the Danish-based multinational biotechnology-using company, Novo Nordisk A/S. A total of three hundred and thirty-two participants from thirty-two countries, of which sixty-three were PhD students, attended the Symposium. The Symposium evaluation showed a high level of interest in the topics presented and discussed.

The fourth ESBES Symposium was organised by the Department of Biotechnology in Delft in The Netherlands in 2002. The Symposium attracted two hundred and eighty participants from over thirty countries. Due to the success of the plenary session in ESBES-3 and the continued press coverage on public opinions of biotechnology, a full plenary session was again included in the programme. The session addressed bioethics delivered by Professor Hans Tramper (Chairman, Bioprocess Technology, Wageningen University) and "*Biotechnology in European Society - perceptions, consequences and remedies*" presented by Mark Cantley, Special Advisor to the European Commission in the then "Quality of Life" Programme. Again both contributions were published in the Symposium Proceedings (Van der Lans et al., 2002).

By now in 2002 it was assumed by the ESBES-4 Symposium organisers that the lack of knowledge about public perception issues in ethical and legal aspects was not the only constraint for scientists to be active in public communication. The press had extensively reported on the issues and the communication activities in which the Department of Biotechnology was involved had also concluded that the incentive for being active was now perhaps a more important constraint. Therefore the Department developed an activity during the conference to encourage young people to be involved in public communication and train their skills in writing for a lay audience. The idea behind it was that if young scientists knew how to deal with this they would continue to do so later in their careers. This was done by the publication of a special ESBES-4 newspaper which was written by, and distributed to, participants at the end of the Symposium. Forty young scientists who had received a grant to attend the symposium were asked to write a popular article on the most important research results presented, the most hilarious situations, or the most attention-catching experience in the Symposium. The TU Delft Faculty communication officer provided assistance in writing these popular articles. In order to increase the attention of all participants to this activity the best entries were rewarded with a small prize in a ceremony during a plenary reception. A total of two hundred and fifty newspapers were distributed and very well received as shown by the evaluation of the Symposium. The newspaper reported on:

- the gift to all participants of a Delft blue tile depicting Anthonie van Leeuwenhoek, stirring a fermentor;
- the honorary fellowship that was awarded to Professor Karel Luyben by the (then) President of the EFB;
- a question of a PhD student asked in a session;
- the presentation of Mark Cantley on risk perception;
- the difficulties of being a young scientist;
- the strong competition and winners of the Malcolm Lilly award;
- the broad international participation;
- the public interaction with life sciences.

The fifth ESBES Symposium was organised in 2004 in Stuttgart, Germany. The Scientific Committee did not include a session or lecture on public perception issues in the programme as none of the scientists in the Committee considered it necessary to raise awareness for public perception issues.

Members of the EFB Task Group actively approached the organisers of a number of other conferences in the period 1998-2001 with the aim of including similar presentations on biotechnology public perception and ethics issues. In most cases the suggestions were readily taken up. Task Group members were also directly approached by conference organisers to include a presentation or full session in their scientific conference. Many contributions were also published in conference proceedings or journals dedicated to the conferences.

In the additional presentations by Task Group members at international conferences further criteria for public communication were provided. The presentation "*The Biotech Society"* in the Netherlands Biotechnology Society annual meeting in April 1999 argued that trust was an important phenomenon and it included suggestions on how scientists could build trust with the public. The presentation "*De maakbare mens*" ("Designer human beings") in December 1999 to staff and students of Delft University of Technology and Delft citizens discussed the influence of emotions and happiness in public communication. This was triggered by the fact that the debate evening discussed our future society at the time of the millennium and the presenters were asked what they felt should or should not happen in the future. The contribution on "*Ethische aspecten van de biotechnologie"* (*"Ethical aspects of biotechnology"*) to the Congress of the Netherlands Pharmaceutical Society in 1999 paid particular attention to the responsibility of pharmacists as first providers of information on health care products to the public (Osseweijer, 2001).

As the Task Group consisted of about fifty members and an average of one to three or more presentations a year were made by each member, this amounted to a considerable number of some many hundreds of presentations or sessions dedicated to increasing the awareness of scientists on the importance of science communication and informing them about the issues over a period of four years.

4.3. EC International programme "*From Gene to Product in Yeast: a quantitative approach*", 1996-1998

In 1996 the Delft University of Technology received a European Commission grant of €1.7 M to coordinate a research project entitled *"From gene to product in yeast: a quantitative approach"* (Contract No. 95.0132) under the Framework Programme IV "Cell Factory" Programme [19]. The project involved ten European research groups, including two research groups from two large multinational food-producing companies, Unilever and Nestlé. The Department of Biotechnology was responsible for the administrative coordination and contract management. At the end of the project period in December 1998 the project participants organised a scientific meeting for European researchers in the yeast and related "cell factories" field to present and discuss the findings of the European Commission-funded

[19] Micro-organisms such as yeast, lactic acid bacteria, etc which are used to produce valuable materials such as alcohol, enzymes and proteins are generally referred to as 'cell factories'

research projects in this field. The industrial project participants were eager especially to address the problems of public perception as a heated debate on labelling of food products was taking place at the time. In collaboration with EFB Task Group it was decided to organise a panel discussion on public policy and perception issues for Members of the European Parliament with the objective of discussing the positive contribution of biotechnology to Europe, a public biotechnology food event aiming to show that biotechnology could produce added value food products and a press facility with the objective of raising press coverage on new developments in this field of biotechnology. The Task Group had recognised at that time that the European Parliamentarians were not well informed about the beneficial contributions of biotechnology while they received a great deal of lobbying about the potential risks of biotechnology from environmentalist non-governmental organisations (NGOs) aimed to stop the biotechnology developments and to ban the further introduction of products and processes. The Task Group argued that this could be balanced by showing Parliamentarians the benefits of biotechnology, preferably by senior managers, followed by a discussion on the issues involving all relevant stakeholders. The argument for organising a biotechnology food event was that if people were able to see and taste the food and know that a number of products (such as smoked sausage - "rookworst") already contained biotechnology-produced ingredients, it would perhaps alleviate the opposition to biotechnology products in their minds. The objective to raise press coverage followed from the recognition that it was important to communicate benefits of biotechnology and that a large audience could be reached through the national and international press. An additional grant request was made for the costs of these activities to the European Commission and was awarded with c. €35,000.

Approach

The suggested programme for the panel discussion for politicians and European parliamentarians was first discussed with a number of EFB Task Group experts. The resulting outline for the programme was then presented and discussed with the responsible European Commission officer, Dr Alfredo Aguilar. He agreed with the proposal and contacted the European Commission officer whom we wished to invite for the panel presentations and discussions. Together with the EFB Task Group experts on political issues, the European parliament and networking (Professor Richard Braun, Dr Albert Saint Remy, Dr David Bennett and Professor Tomasz Twardowski) the experts for the panel discussion were selected and invited. The final arrangements were presented to the Organising Committee of the Symposium and approved.

The organisation of the biotechnology food and drink reception was prepared in close collaboration with the project consortium partner, Professor Theo Verrips of Unilever, and involved a number of Unilever staff. In addition to Unilever products, biotechnology-based drinks (wine, beer, spirits) and GM-products freely available on the European market together with Asian fermented products were presented for tasting. Each food product was presented in a market stall with cards explaining the origin and relation to biotechnology of the products offered. The final decisions on the choice of food and drink products presented were made by the Unilever staff for legal responsibility reasons. The session especially invited the media and European Parliamentarians.

The organisation of the media relations was first discussed with the EFB Task Group Working Group on Media and in particular with its co-convenor, Dr Bernard Dixon. It was well-recognised that simply sending a press release on the event to journalists would attract few. Therefore a different approach was suggested which was successfully used in previous scientific conferences. Each conference abstract would be analysed for topics likely to be interesting to the press such as research on the production of collagen by micro-organisms and the results of testing of GM yeast by a French research group to produce a better wine, and rewritten in the form of a press release. Journalists from throughout Europe would be directly approached by fax and telephone and invited to the Symposium free of charge. They were also offered extensive press facilities such as a press room with fax and internet connections together with an interview room. The organisation was discussed and carried out in close collaboration with the head press officer of Unilever.

Results

The meeting was held at the premises of Unilever Research Laboratory, Vlaardingen on 29 November to 2 December 1998. Unilever offered their conference facilities and lunches free of charge and the setting was expected to attract key researchers from throughout the world. A total of two hundred and eighty-one participants was welcomed representing twenty-nine countries from Europe together with the United States, Cuba, Australia, South Africa, South Korea and Japan. About a quarter of the participants were from industry (Osseweijer and Van Dijken, 1998).

In collaboration with the responsible scientific officer of the European Commission Research Directorate-General, the Symposium was organised with the objective of providing a meeting within the European Commission Framework IV Cell Factories Programme. It therefore especially invited those who were involved in similar research projects. Additionally participants were invited to discuss future research proposals for the European Commission's Framework Programme V. Achievements in European Commission-supported projects were presented and discussed while the latest developments in using "*Yeast as a Cell Factory*" and related important areas such as the use of genomics were also presented and discussed. The scientific programme consisted of twenty-three oral presentations, two round table discussions and one hundred and twenty poster presentations.

The special session for the members of the European Parliament, Industrial Platforms[20] and the press consisted of two industry Board members of large European food companies presenting what they felt were important achievements of European Commission-supported research projects and major concerns in consumer acceptance of biotechnology. Dr Etienne

[20] Industrial Platforms were established by the European Commission consisting of industrial researchers who would advise the Commission on important developments

Magnien of the European Commission's Research Directorate-General outlined the Commission's plans for the Fifth Framework Programme biotechnology research programme and related these to evaluations of the Fourth Framework Programme achievements. The session emphasised the importance of European Commission-supported research in Europe and highlighted the issues in consumer attitudes towards biotechnology applications. At the subsequent informal reception with the biotechnology food and drink products all participants tasted the products presented and no refusals to eat or drink biotechnology produced products or with GM-ingredients were registered. Some twenty politicians and industrial platform members attended and a number of positive reactions were received (see Figures 4.3.1 and 4.3.2).

Monday 30 November 1998

Life sciences and society; the role of Cell Factories
Chairman: Prof Raymond Spier, Surrey University
Co-chairman: Drs P. Osseweijer, Delft University of Technology, NL

17.00	**Framework IV achievements and Framework V opportunities: the importance of life sciences for Europe** Dr E. Magnien, Head Biotechnology Unit DG XII
17.30	**Industrial biotechnology in Europe: Options and obstacles** Dr E. Veltkamp, Senior Vice-President Unilever Foods
18.00	**Impact of gene technology on the food industry** Drs D. Toet, Assistant Vice-President, Biotechnology coordination, Nestlé
18.30	**Panel statements** Dr K. Ammann (Botanical Garden Bern),Ir C. Smink (SWOKA); Dr H. Kuiper (Rikilt, DLO), Mr M. Cantley (OECD), Ir P. Schenkelaars (SBC Schenkelaars Biotechnology Consultancy, Leidschendam),
18.45	*Discussion followed by reception with biotech food and drinks*

Figure 4.3.1: Extract from Symposium Programme "*Yeast as a cell factory*" , Unilever Vlaardingen, 1998

Dr Bernard Dixon provided the necessary knowledge, expertise and press contacts for the activity to attract the media. Together with the assistance of Stéphane Hogan of the European Commission's Research Directorate-General and the Unilever Press Office, they contacted over one hundred and fifty European journalists to inform them about the meeting. Over fifteen press releases were prepared and sent based on the abstracts for oral and poster presentations of the Symposium. Special information was given on the session for politicians and European Parliamentarians. In total fifteen journalists were welcomed of which four were from daily newspapers in The Netherlands and one from the ANP ("Algemene Nederlandse Persdienst", the general Dutch press service). Several interviews were carried out and articles with photographs appeared in the scientific sections of daily national newspapers. A reporter from the European Commission journal "*Research Technology and Development"* carried out several interviews and attended the full meeting as did a journalist from the scientific journal "*Helix*". A reporter from the Swiss radio station "*Suisse*" held a broadcasted interview. In addition to journalists attending the event, other journalists used the prepared press releases (Reuters, ANP, *The Times*, etc) for coverage of which some telephoned for further information. Over fifteen newspaper articles covered the results and potential impact of yeast research reaching a wide audience in Europe. Scientists involved in the interviews were enthusiastic about this approach and their introduction to the press which for some proved to be their first encounter with the media.

Figure 4.3.2: An overview of biotech food and drink sampling during the Symposium "*Yeast as a cell factory*" , Unilever Vlaardingen, 1998

The Symposium participants indicated in the evaluation questionnaire that they very much appreciated the meeting which was often stated as an additional comment at the end of the questionnaire. 92% of the respondents described the programme as "*good to excellent*". Based on this positive evaluation, the European Commission project officer decided to include two presentations on this event during the prestigious EC Framework IV meeting *´Grand Finale, Cell Factory Area within the Biotechnology 4th Framework Programme"*, held in Graz in Austria in October 1999. One presentation provided an overview of the scientific results of this project while the other was coupled to a panel discussion on public perception issues to show other European project coordinators an example of public communication activities within a European project (Osseweijer, 1999 number 75 and 76).

4.4. Concluding remarks

The objective of including sessions on biotechnology ethics and public perceptions in conferences was to provide scientists with information on public opinions of biotechnology and to encourage scientists to become involved in public communication activities. This was done by presenting lectures emphasising the importance of public acceptance for biotechnology development and by illustrating the role of scientists in achieving it. When possible, discussions were held to exchange views with the audience. The Symposium evaluations showed that the sessions were well appreciated. This resulted in the continued inclusion of such sessions in succeeding ESBES Symposia and a series of invitations for EFB Task Group members for presentations on these topics in many other scientific conferences. It was noticeable that during the years when more press attention was being given to negative aspects of biotechnology, conference organisers were more keen to include this type of sessions in their programmes.

During the ESBES Symposium in 1998 the sessions addressed the importance of scientists informing people about the scientific principles behind biotechnology and on the possible impact of its applications. The 2000 Symposium addressed understanding and responding to public interests and concern with lectures on ethics and risk perception. These presentations also provided examples of communication activities. The Symposium in 2002 raised bioethical issues as well as the political consequences of the public opinion, including how this led to stringent regulations in Europe. The importance of stimulating public interest was also addressed in 2002 together with the importance of skills, when young researchers were asked to write newspaper articles of interest for the general public and their colleagues.

During these years there was a general, progressively increasing, demand for inclusion of presentations, sessions and panel discussions on public perception issues in biotechnology-related scientific conferences. The driver for this development was the increasing public controversy surrounding biotechnology issues and the increasing awareness of scientists that they needed to respond to it. By now the Eurobarometer public opinion survey results were well known to a large number of scientists. The activities organised in Europe had also concluded that information provision in a one-way setting (the so-called "deficit model") was not enough to increase public acceptance and the contextual model for science communication became more accepted. Scientists were now alerted but in general did not know what to do nor how to do it.

During the final Symposium of the European Commission-funded international yeast research project described in Chapter 4.3 additional activities were organised to demonstrate to the three hundred participating scientists how they could reach the media and politicians, and thereby contribute to the public debate. The results showed that many scientists had never been in contact with the press before. The objective of illustrating scientists' involvement in public communication activities was well achieved.

The public communication sessions during the 1998 Symposium addressed the explanation of science, the potential impact in benefits and costs, and the response to ethical, social, safety and legal issues in the forum discussions with experts in these areas. The session for politicians also introduced a dedicated activity for an especially important target group. The buffet with biotechnology foods and drinks showed trust in the products. However, the approach in the presentation of the buffet was on rational explanation of the biotechnology used for the food and drink products. The extended media relations and press facilities organised with the Symposium were successful in reaching the public through media coverage and showed scientists an example of how to reach the press. The coverage predominantly focussed on the scientific content and its benefits. Notably the media did not pick up on the Forum discussion which dealt with ethical, social, safety and legal issues.

Another indication of the impact in raising scientists' awareness of the public communication activities in the Symposium was the request to give a presentation and discussion on public perception issues in the final European Commission Framework IV meeting *′Grand Finale, Cell Factory Area within the Biotechnology 4th Framework Programme"* in Graz in Austria in October 1999, which was attended by the leading research coordinators of international research projects.

The activities provided the Department with the opportunity to try out novel ideas to include in scientific conference programmes and evaluate the effects using the expertise from the Task Group (see Chapter 2). Although the reactions were positive the input required is substantial in time and finance. It can be concluded that the many presentations in scientific programmes resulted in an increased awareness, or confirmation of the awareness, both within the scientific community as well as within the offices of the European Commission scientific officers. The activities related to press coverage and article writing proved helpful for those involved to increase their skills, or at least provide an example of the skills.

The communication strategy of the TU Delft Department of Biotechnology during those years was more related to the contribution it could give to make others aware of the urgency to be involved in public communication. It argued that if more biotechnologists would actively engage in science communication it would improve public opinion and perhaps increase funding for research and attract more students. The institutionalisation of science communication needs broad support from within the scientific community but to expect a change in behaviour as a result of conference presentations underestimates the hurdle scientists have to take to actually be involved in science communication. The constraints include the allowance of time from their seniors or supervisors, rewards for their activities, time and finance for skill training, time and finance for the resulting science communication involvement and finally, but perhaps most importantly, the approval, encouragement and example of their senior colleagues and peers.

Conclusions Part I: Knowledge: Raising awareness

Around 1990 it became clear that public perceptions of biotechnology in Europe were not altogether positive. Within the framework of their scientific organisation some alarmed scientists started an initiative to organise public communication and engagement activities aiming to turn the negative perceptions based on their belief in the science and what was within their control. The approach of collecting a group of stakeholders and discussing the possibilities for addressing public attitudes proved successful as shown by the European Federation Task Group on Public Perceptions of Biotechnology. The Group brought together knowledge of social studies and the interpretation of public opinion surveys and media coverage and experience from industrial approaches to deal with public perception issues together with opinions from non-governmental organisations and knowledge about scientific developments. This was complemented by expertise on policy-making and lobbying. The exchange of tacit knowledge regarding positive and negative experiences provided a rapid iterative learning process which was shared at conferences, meetings and in joint publications. It emerged however that a short period of effort in addressing public perception would not achieve a lasting effect on public opinions and the major difficulty was to achieve a sustainable implementation of public interaction.

During the first period of over five years much effort was put in raising the awareness of scientist colleagues throughout Europe. Although the lectures were well received, they did not trigger a great deal of activity in public communication by academic scientists. This explains why further, more interactive activities at conferences were tried to increase the uptake and desired change in attitude by scientists. The process was much more rapidly picked up in industry where the sense of urgency to address negative public opinions on biotechnology was felt to be much more pressing. It was the industry that first recognised the need for training of their R&D staff to deal with public communication.

In comparison with the EFB Task Group on Public Perceptions of Biotechnology, the consortium that carried out a European study to investigate public education as a determinant of opinion was less successful. The expertise of the participants was more dispersed as was shown by their much later recognition and agreement about the constraints of the deficit model of science communication and hence on the premise of the study.

Table 4.1 gives a summary of the conclusions on constraints and positive results of the activities described in Chapter 2, 3 and 4.

Year	Event/ Instrument	Target group	Objective	Approach	Conclusions	Constraints (-) Benefits (+)	Criteria addressed
1991-2006	EFB Task Group (I)	n.a.	Change negative public perceptions	network + events	Provided experience; knowledge, skills and rapid learning process for public engagement	- Implementation is left to individual members - Limited funds for activities + Network of expertise + Proof of principle for novel activities + Access to variety of disciplines, professions and opinion leaders (transdisciplinarity)	Many, progressively over years Most important: development of dialogue model for public engagement; development of training and development of awareness in biotechnology scientists community
1993-1994	EC-FORCE project	Biotechnology Industry	Develop continuous education	Questionnaire + workshops Delft; Madrid and Barcelona	Industry asked training on public perceptions Less developed biotechnology industry context: no need for training in public perceptions	+ Elements for training public perception/ communication well analysed	**Knowledge** public opinion surveys; benefits biotechnology products **exercises** on media relations, study of cases; **skill training** industry communication plan
1997	Task Group questionnaire	Biotechnologists	Analyse knowledge needs and attitudes	Web-questionnaire	*Knowledge* requested on risk; argumentation stakeholders; methods of communication; *Involvement in public communication*: all stakeholders *Responsible for legislation*: scientists	- Too little response to web-based questionnaire + Indication for training elements for later courses	**Knowledge** on risks/legislation; **skills** on communication
1998	ESBES-2	Biotechnologists	Make scientists aware of role of public communication	Lectures on public perceptions	Scientists were interested	+ Commitment building	**Knowledge** public opinion surveys: explain science
1998	Yeast conference	Biotechnologists Politicians; Media	Make scientists aware of the role of public communication Make politicians aware of biotechnology benefits	Media relations Show examples of press relations; Presentation biotechnology food Panel discussion stakeholders	Press covered benefits Scientists ate GM products Panel discussed issues	- Costly and time consuming + Awareness well stimulated - Difficult to involve European Parliamentarians + Press experience for > 10 scientists - Panel discussion too polarised	**Impact** biotechnology **Building trust**, target politicians, **address ELSA** [21] issues

[21] ELSA: ethical, legal and social aspects

Year	Event/ Instrument	Target group	Objective	Approach	Conclusions	Constraints (-) Benefits (+)	Criteria addressed
1999-2006	Lectures and sessions at international conferences	Biotechnologists	Make scientists aware of role of public communication	Lectures in scientific conferences	Scientists in different fields were in general very interested	+ Many requests = motivation for awareness and possible action + More conferences now include sessions on public perceptions etc - Follow-up unknown	**Knowledge** about **building trust**; influence of **emotions**; **ELSA** issues
2000	ESBES-3	Biotechnologists	Make scientists aware of role of public communication	Session on ethics and company approaches to public communication	Very well appreciated	- dependent on organisers	**Knowledge** about **ELSA** issues
2002	ESBES-4	Biotechnologists	Make scientists aware of role of public communication	Session on ethics and regulations Writing for lay people	Very well appreciated	+ skills introduced	**Knowledge** about **ELSA** issues; **skills** on how to **interest** public
1999-2002	EC project-public education	Politicians	Show relation between public information and public opinion	Recommendations on public information	No relation found; Recommendation: increase knowledge of science + ELSA issues; organise public activities and media relations; give credits for scientists in public communication	- recommendations not implemented + recognition of rewards + recognition of dialogue model	**Knowledge** about science; knowledge on ELSA issues; **skills** for public+media relations; **attitude**: institutionalise

Table 4.1: Analysis of activities, objectives, conclusions, constraints and benefits in relation to criteria for communication which were addressed in the activities related to making scientists aware of the importance of public communication. Delft University of Technology.

Part II: Skills: Development of training

Dublin, 2002

Due to Dublin airport efficiency I arrived one minute before my allotted time slot. "Yes, off course chairman, I am ready to go straight away..." Never go unprepared. Know your audience. How often had I heard Peter (Evans) and Bernard (Dixon) emphasise this? So, why did I end up in Dublin to tell my exciting, stimulating story on how to raise public awareness for biotechnology in front of an audience of concerned mothers of Sellafield, Europarliamentarians and scientists? The discussion was good though and I learned a lot.

CHAPTER 5

Development of advanced courses on public perceptions and bioethics of biotechnology (1993-2006)

5.1. Introduction

This chapter addresses the questions *"Can we improve skills for public communication by training?"*, *"Which elements need to be included in training on public communication?"*, *"Which problems did we encounter in developing courses on public communication and what can we learn from doing so?"* and, finally, *"Can we encourage biotechnology scientists and engineers to increase their involvement in science communication by providing them with courses to improve their skills?"*.

It builds on the results and conclusions of the European Commission-funded FORCE programme identifying industrial training needs described in Chapter 3 together with the input provided by the European Federation of Biotechnology (EFB) Task Group on Public Perceptions of Biotechnology described in Chapter 2. After the finalisation of the FORCE project in 1994, the Biotechnology Studies Delft Leiden (BSDL) foundation of the Graduate Research School Biotechnological Sciences Delft Leiden (BODL) in the TU Delft Department of Biotechnology took the initiative to further develop and organise courses on public perceptions of biotechnology in collaboration with the Task Group on Public Perceptions of Biotechnology of the European Federation of Biotechnology. BODL had organised a series of annually repeated advanced courses for its PhD students and for external (international) PhD students and industrial scientists for many years. All courses have been one to two weeks in duration and have included both lectures and hands-on laboratory experimentation. The planned course on public communication would complement the seven existing courses and would provide knowledge and skills for BSDL students. The initial three-day course was organised twice for industrial participants after which it was adapted for PhD students in The Netherlands. In 1997 the course was extended to ten days to include greater emphasis on bioethics, law and regulations, and skill training. The programme was further developed in five more courses held in 1999, 2001, 2002, 2004 and 2006.

Sections 5.2 and 5.3 describe the methodology used to define the course content and presents the results of the three- and ten-day courses respectively. Section 5.4 analyses the problems encountered and provides overall conclusions. (Examples of the three different types of course programmes and evaluation forms are included as Appendix 3).

5.2. Development of a course on public perceptions of biotechnology

5.2.1. Workshop courses on public perceptions of biotechnology directed to industrial participants in 1993 and 1995

First Workshop Course on Public Perceptions of Biotechnology Communication and Company Strategy, London, 1993

The first course was developed as a result of the training needs indicated by biotechnology companies described in Chapter 3. The three-day programme featured media training, public opinion surveys based on the EC Eurobarometer[22] studies and the preparation of a strategic communication plan. The course was primarily designed for industrial managers who needed to implement communication strategies within their biotechnology companies to deal with public concerns. It was held in London in 1993 at the premises of the UK BioIndustry Association (BIA) and the Ciba Geigy[23] Foundation and both organisations helped in advertising the course to their members.

Methodology used to design the course programme (see also Chapter 3)

The objective of the course was to provide training for industry managers aiming to improve business development in biotechnology companies by acknowledging public opinion for biotechnology in an early stage of R&D development. In order to decide on the course topics to be addressed, a detailed questionnaire survey of R&D industry managers was carried out. On the basis of its findings a draft programme was designed and discussed in interviews with a number of public affairs and/or regulatory affairs managers of biotechnology companies. One of the important conclusions from the interviews was that the preparation of a company strategic communication plan, including an "emergency plan" on how to deal with "nasty situations" should be emphasised. These could be, for example, animal rights activists releasing laboratory animals, activists destroying GM-crop trials, or negative or false publications by NGOs. The appropriate didactic methodology for each of the topics was considered and discussed with educational experts. It was recognised that course participants already possessed experiential knowledge from their own company's background that could contribute to the course content. Therefore an interactive learning approach was chosen in a workshop setting to enable mutual learning through debate and problem-oriented exercises.

For the skill training of developing a communication and company strategic plan a "problem oriented approach" was chosen. The draft programme was circulated to the EFB Task Group on Public Perceptions of Biotechnology members for their comments and suggestions. Based on the experiences of the Task Group's Media Group that most scientists wished to develop their ability to redress a false publication and lacked experience in writing and presenting for

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[22] Eurobarometer is a continuing survey carried out by the European Commission among the EU Member States. Every two to three years questions on biotechnology are included. It is carried out by national market and opinion survey bureaus. Questions include opinions on support for new technologies, the need for regulation, the used sources of information and assesses the general level of knowledge.

[23] Presently Novartis Foundation

a lay audience it was decided to focus the media training on the writing of press releases, reactions to false publications, presentation techniques and interview skills. These were aimed at preparing the participants for dealing with journalists and giving them skills to inform the press pro-actively about positive and negative developments in their company.

The final programme was centred around three major themes addressing information, reflection and skills (see Table 5.2.1.1):
- Information: *What, and how much, do we know about European public attitudes towards biotechnology?*
- Reflection: *What can we learn from this for our company?*
- Skills training*: How to ensure a flexible company strategy with pro-active initiatives and sound emergency handling?*

Day	Theme	Content	Methodology
Day 1	What, and how much, do we know about European public attitudes towards biotechnology?	- Survey results - What are the issues? - How do media show this? - Can we spot any trends?	- *Lectures* - Eurobarometer surveys - Consumer surveys
Day 2	What can we learn from this for our company?	- How do the media work? - How can we use the media? - What can we learn from previous cases? - With which groups does one need to establish and maintain contacts (networking)? - Evaluation of various communication approaches and their effectiveness	- *Exercises* - Writing press release /communication articles for various target groups - Oral presentation strategies and techniques on biotech products/production methods for various target groups (shareholders, neighbours, media, NGO's, etc.) - Interview training - **Case studies on good and bad practices:** - rDNA enzyme detergent (Unilever) - GM soya (Monsanto) - Herman the transgenic bull, etc. - Potatoes (Avebe) - Tomatoes (Zeneca) - Chymosin (Gist brocades) - British Nuclear Fuels - Maize (Ciba Geigy, Nestlé)
Day 3	How to ensure a flexible company strategy with pro-active initiatives and sound emergency handling?	- What can be learned from good examples? - Timing? - How to deal with nasty situations	- *Skills training* - Preparing communication plan - Preparing company strategic plan - Preparing emergency handling plan

Table 5.2.1.1: Course on *"Public Perceptions of Biotechnology Communication and Company Strategy"* programme outline, London, 1993

Suggestions for speakers were made by the EFB Task Group on Public Perceptions of Biotechnology members, The Netherlands and UK biotechnology industry organisations, and the industrial managers interviewed which resulted in seven lecturers of which six were Task Group members.

A voluminous ring-bound course book was prepared for the participants which included the course programme, list of participants, details of the organising institutions and background information on the lecturers. Additionally, each lecturer's contribution was presented in a separate chapter with written information on the lecture, sometimes also including relevant background articles and where possible, copies of the overhead transparencies used during the lecture. This provided a flexible system allowing for further inclusions during and after the course.

Results

The twelve participants came from seven biotechnology companies, a governmental office, a research institute, a technology transfer agency and a university (their fields of biotechnology are shown in Figure 5.2.1.1).

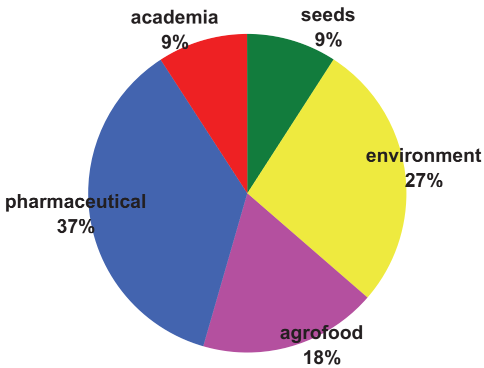

Figure 5.2.1.1: Representation of various biotechnology companies and universities in 1993 course on "*Public perceptions of biotechnology*", London, 1993

The evaluation carried out at the end of the course showed that the participants were very pleased with the course contents (4.23 on a scale 1=unacceptable to 5=outstanding). The programme came up to expectation with an appropriate balance between the different biotechnology fields as well as in theoretical and practical work. The contents and level of the course book materials and presentations were well appreciated and participants felt that there was enough time for discussions. A third of the participants suggested adding more case studies and that examples of these proved very helpful. Although half of the participants indicated that the time away from their work caused some problems, the majority felt the course length could be increased to four days.

Further suggestions included:

1. including more practical information for companies such as on crisis/incident handling by tutors or by other participants;
2. presenting criteria for identification of consumer benefits of recombinant DNA products;
3. providing information about NGOs and on how to organise debates with environmental groups;
4. including topics such as ethics, patents and plant breeding rights;
5. including the handling of relationships between government, NGOs, research institutes and industry R&D.

Table 5.2.1.2 provides an evaluation of the general communication criteria set out in Chapter 1 in relation to the 1993 course.

Criteria for science communication		**Course contents 1993**	**Evaluation**
Knowledge			
	Scientific data	Not included	Not necessary
	Potential impact (cost and benefits)	Not addressed	More requested (B)
	Transparency for judgments, trust	Not addressed	
Skills			
	Scientists in two-way interaction	Dominantly one-way approaches	More two-way requested (C, E)
Attitude			
	Respect for public interest	Media relations Examples of companies	More requested (A)
	Respect for ethical, social and legal aspects (ELSA) issues	Not included	Ethics requested (D)

Table 5.2.1.2: Evaluation of general communication criteria in 1993 course on "*Public perceptions of biotechnology*", London, 1993

Second Workshop Course on "Public Perceptions of Biotechnology Communication and Company Strategy", Delft, June 1995

The first course was organised as part of the European Commission FORCE project. The industrial managers had been very outspoken in their desire to provide such courses and the EFB Task Group on Public Perceptions of Biotechnology advocated the necessity of increasing public communication by scientists. The Department of Biotechnology at TU Delft also wished their students and future employees of biotechnology companies to be properly trained in this field. Therefore it was decided to hold the course again in 1994 as one of the courses organised by the Biotechnological Sciences Delft Leiden (BSDL), graduate research school specifically targeted to biotechnology industry employees. In order to reduce costs and attract participants from Southern Europe it was decided to couple the course to the EFB Task

Group Working meeting in Hydra, Greece, in Spring 1994. Six of the seven lecturers were attending this Task Group meeting. Unfortunately however, in spite of extensive circulation of over 2,500 brochures and advertisement in science journals only five participants registered. The course was therefore postponed to 1995. The course programme was again publicised in a brochure which was widely distributed to 2,500 personal addresses and on appropriate websites and course listings in biotechnology journals.

This time the course was attended by twelve participants from seven countries of which nine came from biotechnology companies in the seed, fermentation, agrofood and pharmaceutical industries either occupied in R&D or in communication, and three from academic institutions (see also Figure 5.2.1.2). The didactic approach and the programme of the course were maintained. The content of the course book was updated and produced as a ring-bound folder similar to the one used in the first course.

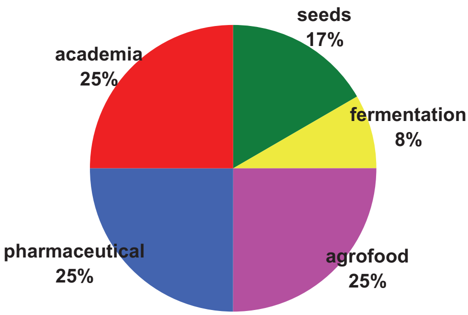

Figure 5.2.1.2: Representation of various biotechnology companies and universities in 1995 course on "*Public perceptions of biotechnology*", Delft, 1995

In the overall evaluating discussion at the end of the course it became clear that we were dealing with two distinct groups of participants: those who were trained in biotechnology research and were now in some way concerned with public perception matters, and those who were trained in public relations and communication who were now concerned with specific matters related to biotechnology. The results of the written evaluation reflected this in conflicting comments such as a request for more basic scientific information on biotechnology and less on communication examples and *vice versa*.

Criteria for science communication		Course contents 1995	Evaluation
Knowledge			
	Scientific data	Not included	Requested by communication experts
	Potential impact (cost and benefits)	Not addressed	Requested by communication experts
	Transparency for judgments	Not included	
Skills			
	Scientists in two-way interaction	Dominantly one-way approaches	Requested by biotech experts
Attitude			
	Respect for public interest	Media relations Examples of company's	More strategies requested
	Respects for ethical, social and legal aspects (ELSA) issues	Not included	

Table 5.2.1.3: Evaluation of general communication criteria in 1995 course on "*Public perceptions of biotechnology*", Delft, 1995

Lecturers involved in the course suggested continuing to target this course to scientists who have to learn to communicate but that it should be updated on existing new public perceptions studies with the emphasis on what can be practically learned from these studies. This would be quite novel as at that time these studies were not translated into practice and no relevant literature had been published on examples of this kind. It triggered a study by the EFB Task Group to collect these data and produce a handbook entitled *"Survey of surveys"* (Hamstra, 1998). Suggestions were also made to define a "common core" for differently oriented participants and offer selected topics as a choice. Participants suggested including more lectures on specific communication activities, non-governmental organisations (NGOs) and examples of company strategies.

BSDL tried once more to specifically target the course to industrial employees in 1997 to be held at DECHEMA (the trade association for the chemical and biotechnology industry in Germany) in Frankfurt on the specific request of colleagues there. More recent case studies and examples of company strategies were scheduled in response to the evaluation. However this course had to be cancelled again due to a too low enrolment of participants.

5.2.2. Courses on society aspects of biotechnology directed at PhD students in 1996 and 1998

ABON[24] course "Maatschappelijke Aspecten van de Biotechnologie" ("Societal aspects of biotechnology"), Delft, 1996

The courses in 1993 and 1995 were targeted to company R&D scientists and university lecturers. In line with earlier recommendations to provide training on public perception issues to future biotechnologists and stimulated by the disappointing registration for the industrially targeted courses, Biotechnological Sciences Delft Leiden (BSDL) decided to also adapt the course for Dutch PhD students. This programme, based on the format of the international course but with Dutch lecturers and in the Dutch language, was offered, not compulsorily, to the PhD students in biotechnology associated through the Association of Netherlands Research Schools in Biotechnology (ABON). The first course was given in Delft in January 1996 to eighteen participants followed by a second in Wageningen in 1998 with seventeen participants.

In close collaboration with industrial (Gist-brocades, later DSM; Unilever) and academic experts in The Netherlands, the didactic approach of the course was maintained by including lectures, discussion and exercises. The programme however was adapted to include Dutch examples of the national genetic modification debate, regulatory and patenting issues, risk assessment, ethics and professional codes. This reflected some of the comments of participants of the previous courses but was merely a decision based on the change in target group. Media training was removed with the view that young scientists would not have to deal with this. The preparation of a strategic company communication plan however was kept as a training in creative thinking and a way of combining the various course elements in an evaluative way. The aim of the course was to make PhD students in biotechnology aware of the societal issues in biotechnology focusing on public perception and acceptance together with their own role and responsibility. A second objective was to train PhD students in committee work with different stakeholders.

[24] ABON: Association of Netherlands Research Schools in Biotechnology

Day	Theme	Content	Methodology
Day 1	What and how much do we know about public attitudes towards biotechnology? What can we learn from the societal debate in biotechnology? Which instruments can we use to measure and control perception?	- Overview of biotechnology applications - Cases of public perception in industry - Applying technology assessment - What is consumer research? - Analysis of biotech debate in The Netherlands - Simulation of field release advisory committee	- *Lectures* - Consumer surveys - Industry cases - Technology assessment cases - Biotechnology debate - **Role play** - Simulation of committee decision field release
Day 2	What is the importance of regulation of food safety, environmental risks and patents for perception? Can scientists' communication play a role in perception?	- Regulation of novel foods - Regulation and risks for environment - Patenting life, theory and practice - Design of communication plan	- *Lectures* - *Skills training* - Preparing communication plan
Day 3	What is the role of ethics in public perception? What is the responsibility of scientists? How can scientists be involved?	- Introduction to ethics - Ethical analysis - Professional codes in biotechnology - Design of company strategy to deal with public perception	- *Lecture* - **Exercise** - **Lecture** - *Skills training* - Preparing company strategic plan - Preparing emergency handling plan

Table 5.2.2.1: ABON Course "Maatschappelijke aspecten van biotechnologie" *("Societal aspects of biotechnology")* programme outline, Delft, 1996 & Wageningen, 1998

The programme in 1998 was similar in content although with a slight reordering of its component sessions. It also included a lecture from an NGO representative as this was specifically requested by the 1996 participants. Further comments were mainly related to the quality of the speakers, the tight time schedule and lack of time for discussion, and the lack of instructions in the skill training of communication plans. Table 5.2.2.2 shows the elements of the course in relation to the criteria for science communication by scientists.

Criteria for science communication		Course contents 1996/1998	Evaluation
Knowledge			
	Scientific data	Introduction	Too focused on GM
	Potential impact (cost and benefits)	Examples of beneficial applications + assessment	
	Transparency for judgments	Knowledge on regulation; Exercise on committee decision ; Not explicitly (trust) addressed	
Skills			
	Scientists in two-way interaction	Exercise on committee decision; no further skill training	Requested more discussion with NGOs
Attitude (strategy)			
	Respect for public interest	Example company plan; role of scientists not addressed	
	Respect for ethical, social and legal aspects (ELSA) issues	Ethical + regulatory lectures + exercise; viewpoints not addressed	Requested more treatment of stakeholder opinions

Table 5.2.2.2: Evaluation of general communication criteria for biotechnology scientists in the 1996 (Delft) and 1998 (Wageningen) ABON courses "*Societal aspects of biotechnology*"

5.3. Development of a course on bioethics and public perceptions of biotechnology

5.3.1. EU Workshop Course on Biotechnology Ethics and Public Perceptions of Biotechnology, Oxford 1997

In 1997 the EFB Task Group on Public Perceptions of Biotechnology carried out a web-based analysis of views held by biotechnology researchers and university lecturers to assess options for increasing their awareness and understanding of public perceptions of biotechnology (see Chapter 2). The objective of this study was to obtain practical information on how the Task Group members could improve their undertaking to provide information on public perception issues to researchers and higher education lecturers, how to increase the awareness of biotechnologists about these issues and how to support the further development of the course on public perceptions of biotechnology. The conclusions relevant for the course programmes were that there was a definite need for training and that these workshop courses for postgraduate students should focus on the concerns of stakeholders, biosafety regulations and product liability, and methods of communication.

By this time the media coverage of biotechnology had become much more intensive. Reporting on environmental groups stressed the negative aspects of biotechnology and the risks of genetic modification. The evaluations of the previous international courses in 1993 and 1995 had indicated the need to increase the ethics and risk assessment and perception components which was similar to the results of the EFB Task Group survey. Additionally the European Commission had significantly increased its attention to bioethics and had recently funded a study on the ethical issues in agro-food biotechnology in preparation for a Council of Europe conference which was coordinated by the Secretary of the Task Group, Dr David Bennett. The 1996 Association of Netherlands Research Schools in Biotechnology (ABON) course had also showed the positive reception of the ethics components while participants requested more knowledge and capabilities on how to deal with bioethical issues. Other initiatives on training in ethics were also developed (De Cock Buning, 1997). Therefore it was decided to extend the course programme to include more theory and case studies on ethics, risk assessment and risk perception.

At the same time a group of biotechnology academics, the Board of the Institute for Higher Education in Biotechnology (HEduBT)), developed the requirements for a European Biotechnology Doctorate degree which in addition to a compulsory period in another European country included compulsory training on biotechnology ethics and public perceptions. The PhD requirements included the obtaining of two credit points for studies and course work in public perceptions and bioethics. Together with Professor Ray Spier (Board member of HEduBT and professor of microbiology, latterly professor of science and engineering ethics, Surrey University), a full programme for a ten-day course was developed. The HEduBT was planning to organise the required training itself with financial support from the European Commission but also accredited the programme developed by the TU Delft Department of Biotechnology in collaboration with the EFB Task Group.

The draft course programme was presented and discussed in detail with the members of the EFB Task Group during their plenary meeting in Spring 1997. The course was aimed for PhD students, post-graduate researchers, industrialists and lecturers in biotechnology from throughout Europe with the additional objectives of:
- achieving an appreciation of the importance of ethics in relation to biotechnology (attitude);
- providing skills to explain and discuss ethical issues in biotechnology (skills);
- achieving understanding of issues involved in the public acceptance of biotechnology (knowledge);
- developing biotechnologists who apply ethical principles in their own work and can present their subject for the public benefit (attitude and competence).

Table 5.3.1.1 shows the extended programme of the course in content and learning methodology used with reference to the objectives mentioned above and the competences sought.

Day	Theme	Content	Methodology	Compe-tences
Day 1	Ethical issues and the truth	- General introduction to the course - Why is ethics important? - Why is public perception important? - Concept of truth - Facts and values - Ad-hoc committees and research institutes	*Introductory round table* **Interactive lectures and discussion**	knowledge reflection (I)
Day 2	Moral theories and philosophy from concept to practice	- Moral theories - How to ensure 'morality' in the production of scientific results - Biotechnology as a profession	**Lectures**	knowledge (II)
Day 3	Importance of ethics for science and engineering I	- Process issues and product issues - Misrepresentation, plagiarism, interference, non-disclosure, conflict of interest - Data-selection	**Interactive lectures and discussion**	knowledge reflection attitude (III)
Day 4	Importance of ethics for science and engineering II	- Resolving ethical conflicts - Examples in biotechnology - Intellectual property rights - Patents, patenting life - Exploitation of foreign bio-resources	**Interactive lectures and discussion**	knowledge reflection attitude (II)
Day 5	Regulation, laws, codes and ethics and the relationship between them	- Law and biotechnology, why? - EC directives, implementation - GMOs, guidelines/regulations - Law and risk assessment - *Evaluation of first week*	**Interactive lectures and discussion** **Role play committee decision-making** *Round table evaluation*	knowledge attitude (III) Reflection
Day 6	Public perceptions of biotechnology: How are attitudes linked to behaviour?	- Who are the stake holders? - Survey results - What is the value of information? - What are the issues? - How do the media show this? - Can we spot any trends? - What are economical consequences?	**Lectures** - **Eurobarometer** **Consumer survey**	knowledge (III)

Day	Theme	Content	Methodology	Compe-tences
Day 7	Research on science communication	- Evaluation of various communication approaches and their effectiveness - Case studies on good and bad examples - What can companies learn from this? - What is the role of scientists?	**Case studies on good and bad practices**: - rDNA enzyme detergent (Unilever) - GM soya (Monsanto) - Dolly, Herman; etc - Potatoes (Avebe, Puztai) - Tomatoes (Zeneca) - Chymosin (Gist brocades) - British Nuclear Fuels - Maize (Ciba Geigy, Nestlé)	knowledge reflection (III,IV)
Day 8	How do the media work?	- Newspapers, journals, radio and TV - Who are the gate keepers? - Timing of information and press releases - Debates, lectures and interview techniques - Training in written and oral communication	**Skill training** - Writing press release/ communication articles for various target groups - Oral presentation strategies /techniques on products/ production methods for various target groups (share holders, media, NGO's,etc) - Interview training	skills (II)
Day 9	Campaign planning	- The role of the industry - What is the importance of networking? - Pro-active initiatives, emergency handling - Internal and external communication - Developing a communication plan	**Interactive lectures and discussion**	knowledge reflection (IV)
Day 10	Company strategy	- Examples of companies' strategies - Developing a company strategic plan - Handling of nasty situations - Panel review - *Course evaluation*	**Lectures** - Examples from different companies' - Examples from NGOs **Exercises** - Communication plan - Company strategic plan - Emergency handling plan - Presenting plans, panel discussion - *Written evaluation*	knowledge (IV) skills (IV) reflection

Table 5.3.1.1: Course on *"Biotechnology Ethics and Public Perceptions of Biotechnology"* programme outline, Oxford, 1997

Lecturers were selected from the extended networks of the EFB Task Group on Public Perceptions of Biotechnology and Biotechnological Sciences Delft Leiden (BSDL). A European Commission grant proposal was prepared and awarded for the participation of PhD students and academic staff from less developed regions in Europe to participate in the course through a fellowship scheme. St Edmund Hall, University of Oxford was chosen as the venue both to attract PhD students with a course at Oxford University and enabling them to include it on their curriculum vitae, and because the college provided suitable good facilities at a moderate price.

Brochures were printed and distributed to over three thousand biotechnologists and the programme and its fellowship scheme were publicised in a number of biotechnology journal course listings. The course was also advertised on the BSDL and EFB Task Group websites with links to a number of other websites, including the HeduBT site. The ring-bound course book contained a general introduction, background information on the organising institution, a participants' list and a chapter for each lecture to a total of twenty-nine chapters.

The didactic approach of the course was much more interactive than any of the previous courses. The course was considerably longer, ten days, to incorporate the novel elements and to enable appropriate attention and time to be given for the difficult skill training. The strongly interactive approach was chosen to create a fast learning track in the development of a model course programme. It was reasoned that through continuous feed-back during the course, the organisers would be able to implement immediate changes, which in turn could be evaluated. Additionally, it provided a structured framework for evaluation of the overall course, the questions asked in the introduction *"What do you expect to learn?"* and *"Why?"* being evaluated mid-term during the course and at the end. Each participant was confronted with his or her answers and asked to specify which elements were already addressed and whether this was satisfactory, which needed further attention, which unexpected learning elements were experienced and if this had changed their view on why they wished to learn this. In order to further support this approach, the twenty-three lecturers were asked to stay several days to provide more detail and to respond to the specific questions of participants in both formal and informal discussions. The following Table shows the interactive approach used.

Interaction on course content	Questions asked	Methodology	Actions
Before course	CV	Written request	Inform lecturers
Introduction	- What is your background? - What do you expect to learn? - Why?	*Tour de table* with standard questions	Refer to programme If necessary inform lecturers for specific emphases/references or adapt exercises
Mid-term	- Did the course so far fulfil your expectation? - What needs to be added in content and what in exercises? - Which part did you like particularly like? - Why? - What do you hope to learn in the second half of the course	Structured discussion	Input next course Refer to programme/ course book If necessary inform lecturers for specific emphases/references or adapt exercises
End	Overall evaluation	Written evaluation form with multiple choice and open questions; structured discussion	Input next course
After course		Evaluation report	Inform lecturers

Table 5.3.1.2: Methodology used for interactive programme evaluation approach for courses on "*Biotechnology ethics and public perceptions of biotechnology*" (Oxford, 1997-2006)

Results

A total of twenty-three participants were selected from ninety applications on the criteria of their motivation and representation (based on letters of motivation and a CV). The participants came from eleven countries and included four university lecturers, six consultancy employees, a governmental officer, an institutional regulatory affairs manager, a company scientist, five postdoctoral researchers and five PhD students.

In general participants were extremely positive (4.36 on a scale of 1 to 5) on the contents and organisation of the course. After the first week the mid-course evaluation session demonstrated that the lectures and exercises had raised quite a number of questions and different ideas. The majority of participants considered that rational reasoning through argument was quite difficult but very illuminating. Some expected more concrete examples of an argumentation based on a bioethical issue. Most felt that they were better equipped now to discuss ethical issues, especially by having a framework to analyse thoughts provided by the lectures on moral theories. People felt they were provided with more systematic and rational ways and more guidance for dealing with issues related to biotechnology. Abstract philosophy was less appreciated and people would have been helped by a list of 'ethical vocabulary and terms' provided beforehand. Sometimes the discussions were felt to be too much between the tutors and not enough involving of the participants. All participants indicated that they had learned significantly, including from each other, and that they had gained more understanding of people's different views. The majority felt they had learned more than they anticipated and over fifty per cent had broadened their views on the important elements for interactive public communication. After the second week a final evaluation discussion was based on the reflection provided during the mid-term evaluation through a structured discussion. Everybody agreed that the course had been extremely enjoyable and that a lot more information, guidance and materials were provided then was expected. Participants said that they had not only learned a great deal about the subjects dealt with but also about themselves. Although exhausted by the long evenings and heavy discussions, all were very satisfied. The venue of St Edmund Hall at the University of Oxford was much appreciated.

Some suggestions for minor alterations or additions were given:

1. including a session on the wider context of the influence of economic and political aspects (GATT[25], etc) and world market developments in biotechnology on networking relations;
2. planning more group work in the first week, e.g. a human cloning consensus exercise and a food biotechnology issues forum discussion with group members playing the role of different organisations followed by summary presentations to a tutors' panel;
3. including the role of the media in ethical perspective and a discussion on media handling with representatives from NGOs, companies and academics;
4. starting the role-playing company exercise during the first week and building the subsequent exercises around this theme.

The last suggestion would necessitate a different didactic approach. The company exercise was intentionally planned for the second week to allow for reflection on the ethical issues and cases dealt with during the first week and to simulate a pressurised time schedule similar to real company situations. The participants showed in their final presentations of company strategic plans a clear appreciation of ethical issues and a good understanding of the issues in public perceptions of biotechnology. This was assessed by the expert panel members, who questioned the participants on their choices for specific strategies and their actions in handling the 'nasty situations'. These discussions also showed that participants were now able to explain and discuss ethical issues. Table 5.3.1.3 shows an evaluation of the general criteria for scientists' involvement in science communication addressed in this course.

[25] General Agreement on Tariffs and Trade

Criteria for science communication		Course contents 1997	Evaluation
Knowledge			
	Scientific data	Issues related to all fields in biotechnology	
	Potential impact (cost and benefits)	Examples of beneficial applications + patents + assessment	
	Transparency for judgments	Knowledge on regulation, law, truth; Exercise on committee decision ; lectures on liability and responsibility	
Skills			
	Scientists in two-way interaction	Exercises and discussions on stakeholder relations; networking	More group work (B)
Attitude			
	Respect for public interest	Media training; how to reach media; examples of communication plans	Critically discuss media handling with stakeholders; role of media (C) start company plan earlier (D)
	Respect for ethical, social and legal aspects (ELSA) issues	Ethical + regulatory lectures + case studies + exercises; discussion on viewpoints by stakeholders	Include economic, political issues (A)

Table 5.3.1.3: Evaluation of communication criteria for biotechnology scientists in course "*Biotechnology ethics and public perceptions of biotechnology*", Oxford, 1997

5.3.2. EU Workshop Course on Biotechnology Ethics and Public Perceptions of Biotechnology, Oxford 1999

The second course remained targeted for a general audience including PhD students, post-graduate researchers, biotechnology company staff members and academic lecturers in biotechnology from throughout Europe. The programme of the course was optimised to respond to the comments and suggestions received during the first course. More group work was included in the first week (B, Table 5.3.1.3) and a lecturer was invited to address the political issues in a wider context (A). The company planning exercises were maintained in the second week (D) for didactic reasons. The media handling and reflection on the role of scientists was also included through a discussion (C). An updated detailed course book was prepared for the participants and lecturers. The didactical approach for interactive learning through mid-term evaluation was continued to discuss the participants' views on the training contents and methodology. As in the previous course, after an introduction on ethics the first week's programme contained discussion of several cases, debating the ethical aspects and highlighting the reasoning for decisions. Examples were updated to include recent cases and included cloning, a genetic disease case and GM food issues. Other topics of the first week included liability, patent issues, risk assessment procedures and risk perception. During the evening discussions additional speakers were invited to highlight, for example, religious viewpoints and patient views on genetic medicine. The second week covered the media culture (C), including a media analysis of the then recent Pusztai case[26] (Ewen & Pusztai, 1999) This two-day session also discussed how the media could be used and who the media gatekeepers are followed by training in writing for the general media, public speaking and interview handling. Public perception surveys, communication strategies and company strategies were the main topics of the latter part of the course. This included preparation by groups of participants of strategic company communication plans for their virtual companies. These "companies" had to deal with a "nasty situation" such as happens to real biotechnology companies. A presentation of the company's strategy and handling of the "nasty situation" to an expert panel constituted the last part of the course. This planning exercise summed all the relevant knowledge and skills provided during the course and provided an excellent way of evaluating the achievements of the course objectives.

In addition to the distribution of brochures to three thousand addresses of PhD students, post-graduates and lecturers in biotechnology the programme was also fully publicised at the BSDL Institute's, EFB Task Group's and HeduBT websites and was advertised in the journal *"Nature Biotechnology*" and on several listings of events in other scientific journals. This course also received a European Commission grant enabling a low registration fee and providing fellowships for participants.

Results

A total number of eighty expressions of interest were received, twenty-six people applied to participate, but four of which had to withdraw for various reasons. The selection criteria for admission were decided by the Board of the course and included the prospective participant's motivation to attend and representation from a biotechnology field and country. Participants came from Italy, Greece, Germany, The Netherlands, France, Estonia, United Kingdom, Ireland, Czech Republic, Belgium, Spain and Austria. The final participants' group included four academic lecturers, a consultancy employee, nine PhD students, three postdoctoral researchers and five scientists involved in communication of public perception and ethics.

In general participants were again extremely positive about the contents and organisation (awarded 4.6 on scale of 1 to 5) of this second course. *"Thanks"; "Excellent management and teaching"; "A high level course"; "Demanding but rewarding", "It was great"; "When is the advanced advanced course?"* are examples of participants' comments, although one participant felt an opportunity was missed to incorporate students' knowledge through using a

[26] The discussion on the Pusztai case was extremely interesting as one of the 25 scientists who signed the original supporting declaration to Pusztai participated in the course. This provided a lot more direct input in the case analysis.

too tight time schedule. A more prominent role given to the global and culturally different participants would add to the learning experience. The evaluation session after the first week resulted in the same positive remarks as in 1997, some mentioning that this was their first experience with philosophy at a practical level. The variety in speakers was greatly appreciated. Some would have liked more widely European-focussed examples as UK issues were too dominant. The evaluation after the second week also demonstrated similar positive opinions on the course content and organisation and showed that some remarks made during the mid-term review were now addressed.

Some additional suggestions for slight alterations or additions were given:

1. adding conflict and problem solving theory and training, and including a presentation by a large consultancy firm;
2. accentuating the role of science in society and addressing the question of *"Who should pay for research?";*
3. shifting the balance from UK-oriented sessions on law to more European legal systems;
4. adding psychology and/or intercultural management to underpin the understanding of public perceptions;
5. introducing more integrated group work in the bioethics sessions.

These suggestions are integrated in Table 5.3.2.1 which shows the comparison of general communication criteria for biotechnology scientists and the course content.

These suggestions were used for designing the programme for the next, third, *EU Advanced Workshop on Biotechnology Ethics and Public Perceptions of Biotechnology* which was again held in Oxford in 2001.

Criteria for science communication		Course contents 1999	Evaluation
Knowledge			
	Scientific data	Issues related to all fields in biotechnology	
	Potential impact (cost and benefits)	Examples of beneficial applications + patents + assessment	
	Transparency for judgments	Knowledge on regulation, law, truth; exercise on committee decision ; lectures on liability and responsibility	Role of science in society (B)
Skills			
	Scientists in two-way interaction	Exercises and discussions on bioethical issues; stakeholder relations; networking	Add conflict handling (A)
Attitude			
	Respect for public interest	Media training: how to reach media; role of media; examples communication plans; role of scientists	
	Respect for ethical, social and legal aspects (ELSA) issues	Ethical + regulatory + economic + political lectures + case studies + exercises; discussion on viewpoints by stakeholders	Shift balance to EU (C) include intercultural management and psychology (D) greater integration of bioethics exercises (E)

Table 5.3.2.1: Evaluation of communication criteria for biotechnology scientists in course "*Biotechnology ethics and public perceptions of biotechnology*", Oxford, 1999

5.3.3. Workshop Courses on Biotechnology Ethics and Public Perceptions of Biotechnology, Oxford, 2001, 2002, 2004 and 2006[27]

This process continued similarly for the programmes of the fourth and fifth *(EU) Advanced Workshop Courses Biotechnology Ethics and Public Perceptions of Biotechnology* held in Oxford in 2002 and 2004 and the sixth course retitled as *"Advanced Course on Strategic Communication in Biotechnology"* in 2006. The course content adaptations are summarised in Table 5.3.3.1.

[26] In 2006, the course was retitled "Advanced Course on Strategic Communication in Biotechnology"

1999	2001	2002	2004	2006
Knowledge	**Additions to 1999**	**Additions to 2001**	**Additions to 2002**	**Additions to 2004**
Issues related to all fields in biotechnology		- GM issues in Asia	- Participants presentations - Biodiversity	
Examples of beneficial applications + patents + assessment	- Risk perception		- Deletion patents	
Knowledge on regulation, law, truth; exercise on committee decision-making; lectures on liability and responsibility	- EU perspective in regulation and law	- Precautionary principle	- Cultural values - US health law	- Global economical trends
Skills				
Exercises and discussions on bioethical issues; stakeholder relations; networking	- Case on rational argumentation		- Ethics games	- Communication strategy in start programme - System approach for dialogue
Attitude/strategy				
Media training; How to reach media; role of media; examples communication plans; role scientists	- Academic communication strategies - Presentation EU programmes on perception issues			
ethical + regulatory + economic + political lectures + case studies + exercises; discussion on viewpoints by stakeholders		- Company strategy on co-existence - Communication strategy of retailers and of consumer organisations	- Implementation strategies in developing countries - Business ethics - US approach to strategic communication	

Table 5.3.3.1: Course adaptation in 2001, 2002, 2004 and 2006 courses on "*Biotechnology ethics and public perceptions of biotechnology*"

The participants in the European Commission-supported course of 1997 were mostly Northern and Western European while in 1999 more Southern and Eastern European participants registered. In 2001 more registrations were received from Eastern Europe and Turkey with some from the USA, Canada, India and Malaysia. This trend continued in 2002 with participants from India, New Zealand, Australia, Kenya, Canada, USA and in 2006 from China. The background also shifted slightly to include cultural anthropologists, medical doctors, economists, social scientists and regulators in addition to biotechnology scientists. Their affiliation was always spread including academic lecturers, industry managers, PhD students often in their final year, postdoctoral researchers and administrators.

An important change occurred in 2004 when the organisers could no longer secure a further European Commission grant as the Commission evaluation panel considered that the course should be financially self-supporting by now. The participation declined and shifted relatively to more PhD students and postdoctoral researchers. The consequences of this decision are discussed in Section 5.4.

In May 2006 an evaluation was carried out amongst the participants of the ten-day courses of 1997, 1999, 2001, 2002 and 2004. Table 5.3.3.2 shows the results in relation to the questions posed. A total of 95 ex-participants were emailed, of which 70 received the email request. A total of 18 responses were received (=26%).

A total of 76% of the respondents said that they had changed their attitude towards public communication. Most explained that this was due to a better understanding of the audience in communication and that as a result they were now *"more conscious", "less naïve, and not prone to overwhelming opinions", "more secure in interaction",* and *"listening before giving an opinion"*. Most indicated that they had genuinely increased their involvement in public communication and some were active in raising awareness of colleagues to the importance of public communication. The course was judged as very useful and an average of 4 on a scale from 1=not very useful to 5=extremely useful was given as a final assessment on the applicability of the course contents and training. In comparison to other courses for their professional education the course was also regarded as useful with an average of 3.5 on a scale from 1=not very useful to 5=extremely useful. Several participants mentioned that it changed their career and the overwhelming majority recommended the course to colleagues (67%) or will do so in the future (22%). In the six courses of this kind organised, one participant had been very critical during the 2002 course and walked out near the end of the course. However she returned the questionnaire stating that although the course was not really relevant for her as a communication professional she had learned from it and she would recommend it to scientists. The responses about the subjects which were regarded as most valuable showed a good representation over the categories and those about the skill training taken up and used after the course showed that the courses provided a range of useful elements. Most people used the contents of the course book and the presentations and also contacted fellow course participants and lectures after the course. The results show that a considerable number of activities were organised after the course but conclusions have to be drawn carefully as the participants' level of activity in public communication before the course was not assessed.

	Affiliation (results in absolute and %)							
Use & contacts	**PhD N=7**		**Academic Lecturer N=4**		**Other N=7**		**Total N=18**	
Use Course Book	5	71%	4	100%	4	57%	**13**	**72%**
Use Presentations	4	57%	3	75%	2	29%	**9**	**50%**
Contact lecturers	3	43%			5	71%	**8**	**44%**
Contact participants	6	86%	3	75%	3	43%	**12**	**67%**
Unanticipated use	Relation with examiner	14%	Course developed	25%	TV debates; awareness building to colleagues	29%		
Prioritised skills training								
Role play GM release	2	29%	2	50%	3	43%	**7**	**39%**
Case study Law	3	43%	1	25%	4	57%	**8**	**44%**
Press release writing	2	29%	2	50%	3	43%	**7**	**39%**
Article writing	2	29%	1	25%	2	29%	**5**	**28%**
Interview training	1	14%	3	75%	3	43%	**7**	**39%**
Presentation training	1	14%	1	25%	3	43%	**5**	**28%**
Making communication plan		0%	1	25%	4	57%	**5**	**28%**
Dealing with nasty situations	3	43%			1	14%	**4**	**22%**
Ethics game			1				**1**	**6%**
Organised activity (behaviour)								
Press release	1	14%	1	25%	3	43%	**5**	**28%**
Organised debate	2	29%	1	25%	3	43%	**6**	**33%**
Participated in debate	4	57%	2	50%	4	57%	**10**	**56%**
Demonstration to public group		0%			1	14%	**1**	**6%**
Public presentation	2	29%	1	25%	3	43%	**6**	**33**
Education on course topic	3	43%	2	50%	2	29%	**7**	**39%**
Presentation on course topic	2	29%	4	100%	2	29%	**8**	**44%**
Other	Round tables, conferences participants				Writing article			

Table 5.3.3.2: Evaluation amongst the participants of the courses on "*Biotechnology Ethics and Public Perceptions of Biotechnology*", Oxford, 2001, 2002 & 2004 (n=18)

5.4. Concluding remarks

The initial three-day international course on public perceptions of biotechnology communication and company strategy was aimed for the biotechnology industry and developed at the specific request of biotechnology companies. Two courses in 1993 and 1995 were attended by twenty-four people and in spite of industry's involvement in developing these courses two courses in 1994 and 1997 had to be cancelled through insufficient attendance. This was so even though there were no other courses on public communication in biotechnology otherwise available and the courses were widely advertised. The course fee was not significantly different from other comparable industrially-aimed courses and therefore the only conclusion that can be drawn is that industry as well as university biotechnologists were insufficiently interested and/or convinced then about giving their time and money to learning about public perception and communication issues.

On the other hand during this same period the research schools in The Netherlands showed considerable interest in providing this type of training for their PhD students. They invested in two non-compulsory courses which were held in 1996 and 1998. This was accompanied by their further intention to incorporate this type of education in undergraduate and Masters degree curricula.

The continued development of the course programme in 1997 and the extensive inclusion of bioethics in its content followed directly from discussions within the EFB Task Group on Public Perceptions of Biotechnology recognising that "deficit model" one-way provision of information about biotechnology alone was not enough to address public concerns and that two-way dialogue, the "contextual model", involved and necessitated understanding of ethical and social issues. Durant (personal discussions during meetings of the EFB Task Group on Public Perceptions of Biotechnology) concluded from the 1996 Eurobarometer survey results that usefulness is a precondition of support and in no case is a "not useful" biotechnology application given support. People will accept some risk if the application is useful and morally acceptable. For instance GM crops containing an important vaccine or new medicines produced by yeasts are likely to be accepted. Moral concerns in the societal arena act as a veto regardless of views on risk and use. This was shown by the disinclination towards the production of medicines by transgenic animals. A main lesson from the study was the conclusion that "*if risk is less significant than moral acceptability, then public concerns are unlikely to be alleviated by technically based reassurances and other policy initiatives dealing solely with risks*" (Gaskell et al., 2000).

These results reflected the views of the EFB Task Group on Public Perceptions of Biotechnology of which Professor John Durant was the chairman. They argued that communication needed also to address ethical as well as legal and risk issues, and it was this recognition that led to the decision to include bioethics, biotechnology regulations and risk perception in the course programme. The inclusion of bioethics and risk perception was also confirmed by the responses to the website questionnaire carried out in 1997 with the EFB Task Group described in Chapter 2.

The new, extended course programme continued to be based on a problem-oriented approach but now reorganised by the need for inclusion of the handling of ethical issues in communication activities. In addition to role-playing and company strategic planning exercises, a number of contemporary examples of communication strategies were given on company, environmental organisation and university strategies which were later extended to include retailer and consumer organisation strategies. During the development of the courses further exercises were added such as rational decision-making, dialogue and ethical role play games. These developments reflected a shift from one-way to two-way communication skills training. Insights in all of the areas covered by the course were rapidly developing in particular through the key multidisciplinary expert network of the EFB Task Group. Through this network tutors could be chosen who were leaders in their fields and directly involved with biotechnology communication. This was reflected in the evaluations which showed that the lecturers were all very much appreciated. In contrast, the evaluation of the Association of Netherlands Research Schools in Biotechnology (ABON) courses showed some clear criticism of the Dutch lecturers selected for their expertise in The Netherlands.

The interactive evaluation approach through structured oral and written evaluations carried out in the middle and at the end of each course showed a high level of appreciation for both the didactic content and the problem-oriented approach. The issues raised were able to deliver new perspectives offering inspiring ideas. The ethical debate exercises provided skills that were in general not yet possessed. Some mentioned that this was their first experience with philosophy at a practical level. A large number of participants said spontaneously that they were better equipped now to discuss ethical issues. People felt they were provided with more systematic and rational ways together with guidelines for dealing with biotechnology issues and that they had more understanding of people's differing views. This supports the view that biotechnology scientists are professionally socialised dominantly in an empiricist framework and that this training could provide the skills to understand people with other socialisation experiences. The multidisciplinary variety of speakers was greatly appreciated as well as the variety both in country of origin and in scientific background and profession of the course participants. Participants said that they had not only learned about the subjects dealt with but also about themselves which shows reflection on their own knowledge and skills.

These positive remarks were underlined by the continuing contacts between participants after the courses, discussing their jobs and their dealings with public perception issues. Some reported on their activities to develop a national course in their own country based on the training and materials they had received. Others suggested the organisation of a reunion, which was tried in 2004 but was not successful as most young ex-participants could not afford the travel and were not supported by their employers to attend the reunion.

From the evaluations carried out during the courses it can be concluded justifiably that the first three initially-set course objectives (as described in Section 5.3.1) were met and that a framework was provided for ethical consideration. The training provided the skills for handling public perception issues at the state-of-the-art of the time. Table 5.4.1 shows an evaluation of the objectives.

Objectives	Results
Achieving an appreciation of the importance of ethics in relation to biotechnology (attitude)	Participants showed a clear appreciation of ethical issues in their final presentations of company strategic plans
Providing skills to explain and discuss ethical issues in biotechnology (skills)	Role-play exercises on debate and committee decisions showed that participants were able to explain and discuss ethical issues
Achieving understanding of issues involved in the public acceptance of biotechnology (knowledge)	Participants showed a good understanding of issues in public acceptance of biotechnology in their final presentations of company strategic plans
Developing biotechnologists who apply ethical principles in their own work and can present their subject for the public benefit (attitude and competence)	Many participants reported on new activities they initiated in their work after the courses The evaluation shows that 76% had changed their attitudes to public interaction

Table 5.4.1: Evaluation of course objectives for courses on "*biotechnology ethics and public perceptions of biotechnology*"

Did the courses overcome biotechnologists' reluctance to increase their involvement in communication of matters arising from their practical activities?

Before each course two thousand five hundred to three thousand brochures were distributed to biotechnologists with the aim and programme of the courses accompanied with website and journal advertisements. This publicity may possibly have had an influence in promoting the importance of public communication but only a relatively small number of participants finally attended. Those who did were already aware to some extent of the importance of their involvement in science communication since they were prepared to spend time and funds in attending the course and were therefore a self-selected group not representative of the majority of biotechnologists. Their letters of motivation confirmed these views. Nobody attended the course on the request of his or her supervisor. The awareness and drive to actually be involved in communication grew further after the course. Many participants reported on the activities they organised after their courses and that they had encouraged their colleagues to become involved in public communication activities. The evaluation among participants of courses in 1997 to 2004 carried out in 2006 showed that the skills were well taken up and that a good proportion were active in public communication activities. The majority (76%) said that it had changed their attitude and that they were more comfortable to be active in public interaction, which is confirmed by the number who had since been involved in public debate (57%). Although other influences may have contributed to this learning effect, this indicates that the courses significantly increased the willingness and confidence of those who participated in them to be actively involved in communication.

Overall, the fact that a relatively small number of biotechnologists in total actually followed the courses is in accord with the findings of the Wellcome/MORI and Royal Society surveys of scientists' communication activities and the reasons why they may or may not engage themselves in them discussed under "*Studies about the views and attitudes of scientists in science communication"* in Section 1.2.1.

The five extended ten-day courses provided from 1997 to 2006 were followed by a total of one hundred and thirty-seven participants, an average of nineteen students per course overall. The first four courses offered fellowships for PhD students which reduced the course fee to €500 for attendance including full board and accommodation for Northern European students and provided free attendance for students from less developed countries in Europe. A total of some two hundred applications were received, representing a very small proportion of the young biotechnology researchers in Europe. Of the courses sponsored by the European Commission in 1997 to 2002, thirty-four of the ninety-two participants were given a full fellowship to attend; thirty-one received a 50% reduction and twenty-seven participants paid the full fee of around €1,000. The fifth course in 2004 did not receive European Commission funding which necessitated the course fee being increased to €2,400. This reduced the international interest considerably from forty to eighty enquiries to twenty-five enquiries to participate. The national Dutch Centre of Excellence the "Kluyver Centre for Genomics of Industrial Fermentation" had adopted the course in its business plan in 2002 and provided financial support for organisation and reduction of fees (€900) for its members. The Centre aimed to provide its members with training in communication including addressing ethical, legal and societal issues. This course formed part of an extensive communication and education programme. A total of nineteen participants registered of which ten were from the Kluyver Centre. Because the course was so very well appreciated and the Centre wished to encourage its members to follow this training it was decided to organise a sixth course in 2005. The fees were maintained at €2,400 with a reduction of €900 for Kluyver Centre participants and PhD students. However, due to the restricted interest of only sixteen candidates it was decided to postpone this course to 2006. In 2006 though, only thirteen candidates registered. The Centre decided however to go ahead with holding the course as it totally supported the programme content, didactic approach and objectives. The programme was condensed to seven days to prevent excessive close contact within a small group and to experiment with a shorter timeframe. The fees for attendance were adapted to €2,150 for full registration and €1,750 for PhD students and Kluyver Centre participants. Presently discussion has started to critically evaluate the bottlenecks for participation. Figure 5.4.1 shows a timeline with all courses and the number of participants per course.

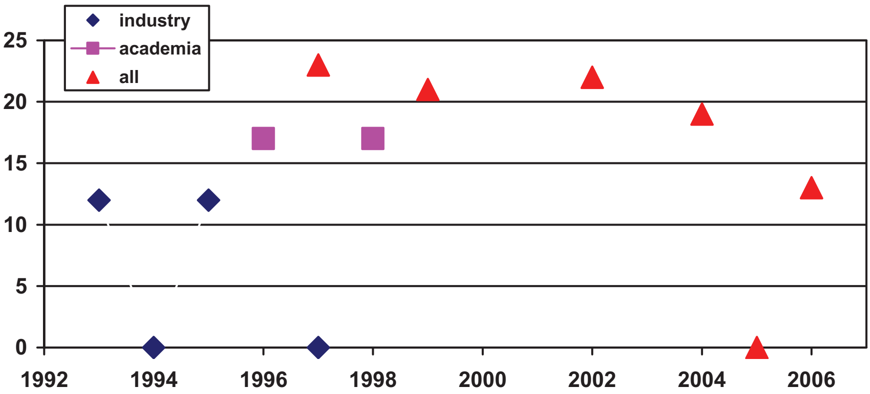

Figure 5.4.1: Number of participants per course for the 3-day course on "*Public perceptions of biotechnology*" (targeted at industry); the ABON course on *"Societal aspects of biotechnology"* (targeted at academia) and the 10-day courses on "*Bioethics and public perceptions*" (targeted at all). The courses with a zero value were cancelled or postponed

These figures support the conclusion that science communication knowledge and skills are not considered priority competences by PhD tutors or biotechnology scientists. This is confirmed by the statements of the participants who received a grant (65%) and who stressed that without it they would not have been able to participate. With the courses being unique in this field, this would have been due either to the limited funds available for training and/or an indication of their supervisors' priority for such training as against other competing demands for their available funds such as conference attendance or purchasing research equipment and materials. This very much contrasts with the views of the course tutors. These leaders in their fields often stayed voluntarily for several days during the course in addition to their own contribution in spite of their busy schedules and many commitments. They also happily accepted invitations for updated contributions to subsequent courses without fee. They repeatedly stated that they had learned a lot from both each other and from the students about the rapidly developing insights and experiences from the range of disciplines and organisations involved in the courses. This view was also confirmed by the evaluation of the participants in 2006.

During the successive development of the courses the criteria for public communication discussed in Chapter 1 were increasingly included in the programme. The three-day course programme for industrial biotechnologists already included criteria 1 and 2 as participants used their own scientific expertise and its impact for society as examples to train in presentation and interviews. The explanation of the potential impact, benefits and costs (criterion 2) was addressed more deeply in the three-day academic course when lectures and case-studies were carried out on constructive risk assessment. In the first type of course the impact considerations were the greater part of the communication activities for the

Criteria for science communication		Course contents 3-day industrial course	Course contents 3-day academic course	Course contents 10-day course
Knowledge				
1	Scientific data	+	+	+
2	Potential impact (cost and benefits)	+	++	+++
3	Transparency for judgments	-	+	+++
Skills				
4	Scientists in two-way interaction	+	-/+	++
Attitude				
5	Respect for public interest	++	-	+++
6	Respect for ethical, social and legal aspects (ELSA) issues	-	+	+++

Table 5.4.2: Overview of criteria for biotechnologists' communication addressed in the three different types of course programmes organised from 1993-2006 (+++ = very well addressed; ++ = well addressed; + = addressed; +/- = partly addressed; - = not addressed)

pragmatic reason of promoting biotechnology to the public and to the market as can be expected from industrial participants. The ten-day course however addressed this criterion in a more open way not linked to marketing but to the ways in which society could benefit from technology development. The programme discussed and practiced the argumentation and criteria for effective communication which also included attention to risk perception. In none of these courses did the tutors address the need for explanation of the impact, benefits and costs if a technology were not taken up.

The three-day programme for industrialists did address the skills for biotechnologists in two-way interaction in examples for pro-active company strategies but the training focussed more on one-way methods such as press releases. The academic course scarcely addressed the skills of communication although several lecturers addressed the negative aspects of antagonistic public perceptions on technology development. It did not include any media and presentation training. Some attention was given to role-playing exercises and to the design and presentation of a company plan but no further emphasis was given to two-way communication or to pro-active strategies that include two-way interaction.

The first course on "*Bioethics and Public Perceptions of Biotechnology*" in 1997 was established directly as a consequence of the need to include criterion 5: "Understanding and responding to public interests and concerns, including ethical, social, safety and legal reasons". This automatically increased the attention for two-way interaction (criterion 4). The need for trust building (related to criterion 3) was discussed following the lectures on public opinion survey results in both three-day courses. However most tutors as well as participants were uncertain about how to best approach this. The discussion on bioethics in the academic courses further addressed this criterion. During the ten-day course much more intense attention was given to this matter with debates on truth, value of information, different cultural values, etc. Stimulating public interest (criterion 5) remained part of the problem-learning approach exercises and used the target group method. The industrial three-day course and the ten-day course however gave much more attention to examples from companies, retailers, NGOs, etc. During the subsequent courses it was interesting to note that increasing reference was made to emotions and to cultural contexts in the strategic company communication plans presented by the participants. The reason for including emotions as a strategy to raise public interest was not discussed in a formal presentation or discussion and thus reflects the ability of participants to translate their own feelings as members of society to their professional public communication activities.

The involvement of the Department of Biotechnology at TU Delft provided availability of advanced education in this field for their own PhD students and staff. In total twenty-eight people participated (twenty-three PhD and Designer students[28] and five staff members) from the overall enrolment of one hundred and eighty-three participants (15%) with a clear increase in participation during the later programmes. The involvement in the course development also provided quality material, skills and knowledge for its Master education programmes as two lecturers participated in the course. The initial European Commission funding provided the financial support for the development and organisation of the first course in 1993 and for the extended courses from 1997 to 2002. No further investment of the Department was needed. However, when the European Commission funding ceased the Department decided to continue the provision of the course with substantial financial support from its own resources budgeted from the national Centre of Excellence, the Kluyver Centre for Genomics of Industrial Fermentation[29]. This decision reflects a conscious choice to invest in science communication activities and to provide training for its own PhD students.

The experience with the courses, and especially the insight that quality training and education in this field needs constant input from social research, helped significantly in the initiation of the establishment in 2004 of the “Biotechnology and Society” research and education group in the Department of Biotechnology at TU Delft. The course has become much appreciated as a crucial element of the Department’s approach to institutionalise science communication.

[28] Two year programme for Designer in Biotechnology, organised by the Institute for Biotechnology Studies Delft Leiden

[29] The Centre of Excellence “Kluyver Centre for Genomics of Industrial Fermentation” in which nine research institutions participate included the provision of the course three times in their 5-year business plan from 2002-2007 (http://www.kluyvercentre.nl).

Conclusions Part II: Skills: Development of training

Initiated in 1993 at the request of the biotechnology industry, training was developed to teach biotechnologists in dealing with the public. With input from several speciality fields, i.e. public understanding of science, media relations, ethics, law, risk assessment and perception, communication theory, etc., the courses developed rapidly reflecting the accumulating knowledge and developing insights on these topics. The open learning approach adopted for the courses in combination with frequent reflection during the courses resulted in an effective didactic instrument for discussing and internalising the attitudes of participants. The majority of the participants became more active in the organisation of, and involvement in, public engagement activities as shown by the evaluation amongst participants of the five courses from 1997 to 2004.

The extensive attention to ethics and moral systems proved helpful in creating a reflection on participants' own values and norms, standards and principles. It is argued that this is an important factor for public engagement which will be further discussed in the final conclusions.

The major constraint is the lack of priority given towards this training, shown by the low total participation in the courses. This indicates the existence of other major constraints or lack of agreement on the need for training in public communication by biotechnologists in accord with the findings of the Wellcome/MORI and Royal Society surveys discussed under "*Studies about the views and attitudes of scientists in science communication"* in Section 1.2.1.

Part III: Attitude and behaviour: Willingness to act

Heidelberg, 1998

I meet Carmel (Mothersill) in the airport where the limousine service is ready to take us to EMBO and Frank Gannon. An hour later we meet Frank to discuss this novel idea for a meeting on future perception issues in biotechnology. After lunch it is all arranged, Frank gets the Nobel prize speakers and we get the other stakeholder experts; we will lock them all up in a nice location on the Irish coast and write a report on their recommendations. And it all worked brilliantly!

CHAPTER 6

Focus on Future Issues in Biotechnology (1999)

6.1. Introduction

The European Federation of Biotechnology Task Group on Public Perception of Biotechnology (see Chapter 2) had been at the forefront of the movement promoting public communication in the biotechnology field. The membership of the group with leaders in public opinion survey research, industry public affairs, journalists, research directors, policy advisors and leaders of public interest groups generated an informed critical evaluation of the European biotechnology development and public opinion scene. Its group meetings averaging two days each half year provided high level discussions of the latest insights in public opinion survey results, national activities and their results, political opinion and trends, agenda-setting of environmental organisations and many other relevant issues. Trustworthiness was regarded as a prerequisite in public communication. The group positioned itself therefore so as to maintain its independence from influence from all interest groups. During those years of controversy the increasing activities of environmentalist groups and opposition to biotechnology which ranged from genuinely-held concerns to the illegal destruction of GM-crop field trials and the consequent media coverage led to generally defensive reactions from companies and scientists. The EFB Task Group continued to stress that pro-active communication activities addressing public concerns about both ethical as well as safety issues carried out by trusted scientists and other professionals were key to achieving a balanced view about the pros and cons of biotechnology by the public. This led to the need to forecast the issues likely for tomorrow.

Although the EFB Task Group as a whole had the objective of developing pro-active strategies to deal with public perception issues, it had depended up till then on individual members' intuitions about emerging issues. There were no specific activities directed to developing pro-active strategies. This chapter describes in Section 6.2 the organisation and results of a new model to address this, Section 6.3 evaluates the results in comparison with the general criteria for communication described in Chapter 1 and gives some concluding remarks.

6.2. Objectives for a novel instrument

During the Task Group Working Group on Biotechnology Research and Higher Education meeting in November 1997 two interesting contributions were made which ultimately led to the plan to develop a method to identify emerging society issues. Professor Emilio Muñoz, a member of the Task Group from Madrid, reported on a meeting of the Council of the European Molecular Biology Organisation (EMBO)[30] in Heidelberg where public perception and ethics of biotechnology was discussed. He felt that this meeting had been a very good first step in a good direction, however the established, eminent scientists of EMBO were questioning how best to handle the issues. An EMBO committee was set up to investigate how to respond to public perception issues. Professor Muñoz suggested contacting the EMBO organisation to see if the Task Group could be involved. Later during the same Working Group meeting Dr Carmel Mothersill of the Institute of Biotechnology in Dublin raised the issue of the relationship between scientists and law makers. She emphasised that legal professionals had difficulties in dealing with moral ethics in biotechnology and suggested that scientists should make greater efforts in collaborating with them. She argued that "*One of the major problems is that law always, by definition, runs behind facts and therefore there is the difficulty in assessing new technologies and their possible impact on society in the future*". Dr Mothersill suggested establishing a "think-tank" of high-level scientists. It was agreed that such a think-tank should consider the possible development of new confronting issues resulting from scientific advances. This should not be in as formal a manner as in Delphi studies but informal and focusing on public perception issues. Legal professionals should be part of the think-tank activity. It was considered that different think-tank groups should be set up for different fields of biotechnology. Ways for approaching appropriate scientists were discussed and it was decided to determine whether this could be linked with the EMBO initiative as this would increase the profile and impact of the meeting and any messages that would result from it. A meeting with the EMBO Executive Director, Dr Frank Gannon, led to the organisation of an expert workshop by the EFB Task Group and EMBO.

Methodology

The suggestions made by the group were discussed with Dr Gannon who welcomed the idea and agreed to invite the best-placed expert EMBO members for the event. Together a programme was developed and decisions were made on organisational matters and finance. The meeting was planned to take place in Dublin and include experts in a variety of disciplines, including ethics, legislation, policy making, religion, science communication, law, economy, industry, social sciences and biotechnology. It was decided to focus on two emerging fields, "Novel foods" and "Ageing". The organisational tasks were divided: Dr Gannon of EMBO would invite the experts scientists on "Ageing" and "Novel foods" while Dr Mothersill in Dublin would look after the local organisation and the invitation of law

[30] EMBO members are elected on the basis of proven excellence in research. EMBO has 41 Nobel laureates

experts and the TU Delft Department of Biotechnology would invite the other experts and look after the final programme, reporting and finance.

Results

The resulting meeting entitled "*Focus on Future Issues in Biotechnology: Novel Foods and Ageing*" was held in Killeney Bay, Dublin, in April 1999. The meeting brought together a number of European experts in legal, ethical, social, scientific, political and theological fields to discuss the related societal issues of the contribution of biotechnology to novel foods and ageing. EMBO provided four top-level, worldwide-recognised scientists, two on *Ageing* and two on *Novel Foods*. In order to allow for free brain-storming, the meeting took place under Chatham House rules[31]. The scientists presented their views on long term future scientific developments in their respective fields which were followed by discussions about the likely issues resulting from those expected developments from economic, ethical, legislative and risk assessment points of view. A number of short presentations were given so that all participants were at the same level of information. These included an overview of further available sources and methodologies for predictions such as technology forecasting studies, Delphi studies etc., insight into the latest public opinion studies (Eurobarometer 1999 and Marris et al., 2001), risk assessment and perception in relation to law, the operational setting of law making, and the cultural variation in Europe and its implications for public issue handling.

In parallel session the two themes discussed the following questions:

Ageing:

1. *Economic points of view:*
   Relating to health care provisions; insurances; retirement; education; social welfare provisions; who pays?
2. *Ethical points of view:*
   Age build-up; population distribution; euthanasia; rights of youth/age; priorities for treatment; (inter)national intelligence; privacy of (genetic) information; quality of life
3. *Legislative points of view:*
   Who decides? Control (implementation + policing); patenting; responsibility-liability; personal responsibility for health (related to 'good life style')
4. *Risk assessment points of view:*
   Overpopulation; which risks can be foreseen; risk perception; who controls risk assessment (vested interest)

Novel foods:

1. *Economic points of view:*
   Implications for raw material providers. How does this influence world finances? Different role of pharmacists ("healthy foods"); Added energy into processed food.

[31] The debate may be freely reported but no part attributed to specific contributors

2. *Ethical points of view:*
   Increased production costs acceptable? "Natural" trends; choice for all?; biodiversity
3. *Legislative points of view:*
   Contained-versus non-contained use; patenting and labelling; liability versus responsibility; who decides? control (implementation + policing)
4. *Risk assessment points of view:*
   Biodiversity; which risks can be foreseen; risk perception; who controls risk assessment (vested interest)

The conclusions of both sessions were discussed in plenary. On the basis of these conclusions a discussion on the preparation of law and legislation was held asking the questions:

- *"What do we like to see?"*
- *"What will we expect if nothing was controlled?"*
- *"What is the role of scientists and lawyers?"*
- *"Is there a mechanism and would we wish the law to be pro-active?"*
- *"If so, how can one do that?"*
- *"Can one build models to predict what will happen and can one put a law in place pro-actively?"*
- *"How can one monitor (compare "Cell-cycle check points")?"*
- *"How can we involve and inform the public?"; "What does this imply for education (responsibility + law-training)?"*

The meeting was concluded with the agreed formulation of a press release with the final recommendations and conclusions. A full report was published later that year (Braun et al, 1999).

6.3. Concluding remarks

The objective was to achieve an insight into possible future concerns resulting from the developments in ageing and novel foods together with discussing ways to handle these issues in a balanced pro-active manner with particular attention to the relationships between social issues and legislation. The main conclusions from the "*Focus on Future Issues in Biotechnology*" workshop were (Braun et al, 1999):

1. *"Scientists must become more visible and involved in public debate on the uses of their work.*
2. *This is especially true for biotechnology, where there is currently a lack of public support for its applications in agriculture and food production.*
3. *There is an urgent need to communicate the enormous benefits modern biotechnology can contribute in the shift to a more sustainable agriculture within Europe, and to a more*

productive and sustainable agriculture in the developing world. Examples include reduced use of pesticides and more low-till agriculture.

4. *The current debate about risks is unbalanced: the conjectural risks to safety are minimal, and GM foods are as safe as traditional products; environmental risks are in general likely to be much less than those resulting from current unsustainable practices.*
5. *Consumers and industry are faced with a lack of legal clarity, damaging to industrial and scientific interests in innovation and economic performance, and with no compensating benefit to public safety or environmental protection; for example, the current lack of official agreement on a threshold for the labelling of GM foods.*
6. *At present there is lack of understanding and appreciation for the importance of continuing support for basic biological research: Current commercial investment is exploiting the fruits of earlier decades of scientific endeavour, but finance for the latter is not being maintained at viable levels in Europe.*
7. *The confusion surrounding current debate in Europe, about food safety and environmental protection, is damaging Europe's longstanding and future position as a major agricultural producer and exporter."*

The press release with these recommendations was sent to a number of media agencies and the European Commission.

Analysis of these conclusions reveals that the first point is a clear recommendation directed to biotechnology scientists. All the other points are warrants underlining this recommendation. The argumentation behind this recommendation is that scientists are best placed as experts to debate the risks and benefits of biotechnology developments. It also recognises that many scientists are hesitant about promoting their visions as it would be seen as "lobbying". This was thought unjustified and training was suggested to be provided to help scientists who are not natural communicators. Although the report clearly speaks of debate, the second conclusion above underlines the importance of explaining the science to an uninformed public based on scientific facts in order that they should understand how illogical their opinions on GM are. This is very much based on the fundamental assumption of the so-called "deficit model" of science communication that more information will make people more supportive. The third conclusion emphasises the importance of including reference to the benefits in the communication, including also the argumentation of the consequences, i.e. costs, of not implementing the new technology, especially also in relation to the needs of developing countries and global issues such as hunger and sustainability. The fourth and part of the seventh conclusion is an observational view that media coverage is led by hysteria and based on non-rationality and that the current public debate was led by too much emotion and too little scientific rationality, and does not derive any further conclusion or recommendation from that observation. The fifth as well as the seventh conclusions seem intended to recommend politicians to define the legislation for labelling as soon as possible and to define a threshold for traces of GM-derived components. The arguments are related to economic growth: Europe will lose its competitive market position in science, agriculture and life science technology. The sixth conclusion emphasises the need for scientists to include an explanation of their scientific goals and the social consequences of science in general in their public communication in support of the viewpoint that democratic processes decide on public support for science and hence that scientists should put forward the arguments to publicly invest in science.

The workshop therefore recognised the criterion 1 (explaining the science) and 2 (impact of the technology) for public communication activities, and presented these in its press release. This is in spite of the fact although that the workshop was organised to discuss criteria 6 (listening, understanding and responding to ethical, social economical and legal issues) and that it does recognise the importance of discussing these elements, it contains no reference to the crucial inclusion of listening, understanding and responding to these issues. The workshop did however refer to the importance of trust relationships and the way scientific facts are verified (criterion 3) with some statements relating to the lack of trust and a lack of legal clarity, but did not suggest any other action than involving scientists in the debate to change this situation. The stimulation of public interest is only implicitly referred to in statements 5, 6 and 7 without recommendations on how to achieve this (criterion 5). Table 6.4.1 shows an overview of the criteria addressed in this workshop.

Criteria for science communication		1999 Workshop on future issues in biotechnology
Knowledge		
1	Scientific data	+++
2	Potential impact (cost and benefits)	+++
3	Transparency for judgments	+/-
Skills		
4	Scientists in two-way interaction	+/-
Attitude		
5	Respect for public interest	-
6	Respect for ethical, legal and social aspects (ELSA) issues	+/-

Table 6.4.1: Overview of criteria for biotechnologists' communication addressed in the *"Future issues in biotechnology"* workshop, Dublin 1999 (+++ = very well addressed; ++ = well addressed; + = addressed; +/- = partly addressed; - = not addressed)

The recommendations and conclusions did not provide any suggestions about how scientists could be encouraged to increase their involvement in communication. The workshop however did produce a summary and highly qualitative overview of the scientific argumentation on the possible new developments and their possible impact for society in a broad sense. This knowledge is a crucial element for pro-active communication activities and also very relevant for dialogue and other interactive forms of communication. This was recognised by the Delft University of Technology Department of Biotechnology as in its communication strategy for the Kluyver Centre for Genomics of Industrial Fermentation in 2002 it included the organisation of three of such workshops over a period of 5 years.

Delft, 2000

Completely exhausted we drag ourselves up the stairs to the bar of the Department. We had extracted the DNA of hundreds of kiwis, made toothpaste for a whole community, cut and offered thousands of pieces of bread, answered loads of questions and given numerous explanations. The heavy rain during parts of the day shows its marks on people's faces and clothes. But we raise our glasses satisfied, we had a record 2,000 visitors!

CHAPTER 7

Public activities: Open Science Day at Delft University of Technology (2000 – 2001)

7.1. Introduction

In order to inform the public at large on science and technology The Netherlands had joined the pan-European activities for a "Science Week", including an annual "Open Science Day". Companies, universities and research institutes were invited to open their doors and demonstrate their activities to interested citizens. The national organisation was in the hands of the The Netherlands "Stichting voor Publieksvoorlichting over Wetenschap en Techniek" (PWT), later renamed as "Stichting Weten" (foundation for science communication).

Eurobarometer results in 1999 had shown a decline in public support for biotechnology and the studies of Durant et al. (1998) had suggested that scientists should shift their communication activities from scientific facts to listening and responding to public concerns. Several staff members of the Department of Biotechnology of the Delft University of Technology had attended the courses described in Chapter 5 which had provided the skills and knowledge to address this. Participation in the national Open Day would provide an excellent opportunity for the Department to interact with the broader public in a pro-active manner. Therefore the Management Team accepted the suggestion of their Public Relations Commission to actively participate in the activities on Sunday 8 October 2000. The Department was also actively involved in similar activities in 2001, after which it continued with a subset of the activities each year. This Chapter addresses the questions *"What problems can be identified in organising public events?"* and *"Which lessons can be learned from public events that are relevant for science communication?*". Section 7.2 describes the organisation and results of the Open Day in 2000 and Section 7.3 describes the activities in 2001. Concluding remarks with reference to the later year involvements are given in Section 7.4.

7.2. National Science Day 2000

7.2.1. Organisation Science Day 2000

The Public Relations Commission of the Department of Biotechnology was originally established in the mid-1990s to organise the Departmental contributions to attract candidate students to the Faculty's Master degree course. The Commission also organised information meetings for research assignment opportunities for MSc students in the Department. It also had the task of advising the Board of the Department on matters related to communication and marketing. The Commission consisted of academic staff members, technicians and students representing the different research and personnel groups. It was led by the General Secretary of the Department to ensure a direct link with the Department's Management Team. The rather negative media attention for biotechnology which developed through these years triggered the Commission to advise the Department to put more effort into public communication. This is the reason why contributing to the National Science Day was suggested. The national organisation of the Open Day programmes chose a different theme each year. The central theme of the National Science Day 2000 was "*House, Garden and Kitchen*". In March 2000, the Department established a dedicated "Open Day" committee, consisting of scientific and support staff members, PhD students and analytical staff under the supervision of the Public Relations Commission chairman to develop the plans and activities.

The three main objectives of the Department for the activities in the Open Day were to:

1. increase the knowledge of visitors about scientific developments in biotechnology (knowledge);
2. establish a positive attitude towards biotechnology (attitude);
3. interest young people in the study of biotechnology (attitude).

The Department wished to reach a large audience extending from people who are already interested in scientific developments. Based on the lessons from the communication courses (see Chapter 5), strategies were selected to achieve the objectives which are shown in Table 7.2.1.1.

Based on the information received from people who had been involved in previous Open Days it was known that the majority of visitors would be families with young children. In order to increase the interest of people with no direct interest in science, the organisers developed activities for entertainment, especially young children's. The expected visitors were divided into a number of target groups based on their level of education, interests and family composition. In this way dedicated activities could be designed for each group aimed at increasing motivation for participation. A staff member or PhD student was put in charge of each activity. Table 7.2.1.2 shows the activities directed to each target group.

As the Department is housed next to the Botanical Garden, the Garden was used to host the Information Streets, Forum and small children's entertainment while the other activities took place in the Department building. Each of the activities are briefly described in the following paragraphs.

Objective	Questions	Strategy	Activity
Increase science knowledge visitors (I)	- How can we get people interested in coming? - How can we get them motivated in participation?	- Wide advertisement - Division in target groups - Motivation + interest through (their children's) entertainment - Address hot media subjects - Address local issues - Address home examples	- Press releases + relations - Local advertisement - Demonstration laboratory - Ancient laboratory - Information streets - Lectures
Create positive attitude (II)	- How can we address ELSA issues? - How can we motivate people to participate in discussions? - How can we create a positive association with biotechnology?	- Discuss controversial issues reported in media - Involve known speakers and professors - Discuss local issues - Link to entertainment - Discuss benefits/ problems through experience + life examples	- Interactive forum with known speakers linked to entertainment - Workshop on rDNA - Information streets - Using taste/ smell/touch and competitions
Interest prospective students (III)	- How can we interest young people in biotechnology?	- Provide information study programmes + advice - Create conducive atmosphere - Show employment opportunities - Make professors available	- Stand with study programmes + study advisor - Information streets with industrial participation - Involve professors

Table 7.2.1.1: Objectives and chosen strategies and activities at Open Science Day 2000, Department of Biotechnology, TU Delft, 2000

Target group	Dedicated activities
Adults (educated)	Lectures, demonstration laboratory, ancient laboratory, information streets, Interactive forum on cloning, workshop on recombinant DNA
Prospective students	Information stand on study programmes, lectures, information streets
Children aged 2-6 years	Video room, Steam train, jumping cushions, sugar spins and popcorn machines
Children aged 7-12 years	"Fun laboratory", special children lectures, interactive forum introduction act

Table 7.2.1.2: Dedicated activities per target group at Open Day 2000, Department of Biotechnology, TU Delft, 2000

Interactive forum discussion on cloning

A forum discussion on cloning was set up to discuss questions from the public, using the formula of a popular Dutch television show "*Farce Majeure*". Cloning was still a well reported subject in the media after the birth of Dolly, the cloned sheep, in 1999. It was considered therefore that it would be likely to raise the interest of visitors. The forum members included Professor Jan Hoeijmakers, expert on human genetics from the Erasmus University Rotterdam, Ysbrand Poortman, Director of European and Dutch Alliance of Genetic Interest Groups (VSOP) and Professor Gerard van Beynum, Director of Gene Pharming, a company in The Netherlands producing pharmaceuticals from transgenic animals. In order to raise the interest of people walking around the various attractions and involving them in an informal way into the debate, the Forum started with a song based on the popular TV show and an introductory act involving children. The act was themed on the popular TV cartoon series "*Dexter and Deedee*". Two actors dressed as Dexter and Deedee performed the magic creation of a series of Einstein clones for which a local group of school kids happily volunteered.

Information streets

In order to link the overall activities of the Department with the theme of the National Science Day ("House, garden and kitchen") , it was decided to create five "information streets":

1. biotechnology and food, labelled "*Lekker verantwoord*" ("*Approved & tasty*")
2. biotechnology and environment, labelled "*Duurzaam milieu*" ("S*ustainable environment*")
3. biotechnology and health, labelled "*Goed gezond*" ("*Happy health*")
4. biotechnology and plants, labelled "*Wat groeit dat bloeit*" ("*What grows will flourish*")
5. biotechnology education, demonstrating the various university study programmes

Each "information street" demonstrated a variety of techniques and products, providing an overview of the research activities of the Department and the resulting end-products and their use. The Delft Department of Biotechnology research portfolio focuses on fermentation technology using micro-organisms. The research findings are often related to intermediaries, such as food ingredients, enzymes, pharmaceutical components, etc. In order to enable the inclusion of the end-products, arrangements were made with local and national biotechnology companies and institutes to involve them in the activities. This resulted in the contribution of the biotechnology companies DSM-gist (washing enzymes, penicillin, cleaning molasses spills), Intervet (veterinary products), Organon (birth control), Agrocontrol (water analysis), Heineken (beer brewing demonstrations and tasting tests), Sonneveld (bread tasting tests with and without enzymes) and a local wine merchant (wine tasting tests).

Lecture series

The lecture series for adults were presented by professors from the Department and from DSM-gist and included titles such as "*History of biotechnology*", "*The taste of DNA*" and

"*The principles of diapers*". There were special lectures for children addressing biotechnology at the level of final primary school age (12 to 13 years).

Demonstration laboratory and ancient laboratory
A questionnaire sheet was designed to lead visitors through the demonstration laboratory, each demonstration providing an answer to a question. The route demonstrated the production of penicillin but also included a view in a laboratory of 1920, the opportunity to measure one's breath levels of oxygen and bicarbonate, and a look at a variety of micro-organisms under microscopes.

Workshop on recombinant DNA issues
The workshop on r-DNA was organised in collaboration with DSM-gist. Two experts discussed the societal issues resulting from recombinant DNA work with interested lay people.

Fun laboratories and small kids entertainment
In order to attract a wide audience including families, special attention was given to activities for children. The 2 to 6 year olds were entertained by a small steam train which drove children around in the Botanical Garden on rails and a giant jumping cushion also in the garden which allowed the parents to look around. The 7 to 12 year age group was actively addressed through the "fun laboratories". They could carry out a series of practical experiments to make hair gel, cough mixture, tooth paste, etc. and extract DNA from kiwi fruits. The practical rooms normally used for students' laboratory work were transformed into laboratories resembling those in the popular "*Dexter and Deedee*" Dutch TV cartoon series and after completion of three tests children were issued with a special *Dexter Diploma*.

Figure 7.2.1.1: "Fun laboratories" for 7-12 year old children during the Open Science Day in 2002 at the Department of Biotechnology of the TU Delft

Strategies used to motivate people to consider the benefits of biotechnology

Where possible, the Information Streets provided real products to taste, feel or sniff to show the benefits of biotechnology and to bring those examples closer to life experiences of the public. It also provided a topic for chat, that could be taken easily as a lead by the scientists involved to start a more serious discussion on the ethical, legal and social consequences. For example next to a poster explaining the environmental benefits of the enzyme phytase, a run of real chickens was placed to illustrate the difference of the nitrogen content in chicken dung fed with and without phytase. The street on environment also showed a display of photographs about a major local spill accident with molasses, a major ingredient for fermentation production in the DSM factory in Delft, which had recently occurred. This had caused severe problems for neighbours and the canal system around Delft and experts from DSM were available to discuss the problems and their handling. In the "*Happy Health*" street a veterinary pharmaceutical company showed its products and how biotechnology contributed to them. A little goat and pony were positioned next to this street to link these biotechnology products to real life and hence the benefits for veterinary medicine development. In collaboration with the Bakery Ingredients groups at DSM a whole series of bread products were specially baked for this event. Each product had different additives such as enzymes and vitamins. Visitors could taste the differences which was encouraged by blind tasting competitions for which prizes could be won. The planning of special activities was also considered. The forum on cloning was held at the beginning of the afternoon when the organisers expected the highest number of visitors. In anticipation of a possible lack of questions, scientists tried to stimulate visitors to ask a question. When it emerged that people were prepared to ask but did not know about what, these scientists helped them in formulating a question. The Botanical Garden also housed a special café-bar with a jazz band consisting of Departmental staff members to keep people motivated to stay longer, to create a conducive atmosphere and to show another image of scientists.

Documentation booklets were produced and handed out, describing the programme and background information on the research of the Department. For the production, each professor of the Department had been asked to explain their research and its relevance to society in popular text. In collaboration with the University press officer, a press release was prepared and distributed. This resulted in a number of articles in local and regional newspapers and an interview with regional radio. Announcements were also distributed throughout the neighbourhood and to local and regional schools. National announcements of the National Open Science Day also covered our participation. A total of one hundred and eighty people, including almost all the staff, permanent and temporary, of the Department were involved in the organisation and running of this Open Science Day.

7.2.2. Results Science Day 2000

A total of approximately 2,000 visitors were received on a cloudy and sometimes very rainy day, a record for the Delft University of Technology participation in the annual Open Science Day. In spite of the rain, the majority also included a visit to the "Information Streets" in the Botanical Garden. The visitors were asked to complete an evaluation form of which 164 (8%) forms were returned. The evaluation shows that the majority of visitors (70%) were families with children between the ages of six and twelve years old. The majority was positive on the contents of the day (65% spontaneously mentioned this) with the children's experimental laboratory ("*pret lab*") activities rated as most appreciated by both the adults as well as the children. In total 486 children received their diploma for performing three experiments in the "fun laboratory". The act introducing the forum discussion on cloning was felt least interesting although the forum itself was attended by 100 people in spite of the heavy rainfall at the scheduled time. The experience showed that many people were hesitant about asking questions at the forum discussions. The ones who were approached beforehand and were willing to ask a question had been eager to ask the question suggested by the scientist. Table 7.2.2.1. shows the most and least interesting activities, based on the responses received in the questionnaire. Several visitors asked the organisers to hold these days more often and to increase the capacity for children in the "fun laboratory".

Target group	Dedicated activities
Adults	1. *Most interesting* **54%** "Pret lab" experimental laboratory **46%** "Information Streets" **30%** Demonstration lab 2. *Least interesting* **22%** "Dexter & Deedee" act **14%** Lectures 3. *Participation in one of the competitions / test* **27%** Sniff test **19%** Bio quiz in the demonstration lab **19%** Beer recognition test
Children aged 6-12 years	1. *Most interesting* **54%** "Pret lab" experimental laboratory **32%** Steam train **19%** Animals next to information streets in garden 2. *Least interesting* **16%** "Dexter & Deedee" act **16%** Jumping cushion **11%** Animals next to information streets in garden

Table 7.2.2.1: Results of questionnaires of visitors of National Science Day 2000, Department of Biotechnology, TU Delft

The specific activities designed to interest adults were successful with 46% of the visitors enjoying the "information streets" and 30% interested in the "demonstration lab". The lectures were well visited, while the forum on cloning was attended by 100 people. The more interactive workshop on recombinant DNA received the smallest number of visitors (20).

The press releases resulted in good media coverage. Journalists and photographers from the local "*Delftse Courant*" newspaper, the national journal "*Natuur en Techniek*", the university paper "*Delta*", and film crews from the regional broadcaster "*TV Rijswijk*" and the national "*NOS Jeugdjournaal*" attended the event and covered the biotechnology related activities. During the same evening a five minute slot was given to the children's experimental laboratory ("*Pret lab*") with references made to the other activities in the prime time, nationally broadcasted "*Jeugdjournaal*", the national early evening TV News with an average viewing rate of 1.1 million people.

7.3. National Science Day 2001

7.3.1. Introduction

In 2001, a national public debate on biotechnology and food entitled "*Biotechnologie en voedsel*" (*"biotechnology and food"*) was organised at the initiative of the Netherlands Government. Institutions and organisations were invited to participate by organising public activities. The Department of Biotechnology's Public Relations Commission suggested the organisation of a citizens' court role-play session targeted to adolescents with the aim of increasing their awareness of the potentials of biotechnology for food provision worldwide. Following the success of its the National Science Day 2000 activities, the Department agreed to organise this activity as part of the national public debate and linked to the National Science Day 2001 with the theme of "*Food*".

7.3.2. Involvement in the Netherlands National Debate "*Biotechnologie en Voeding*" *("Biotechnology and Food")*

Introduction

The National Committee organising the Dutch *"Biotechnologie en Voeding"* national debate (Terlouw, 2002) had a small budget for the activities to meet the tasks prescribed by the Dutch Cabinet which were to improve information on biotechnology and food for the general public, to facilitate opinion-forming on the use of modern biotechnology in food and to discuss the boundaries people might wish to impose on its use. The Minister involved asked the Committee to pay particular attention to the factors considered important by the public for food safety, food and health, world food problems, the environment and consumers' interests. They also included ethical issues, labelling and the role of the Government, and the

European/international dimension of the issues. The Committee chose five themes with which to address these issues:

- Food safety
- Food and health
- World food provisions
- Environment and ecology
- Consumer interests, including labelling and ethical issues

The debate was organised to report public arguments and opinion, not to vote on the technology as in a referendum such as in Switzerland. It was officially launched with a presentation to which the general public was invited free of charge. This event was designed to explain the way the Committee planned to organise the debate around nine examples of which three were purely hypothetical. Industry, universities, pressure groups and consumer organisations were invited to present their views through exhibition stands in conjunction with a programme of lectures by invited politicians and experts. Information on the activities and background information on the discussion topics was displayed on a dedicated web site. About one hundred and fifty people in groups of twenty-five persons were chosen to discuss the pros and cons of biotechnology applications in food production. Schools and public organisations were invited to organise debates while the public was also approached through the media and via a special insert in the major supermarkets' free magazines. The Committee received twenty-six thousand responses resulting from six different advertisements in national and regional daily newspapers. A specially developed school "*toolbox*" was used by two hundred schools and a theatre group, *Pandemonium*, developed a theatre production.

Over ten thousand pupils variously participated in the debate. About eighty public organisations organised public events visited by varying numbers of people. There were also a number of expert meetings organised including talks by famous scientists, United Nations Food and Agricultural Organisation (FAO) experts and others. As part of these activities, the media increased their coverage of biotechnology mainly via news documentaries. Newspaper coverage was mainly through articles in the Saturday science supplements with most articles balanced and giving fair representation of the different views. The conclusions of the governmental Committee report were on the front page of most Dutch newspapers on the day of their publication.

The proposal of the TU Delft Department of Biotechnology to participate in the National Debate with an activity targeted to secondary school students of 15 to 16 years years of age was accepted and supported by the National Committee. The programme consisted of a role-play and theatre show linked to the theme "Food and Biotechnology". This was planned to be directly prior to the open day of the National Science Week to take advantage of the facilities already planned for the Science Day.

Objectives and set-up of activity for National Biotechnology and Food Debate

The objective of the activity was to increase the attention and hence the knowledge of secondary school students to the relations between biotechnology and food and provide input for the National Debate. The Department also aimed to show to a larger public that it was taking its responsibility to participate in the National Debate. A secondary objective was to increase the interest for biotechnology studies by presenting it as an interesting subject. The approach chosen was that of the then popular debate setting where opponents were invited to put forward their arguments. The debate was dressed up as a role play simulating a court case with which the organisers hoped to attract more media attention and hence reach a larger public. This was further enhanced by the invitation of a well-known television personality to lead the debate. Because the organisers were interested in the possible changes of opinions amongst the students, their opinions were assessed three times: once before the theatre and role-play, once after the theatre and before the role-play, and once after the role-play. A set of questions and statements to assess the students opinions were drafted and finalised after discussion with experts involved in the activity. The first assessment was taken by the teachers at school using a printed questionnaire. The second and third assessments were made at the Department of Biotechnology using an electronic voting system. The evaluation also aimed to critically analyse the appropriateness of the methodology. Table 7.3.2.1 shows the methodology used to reach the objectives.

Objective	Questions	Strategy	Activity
Involvement of secondary school students in National Debate	Can we increase the attention for biotechnology of secondary school students?	- Organise event at university - Take subject that is expected to be of interest to this age group - Involve professors, stakeholders - Involve known person	- Role play with professors + stakeholders - "*Food for the world*" as subject - Chaired by well-known Dutch person
Responsibility to large audience	Can the activity raise further publicity?	- Involve known person - Create setting that may interest media, that makes 'news' - Involve locally well-known people	- Pres releases + relations on activity and known Dutch person, before and after event - Invite manager of local supermarket
Increased number of prospective students	How can we interest 15-16 year old school students in biotechnology?	- Provide information study programmes - Show university setting - Create conducive atmosphere	- Brochures + gadgets distributed - Tour round the laboratory - Lunch in garden
Evaluation of methodology	When and how do opinions change during activity? What can we learn from that?	- Measure opinions before, during and after event - Discuss overall results with teacher and class	- Paper and electronic evaluations of opinions - Final evaluation with teachers

Table 7.3.2.1: Objectives of activity for National Debate "*Biotechnology and Food*" and strategies chosen to achieve them, Department of Biotechnology, TU Delft, 2001.

Three classes of approximately seventy-five students at the pre-university level local secondary school (Grotius College, Atheneum 4, aged 15 to 16 years) were invited to participate in a court case role-play in the lecture room of the Department of Biotechnology on Friday 5 October 2001. The question put to the court was: ”*Is biotechnology needed for our food of tomorrow?; biotechnologists against consumers”*. The classes formed the jury and among them they chose a total of six “lawyers”. The classes were expected to formulate a series of questions which could be raised “in court” by their representatives (their “lawyers”).

The Dean of the Faculty of Applied Sciences of the Delft University of Technology, Professor Karel Luyben, was asked to act as “biotechnologist” and Mr René Peek, manager of a local C-1000 food supermarket, was invited to act on behalf of the “consumers”. A panel of witnesses was formed to provide the argumentation and proof for or against the statement. This panel consisted of three professors (Professors Hans Tramper of Wageningen University, Fred Hagen of Delft University of Technology and Jan Maat of Unilever Research Laboratory) for the biotechnologists. For the consumers, Dr Wilma Aarts from the SWOKA Institute (Institute for Consumer Research), Dr Leon Jansen from the National Food Centre and Geert Ritsema from Greenpeace took their places in the witness box. Leonie Jansen, well-known in The Netherlands from television and music shows, acted as judge for the citizens court.

In order to prepare the school students, the information package on “*Biotechnologie en Voeding*” (“Biotechnology and Food”), prepared for the national public debate was provided two weeks before the role play, together with background information about the “witnesses”. Students were also encouraged to use their biology class books and the internet for further information.

In the morning of 5 October 2001 prior to the role-play, the Pandemonium theatre group performed a play addressing the issues of GM-food. This play was especially designed for the National Debate in close collaboration with the Rathenau Institute[32].

Figure 7.3.2.1: Theatre by Pandemonium during the dialogue activity for school students prior to the National Science Day, 5 October 2001, Department of Biotechnology, TU Delft

[32] The Rathenau Institute is an independent body founded in 1986 by the Dutch Ministry of Education, Culture and Science which also funds it. The Institute has two tasks: stimulating both public debate and the formation of political judgements, and analysing the Dutch science system.

Results of involvement in National Biotechnology and Food Debate
The secondary school, the Grotius College, Delft, was very enthusiastic about participating in this activity. The teachers cooperated by discussing the issues of biotechnology and food with the classes and allowing time for the preparatory work. The pupils from the three participating classes were divided into six groups, each group preparing a set of questions for the witnesses related to one of the sub-themes of the National Debate.

The following questions were prepared by the school students to ask the “expert witnesses”:

Food safety, represented by “lawyer” Jos Elferink

1. The controls for GM food are often done through experiments with rats. Rats are also waste eaters. When rats do not experience negative effects of the food, scientists conclude the food is safe for human consumption. How justified is this conclusion? To “witness” Dr Leon Jansen, Voedingscentrum
2. Researchers who work with GM organisms can sometimes restrict themselves to a report afterwards according to law. What is your opinion about this? To “witness” Drs Geert Ritsema, Greenpeace
3. Is it correct that we as consumers are just involuntary test animals by eating GM food? To “witness” Dr Wilma Aarts, SWOKA Institute for Consumer research

Food and health, represented by “lawyer” Arthur de Vreede

4. Is the production of GM food safe for people who have to work with the biological substances? To “witness” Professor Hans Tramper, Wageningen University
5. If genetically modified food were so good, how is it that many people have a negative opinion about this food? To “witness” Professor Jan Maat, Unilever
6. What do you think of pork cutlets that are made in the laboratory out of muscle cells of a pig? To “witness” Dr Wilma Aarts, SWOKA Institute for Consumer research

World food problems, represented by “lawyer” Sanne Verberne

7. How can biotechnology solve the food problems in the world if the problems are mainly related to logistic distribution of the food in the world? To “witness” Professor Fred Hagen, Delft University of Technology
8. What is the effect of biotechnological food to the economy of developing countries? To “witness” Dr Leon Jansen, Voedingscentrum
9. Which advantage have developing countries from GM food if the knowledge for production is predominantly held by western countries? To “witness” Professor Hans Tramper, Wageningen University

Environment and ecology, represented by “lawyer” Frank Mulder

10. What are the consequences of changes in the DNA of animals and plants for the environment in general? To “witness” Professor Fred Hagen, Delft University of Technology

11. Are there examples that changed DNA has an influence on other organisms in the close environment? We understood that BT-maize could have an influence on the population of Monarch butterflies in the United States. To "witness" Drs Geert Ritsema, Greenpeace
12. People say that biotechnological food has no effect on the environment in the long term. Is there evidence for this statement? To "witness" Professor Jan Maat, Unilever

Consumer interests, represented by "lawyer" Tessel Nederbragt

13. Has biotechnology an influence on the price of products? To "witness" Drs Geert Ritsema, Greenpeace
14. What is the interest of the consumer in the GM food that is now in the shops? To "witness" Dr Leon Jansen, Voedingscentrum
15. Does the label always have to mention the origin of GM food ingredients even if the substance is similar in chemical composition as the natural product? To "witness" Dr Wilma Aarts, SWOKA Institute for Consumer research

Ethics, represented by "lawyer" Eileen Monsma

16. Patenting of pieces of DNA is of importance for the expensive research that has to be done. Are you allowed to ask a patent on a piece of DNA? To whom does DNA belong? To "witness" Professor Fred Hagen, Delft University of Technology
17. Where is the border between what is allowed and what is not in biotechnology? To "witness" Professor Hans Tramper, Wageningen University
18. What do you think of square eggs? To "witness" Professor Jan Maat, Unilever

The expert witnesses had received their questions a few days before the event and had prepared their answer.

Figure 7.3.2.2: School students act as lawyers in a role-play debate on the importance of biotechnology for the provision of food for developing countries, 5 October 2001, Department of Biotechnology, TU Delft

It was noticeable that the scientists were much more factual in their responses than the environmentalist from Greenpeace. The professors emphasised the risk assessments which had been done and the legal framework which was in place while the Greenpeace representative spoke emotively about the loss of species and possible unknown side-effects. The results of the evaluation of opinions are summarised in Table 7.3.2.2.

DEBATE Food and Biotechnology 5-10-2001

First opinion vote by written assessment, second and third by electronic voting

	Agreed			Not agreed			Don't know		
	1st	**2nd**	**3rd**	**1st**	**2nd**	**3rd**	**1st**	**2nd**	**3rd**
- Biotechnological food is dangerous	5%	44%	41%	58%	42%	47%	37%	14%	12%
- **Genetically manipulated food can make humans healthier**	**38%**	**52%**	**52%**	**31%**	**39%**	**48%**	**31%**	**9%**	**0%**
- Feeding 10.000.000.000 people is a problem; application of biotechnology is a condition for a solution in the world food production	34%	46%	44%	28%	44%	54%	38%	10%	2%
- **Biotechnology is bad for the environment and ecosystem**	**15%**	**38%**	**45%**	**34%**	**31%**	**36%**	**51%**	**31%**	**19%**
- Detailed labelling is a source of psychological suffering	13%	17%	6%	49%	56%	85%	38%	27%	9%
- **Biotechnology is necessary for our food of tomorrow**	**31%**	**13%**	**10%**	**38%**	**80%**	**81%**	**31%**	**7%**	**9%**

Table 7.3.2.2: Results of three opinion polls before any information was provided (1); after information was studied and after a theatre play (2); and after role play (3) of 15 to 16 year old school pupils on biotechnology and food, Department of Biotechnology, TU Delft, 2001

The first opinion survey of reactions to the six statements was carried out by the teacher before any introduction on the topic. The results show a high percentage of "Don't knows" varying from 31 to 51%. The general attitude towards biotechnology was positive showing a modest agreement to positive statements and disagreement to negative ones. The second set of opinions on the same statements was measured directly after the theatre play of Pandemonia. It shows a clear reduction in "Don't knows" indicating that their own preparation in the topic plus the play provided trustworthy insights on which to base their opinions. These "Don't knows" were now divided between agreement and disagreement still showing a higher support for biotechnology food as a provider of technology that can make humans healthier and a support for the statement that the application of biotechnology is a condition to help the world food problem. A large increase was shown in the opinion that biotechnology food is dangerous (from 5% to 44%) and bad for the environment and ecosystem (from 15 to 38%) coupled with a slight decrease in these statements' opponents. The general statement *"Biotechnology is necessary for our food of tomorrow"* showed the greatest change. While 31% were agreeing with the statement before the activity started, 80% disagreed with it after their further introduction to the subject and the Pandemonia play. The third measurement was taken directly after the court role play. It again showed a further decrease in "Don't knows". A slight majority of 47% now no longer saw biotechnological food as something dangerous and also felt that GM food can make humans healthier (52% versus 48%). The majority also changed for biotechnology as a condition towards a solution of the world's food production problems as 54% did not agree with this statement. The highest number of "Don't knows" was recorded for the statement that biotechnology is bad for the environment and ecosystem with a majority of 45% agreeing with this statement. An overwhelming 81% did not think biotechnology is necessary for our food of tomorrow.

The evaluation of the event was carried out in a discussion by the teacher with his classes. It revealed that most had liked the theatre play but had not really enjoyed the court role play. The teacher added that according to his experience this group of 15 to 16 year-olds are easily influenced by the opinions of some critical fellow students.

The court case itself was experienced as boring mostly because its organisation was too constraining. The questions of the student lawyers were sent a few days before the activity to the "witness experts" and the judge chairman did not allow further questioning by the student-lawyers who had prepared some further critical questions. According to the teacher this refusal changed the attitude of the disappointed students and influenced the atmosphere to becoming too negative to biotechnology in his opinion. He suggested in future allowing more time to the student-lawyers for their preparation and also not providing the questions to the expert witnesses beforehand. He concluded though that the pupils had enjoyed the overall activity and that he himself would be interested and willing to participate in any future events (Voskuil, Osseweijer and Muilman, 2001).

7.3.3. Involvement in Science Day 2001

Organisation of Science Day 2001

The success of the participation in the National Science Day 2000 triggered the Department to be involved again in the National Science Day 2001. This time the Director of the Botanical Garden had also organised the national kick-off meeting to be in Delft and held on the Friday before the Science Day. The theme for 2001 was "Food". Since the Delft University of Technology Department of Biotechnology is not very active in this area it was decided not to include the information streets and the demonstration laboratory. This was further supported by the evaluation of the activities of 2000 which showed especially that the information streets took a great deal of preparatory time. As the children's laboratory activities were so popular these were again organised. Advantage was taken of the facilities provided for the National Opening including a large tent in the Botanical Garden with a professional cooking installation. These were used to provide cooking demonstrations and as a venue for the performances of the Pandemonia theatre group. The overall objectives of the activity remained the same as in 2000 and where possible a similar approach was taken.

Results Science Day 2001

On Sunday 7 October 2001 the Department of Biotechnology hosted the following activities:

- several performances during the afternoon of the Pandemonia theatre with the show: *"Met of zonder" ("With or without"),* a Jerry Springer-type of discussion between two potatoes. The audience was invited to decide which potato would be in the mash, the GM *Malthezer* or the biological *Eigenheimer;*
- cooking demonstrations and tasting with the opportunity to participate in the public dinner at 5PM;
- cholesterol testing;
- demonstration route through the Botanical Garden *"From plant to product"*;
- the Pokémon-themed (a theme based on a popular cartoon) children's laboratory, where children of 5 to 12 years of age could make hair gel, lemonade, superslime, cough mixture, etc.;
- interactive demonstration of LEGO Mindstorm;
- steam train and clown, Ronald McDonald provided in collaboration with McDonald food chain;
- lectures by staff members *"Food and health"; "New trends in food", "Natural drugs"*;
- café with live music.

The organisation of the press relations was completely in the hands of the communication expert of the Faculty and university staff of "Marketing and Communication" to which the Department delivered its input. Press releases were sent out in collaboration with the City of Delft which coordinated all the activities in Delft. In order to increase the interest of local neighbours, leaflets were distributed and a large banner was attached to the front of the building. A total of 1,600 visitors were received. Again the children's activities and especially the "fun laboratories" were most appreciated by both the children and the adults. The Pandemonia theatre shows were well visited and the cooking demonstrations were appreciated. The press coverage on the Science Day itself was remarkably less than in 2000 with only some local newsletters reporting on the event. A large number of staff members of the Department were again involved in the activity and were treated to a dinner in the Botanical Garden tent after the event.

Figure 7.3.3.1: Announcement of Open Day 2001, the Department of Biotechnology, TU Delft

7.4. Concluding remarks

In 2000 the Department of Biotechnology of the Delft University of Technology organised a Science Day for the public which attracted 2,000 visitors. The objectives were to interest people in biotechnology developments, create a positive association with biotechnology and stimulate young people to consider a career in biotechnology (Osseweijer, 2004). The approach of dividing the general public into a number of different target groups was based on the premise that messages and activities could then be better designed to meet the interests of the different groups. This approach worked very well in creating a positive feeling as is confirmed by the responses in the questionnaire shown in Table 7.2.2.1. Although the majority of parents also responded that they most liked the "fun laboratory", they were not allowed to do the experiments themselves. In discussions with visitors it emerged that they especially liked it because they loved to see their children so enthusiastic in these activities. In line with one of the recommendations of the Workshop on Future Issues (Chapter 6), the information provided for adults was focused on showing the benefits of the activities in the Department of Biotechnology with the emphasis being on the possible uses of the products from its research. Risk perception theory had demonstrated that people tend to feel more threatened by vague, intangible abstractions than by real, concrete things. Therefore it was decided to show as many products as possible so that people could see, feel, smell and, if appropriate, taste them. The collaboration with regional and national companies worked very well to achieve this. The visitors appreciated it with many participating in discussions on how they felt about these products and the technology behind it. Quite a number also participated in the testing opportunities (20-30%). The objective of showing the benefits of biotechnology and providing an opportunity for discussing their concerns with the members of the public was therefore well achieved through this activity.

In contrast the specifically organised forum and workshop did not achieve as much appreciation. In order to address possible ethical concerns on biotechnology an appropriate theme was selected for a forum discussion during the first activity in 2000. At that time after the birth of Dolly, cloning was still a hot issue in the media and therefore a discussion forum was organised on cloning with the aim of responding to the questions and possible concerns of the public. The experience showed that not many people were active in asking questions and only a few who were approached beforehand asked their question often based on the example provided by the scientist. A similar reluctance in participating in a more dialogue type of activity was experienced with the workshop on recombinant DNA technology. This was organised together with DSM and included scientific experts from both DSM and the Delft University as well as the EFB Task Group on Public Perceptions of Biotechnology. In spite of much publicity the activity did not attract many people and the discussions were tame. From these results we can conclude that these activities were not very effective in interesting people in discussing the issues of cloning or recombinant DNA.

Objective	Questions	Strategy	Activity	Evaluation*
Increase science knowledge of visitors (I)	- How can we get people interested in coming? - How can we get them motivated in participation?	- Wide advertisement - Division in target groups - Motivation + interest through (their children's) entertainment - Address hot media topics - Address local issues - Address familiar home examples	- Press releases + relations - Local advertisement - Demonstration laboratory - Ancient laboratory - Fun laboratory - Information streets - Lectures	Well taken up Well taken up ++ ++ +++ ++ -
Create positive attitude (II)	- How can we address ELSA issues? - How can we motivate people to participate in discussions? - How can we create a positive association with biotechnology?	- Discuss controversial issues reported in media - Involve known speakers and professors - Discuss local issues - Link to entertainment - Discuss benefits/problems through experience + life examples	- Interactive forum with well-known speakers linked to entertainment - Workshop on r-DNA - Information streets - Using taste/smell/touch and competitions	+/- +/- ++ ++
Increase number of prospective students (III)	- How can we interest young people in biotechnology?	- Provide information study programmes + advice - Create conducive atmosphere - Show employ - Make professors available	- Stand with study programmes + study advisor - Information streets with industrial participation - Involve professors	Not measured
* Key for Table: -: net proportion of answers reporting activity as the least interesting; +/-: reported as the most interesting and as the least interesting activity +: > 15% net answers to most interesting activity ++: > 30% net answers to most interesting activity +++: > 50% net answers to most interesting activity n.a.: not measured				

Table 7.4.1: Objectives of participation in Science Day 2000 compared with results based on observation, discussion and questionnaire evaluation. Department of Biotechnology, TU Delft

Although this may be due to the wrong selection of issues or their wrong introduction, it is suggested that these types of activities are less appropriate for a general public event. It is interesting to note that these dialogue-type activities such as the recombinant DNA workshop and the Forum on Cloning both attracted much less attention than the other, more one-way information type activities, such as the information streets. It proved very difficult to interest visitors in attending and actively participating in the discussions. Conversely it was not difficult to start a discussion on the benefits and costs of biotechnology in the information streets. Most visitors found the information street on health most interesting indicating that interest is linked with the provision of information that may be directly useful in one's own life.

Providing the opportunity for children to carry out their own experiments was based on the premise that engagement would increase interest and enthusiasm. The children's experiments were carried out in the laboratory rooms of the Department with close supervision and following the proper safety rules, providing white coats and safety glasses. These were a great success including with the parents. There was great demand for the '*Dexter diploma on biotechnology experiments'* given after three completed experiments and it provided a positive association for biotechnology in the children's as well as their parents' minds. Interestingly, not a single parent asked about the risks of the experiments. This was the most appreciated activity for both the parents and the children. It makes chemistry, DNA and laboratories come 'alive' and something one can associate with. From the positive response it may therefore be concluded that it provides a positive association to biotechnology.

One of the objectives of the day was to provide information on scientific work practice to the public with the aim to build trust. This was done by bringing the scientists in direct contact with the public and creating a positive ambiance. The activity in 2000 attracted 2,000 visitors and a large, unknown number of people were presented with positive associations of biotechnology through the newspaper articles and television coverage. As described before, the evaluation questionnaire showed that 65% of the respondents spontaneously mentioned that they very much enjoyed the programmes. It is important to note that this positive result may have had a much wider impact than on just the 2,000 people who attended. Through their conversations with friends and family and through the press coverage, a much wider audience was reached with the message that the biotechnology day was interesting, fun or enjoyable.

Another result from the activities of the Science Day was that scientists were introduced to examples of public engagement which could encourage them to undertake further activities. It also provided a useful example of public communication to all the colleagues from other departments and faculties who came to the events. The senior scientists of the Department of Biotechnology were at first sceptical about the possible success and benefits, and worried about the considerable time commitment needed. These concerns were discussed at length in the Department's Board meeting which concluded with the decision to organise the Open Day in 2000 as a one-off experiment in order to learn from the experience and evaluate its outcomes. It helped that no budget allocation for materials was needed as this was provided by sponsors together with national, regional and central university funds. When asked for their input, the professors enthusiastically delivered their ideas and contributions. They also allowed their junior staff, PhD students, technicians and postdoctoral researchers to commit a significant amount of their time to the activity.

The evaluation was discussed in the Departmental Board meeting following the Open Day. The professors were all appreciative of the results and impressed by the number of visitors and media coverage. However they were still concerned about the enormous time investment for them and their staff, and wondered if involvement in these large time-consuming public activities could be justified as it detracted from the basic tasks of the Department in research and teaching. They nevertheless decided to continue the activities, although with decreased input, as was noted in the programme for 2001. The considerable outreach that was achieved through the activity together with the enthusiasm of the junior staff and the fact that the joint activity also had a positive effect on the atmosphere within the Department underlined this decision. The continued public success of the children's laboratory in 2001 led the Board to agree to repeat this activity on several subsequent open day occasions such as the *"Open Dag Chemie"*, the Netherlands national chemistry day, and many further occasions often linked to the National Science Day. Later events always included the children's laboratory. As the design, experimental protocols and time-schedules for the operation of the children's laboratories were already developed, it meant considerable less time investment for the supervising junior staff. These open days were held on Sundays with the junior staff running them in their own time, both of these factors being important for their supervisors' support and agreement.

The citizens court in 2001 with secondary school students was linked with the Science Day 2001 and the national debate on biotechnology and food. The activity was thoroughly evaluated by means of questionnaires completed by the participants before, during and after the event. The key finding of these evaluations was that support for the use of biotechnology for food production declined as more information and opinions were provided. The activity clearly showed a further polarisation resulting from the theatre play and the dialogue. The theme "*Is biotechnology needed for our food of tomorrow?*" deliberately addressed the world food problems, referring to many ethical and economical issues. The expert panel witnesses in the jury from biotechnology research and industry focused on the factual issues of safety and risk while the public interest organisation representative from Greenpeace focused on the emotional aspects of these issues. The Greenpeace representative's approach resulted in much greater empathy which probably contributed to the school students' polarisation. The teacher however stated that other social group processes influenced the results which makes it difficult to draw a conclusion.

Table 7.4.2 shows that the criteria for public communication were addressed. The brochures with information, the demonstration laboratory, the lecture presentations and the "information streets" on the Science Days and the package of information provided to the school students explained the scientific principles in detail (criterion 1). The potential impact, benefits and costs (criterion 2) were especially included in the lectures but were also addressed in the demonstrations and "information streets". On this occasion the aim was not primarily to promote biotechnology but to provide as balanced an explanation as possible. The Science Days aimed to achieve trust (part of criterion 3) which was done by showing real products to view, smell, feel and taste, by providing expert university professors' opinions about these products in the lectures and demonstrations and by providing experiments for children. The professors made themselves available during the whole day to answer questions and contribute to discussion, and thereby showed the human side of science. Interesting is the use of relationships to emotional values such as by the showing of live animals next to the related

Criteria for science communication		Science Day 2000	National debate Food & Biotechnology 2001	Science Day 2001
Knowledge				
1	Scientific data	++	++	++
2	Potential impact (cost and benefits)	+++	++	+++
3	Transparency for judgments	+/-	+	-
Skills				
4	Scientists in two-way interaction	++	++	++
Attitude				
5	Respect for public interest	+++	+	+++
6	Respect for ethical, legal, social aspects (ELSA) issues	++	+++	++

Table 7.4.2: Overview of criteria for biotechnologists' communication addressed in the Science Days and the activity of the National debate on Food & Biotechnology, Delft 2000 and 2001, (+++ = very well addressed; ++ = well addressed; + = addressed; +/- = partly addressed; - = not addressed)

veterinary products and by discussion of the needs of genetic disability patients in the forum in 2000. This may be seen as an early example of involving emotions in science communication activities and creating a link with happiness and personal satisfaction promoted by social psychologists and marketers (see Chapter 1.2.4). The approaches however were not designed to explain in detail the way scientific facts were verified. This was addressed though in the role-play court and discussion of the school students and stakeholders in some questions posed by the school 'lawyers'. The division into target groups was aimed at achieving maximum interest to the different public groups (criterion 4) by using topics that were anticipated to be interesting to them. For children this was done by linking the experiments to the popular Dutch TV cartoon series of Dexter and Deedee in 2000 and of Pokémon in 2001. The ethical, social and legal issues were discussed in the forum on cloning, during the workshop on recombinant DNA (criterion 6) and occasionally in the one-to-one interaction in the information streets. These issues were also very well addressed in the role play in the questions the students had prepared for the experts.

The experiences of the TU Delft Department of Biotechnology showed that after the initial reluctance of the professors expressed in the Board, all staff members including the Board became involved enthusiastically in the public activity. This was shown by the readiness with which the staff put the extra time and effort into the organisation and their agreement to help in later events. The involvement of all staff also showed that such joint activities were beneficial for the working atmosphere in the Department. The considerations of the Board mainly related to the fear of loss of the scientific output for which the Department is funded.

Although the Board recognised the enthusiasm and was happy to accept the additional time given by the staff, it did not actively support or politically argue within the Faculty for the further institutionalisation of these activities until 2002. Then an opportunity was provided to fund the activities including the staff time required through the Kluyver Centre for Genomics of Industrial Fermentation when the organisation of Science Days received a prominent place in the communication activities of its business plan.

San Francisco, 2004

"So, you want to talk about the precautionary principle?" I find myself opposite a protestor in the streets in front of the entrance of the BIO 2004 conference in San Francisco. A pity the other 19,999 participants prefer to stay indoors or pass quickly by, some curious about the arguments but most are just pleased there are only a few activists heavily outnumbered by San Francisco police (the odds were 80:650!). She, the protestor, was definitely sure, the precautionary principle should be applied to stop all biotech developments because it would just make big companies bigger. My arguments that this was an opinion against multinationals for which biotech was used as a vehicle and that her wish to totally stop biotechnology could actually deprive poor nations of much-needed medical and agricultural developments were wasted. But we had a good 15 minute debate. Is this what they mean with "public participation" ?

CHAPTER 8

Biotechnology scientists' views about public communication (2002-2005)

8.1. Introduction

This chapter addresses the question *"How do biotechnology scientists view their own role in public communication?"*

In 1997, a small opinion survey was carried out by the TU Delft Department of Biotechnology in collaboration with the EFB Task Group on Public Perceptions of Biotechnology to obtain an indication of scientists' views about public perceptions of biotechnology (see Chapter 2). Unfortunately, the internet questionnaire-based studies did not yield enough respondents to be statistically significant and the limited funds of the Task Group prevented further manpower input. As the Department was interested in the indications which the study provided it was not taken further. The results indicated amongst other things that biotechnology scientists felt that they should take part extensively in a variety of activities related to public perceptions, in particular related to the development of safety regulations and legislation, but they also felt they had little influence in the forming of general opinions about biotechnology. The Department had been actively involved in developing and organising training in public perceptions and ethics (Chapter 5), organising sessions in scientific conferences (Chapter 4), organising workshops to discuss future societal issues and organising public activities (Chapter 6 & 7). However, during the many presentations and interactions at scientific conferences about these issues it appeared that the TU Delft Department of Biotechnology was one of the few that had already put some major efforts into organising events and was starting to discuss a strategy for public communication in a university setting.

After the considerable time investment of the staff in the organisation of the Science Day activities (Chapter 7) it followed that the involvement of scientists in such public communication activities was questioned by the Department management. It was realised that the views of scientists about engagement in public activities were not really known. This led to the investigation of scientists' opinions on public communications in general, and on the biotechnology issues in particular and their attitudes towards them. Three small-scale surveys amongst biotechnology scientists were carried out in 2002, 2003 and 2005. By that time a similar but larger and national survey had been published by the Wellcome Trust in the UK and the results are compared. Paragraph 8.2 describes the methodology used and the results, comparing a subset of questions between 2002, 2003 and 2005 responses. Paragraph 8.3 provides some concluding remarks. The data were presented at international conferences but are not published before.

8.2. Methodology and results of three surveys on biotechnologists' opinions for public communication

Methodology

A detailed questionnaire was prepared with forty-one questions, divided into five sections (Appendix 4). Two sections related to the background and knowledge about biotechnology developments of the respondents, two related to their own opinion about the issues in biotechnology and the final section dealt with the respondents' personal involvement in communication activities and their suggestions on how to improve public perceptions if they thought perception was too negative. In order to increase the response rate of questionnaires it was decided to link the survey to a presentation on public perceptions of biotechnology during the 22nd International Specialised Symposium on Yeast (ISSY 2001) in March 2002 in South Africa. The Symposium organiser agreed to send the questionnaire with a short introduction by email to the one hundred and nineteen participants. Participants were promised that their responses would be treated as confidential. The results were grouped by the continent of origin of the respondent, by their experience in the field of less than or more than ten years and by their industry or academic affiliation. The results were presented and discussed in plenary at the Symposium.

The survey was repeated in a similar way for the 11th European Congress on Biotechnology (ECB11), held in August in 2003 in Basle, Switzerland with approximately seven hundred and fifty participants. The results of this survey were presented during the session on bioethics. In 2005 the organisers of the international BIOTRANS symposium approved a similar request and sent the questionnaire to their four hundred and fifty participants. The results were presented during the Symposium dinner. The first questionnaire referred only to applications with GM yeasts as was appropriate for this Symposium, while the second questionnaire asked similar questions but referring to general applications of genetic modification. In the third questionnaire some open questions on how to improve public perception were replaced with questions on the opinion of scientists about priorities for communication content.

Results

In 2002, 57% of the participants returned the questionnaire (n=68 of the 119 participants). In 2003 one hundred and fifty-two responses were received from the seven hundred and fifty Symposium participants giving a 20% response rate and in 2005 one hundred and seventy questionnaires were returned with a response of 40% of the four hundred and fifty participants.

About half of the respondents of all three questionnaires had more than ten years experience in the field. The first survey showed that 77% were from academia, in comparison to 66% in the second survey and 71% in the third. The majority of the respondents came from Europe (65%, 66% and 68% respectively were based in Europe).

Although the respondents generally supported the development of GM crops for food ingredients (80% favour this development), fewer respondents indicated that they were prepared to eat GM food products. These opinions are very similar in 2002, 2003 and 2005. The respondents of 2002 were slightly more negative about the development of transgenic animals for pharmaceutical production that those in 2003 and 2005, but overall a large majority supported this (Figure 8.2.1).

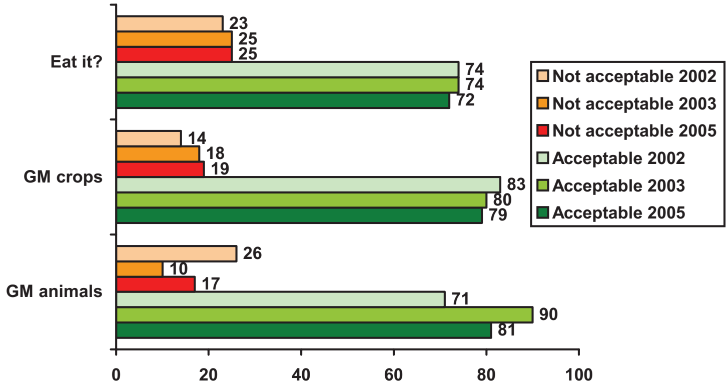

Figure 8.2.1: Comparison of responses (in percentages) of biotechnologists in 2002, 2003 and 2005 to the questions: *1) Do you eat GM food products yourself or would you be willing to eat them if they were available?;2) Are (parts of) genetically modified plants/crops acceptable as food ingredients?; 3) Is the use of GM animals acceptable for the production of pharmaceuticals?*

Figure 8.2.2 shows that just over 50% of the responding scientists found the introduction of GM micro-organisms in nature acceptable.

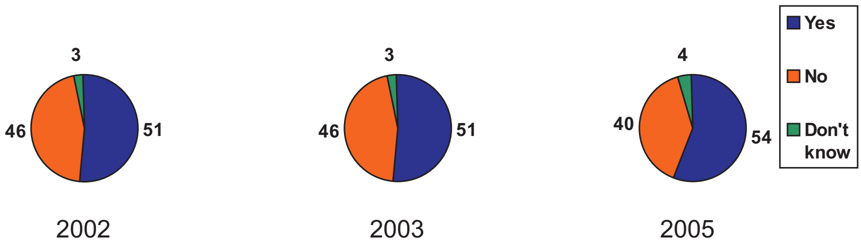

Figure 8.2.2: Comparison of responses (in percentages) of biotechnologists in 2002, 2003 and 2005 to the question "*Is the introduction in nature of GM micro-organisms acceptable?*"

A percentage of 70% in 2003 and 2005 was of the opinion that there are risks for health and environment in using genetic modification techniques.

In 2002 the question only referred to the use of genetic modification (GM) in yeasts, which was seen by 51% of the respondents as risky (Figure 8.2.3).

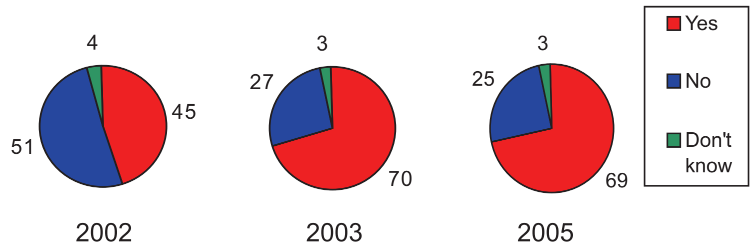

Figure 8.2.3: Comparison of responses of biotechnologists in 2002, 2003 and 2005 (in percentages) to the question "*Do you see any risks for health and environment in the use of GM?*" NB: in 2002 the question was different: "*Do you see any risks for health and environment in the use of GM Yeasts?*"

The question *"Do you think new applications of GM will lead to issues in public acceptance?"* asked about the opinion of scientists on public attitudes. In 2002 quite a number of scientists were uncertain about the development of public issues arising from new applications using GM yeast with 35% responding "Don't know", while in 2003 and 2005 the majority felt that issues would occur in public about applying genetic modification techniques in general (Figure 8.2.4). The question *"Do you see any moral problems in using GM"* asked scientists' own opinions and revealed that only 17% of the yeast researchers had any moral considerations about GM applications in yeast but that 41% (2003) and 36% (2005) of the scientists saw moral problems in general GM applications (Figure 8.2.5).

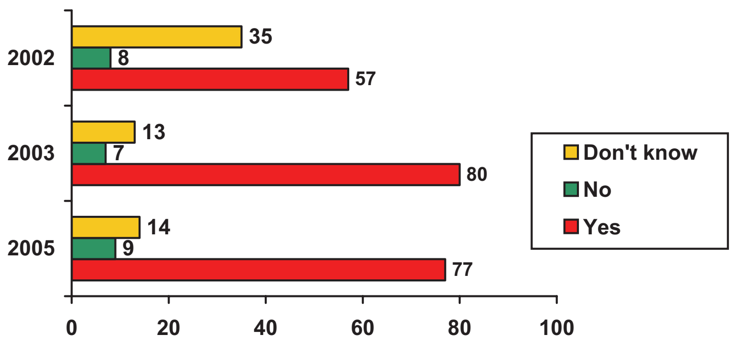

Figure 8.2.4: Comparison of responses of biotechnologists (in percentages) to the question "*Do you think new applications of GM yeast will lead to issues in public acceptance?*" in 2002 and "*Do you think new applications of GM will lead to issues in public acceptance?*" in 2003, 2005

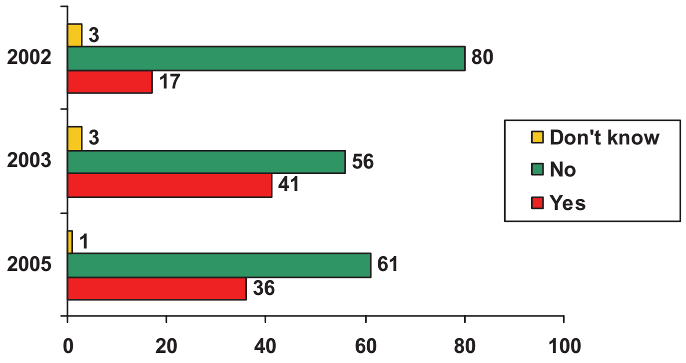

Figure 8.2.5: Comparison of responses of biotechnologists (in percentages) to the question "*Do you see any moral problems in using GM yeast?*" in 2002; rephrased "*Do you see any moral problems in using GM?*" in 2003, 2005

The next questions deal with the opinions of scientists about their own role in public communication and their past contributions to it. Firstly they were asked if they thought it was their task to communicate, later they were asked if they thought it was important that scientists communicate to a larger public. It is interesting to see that 90% of the respondents thought it important that scientists communicate but that only 41 to 68 % in 2005 and 2002 were of the opinion that it was their task to communicate. Differentiation between industrial and academic scientists in the respondents of 2005 showed that more in industry than in academia believed it was their task to communicate (39% versus 47%), while 93% of academics and 89% of industrialists thought it was important for scientists to do so (Figure 8.2.6 and 8.2.7).

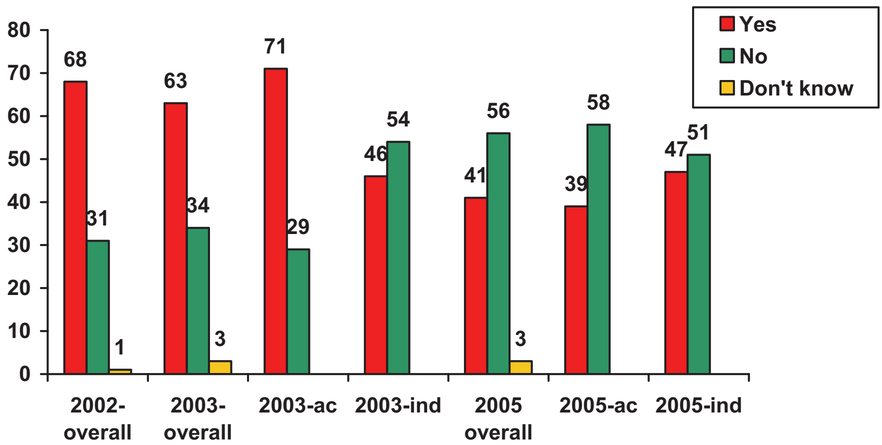

Figure 8.2.6: Comparison of responses of biotechnologists (in percentages) to the question *"Do you think it is your task to communicate?"* in 2002, 2003, 2005 with differentiation between respondents from industry and academia in 2003 and 2005

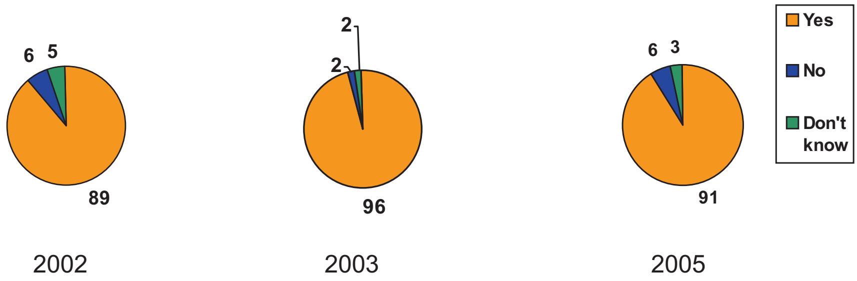

Figure 8.2.7: Comparison of responses (in percentages) of biotechnologists in 2002, 2003 and 2005 to the question *"Do you think it is important that scientists communicate to a larger public?"*

In order to investigate the possible constraints on scientists from being active in communication, respondents were asked whether they thought their own involvement would have an influence on their career. The majority of respondents in 2002 and 2003 believed that their communication activities were not beneficial to their career (59 %) while the answers in 2005 reflected that a majority did not know (47%) (Figure 8.2.8).

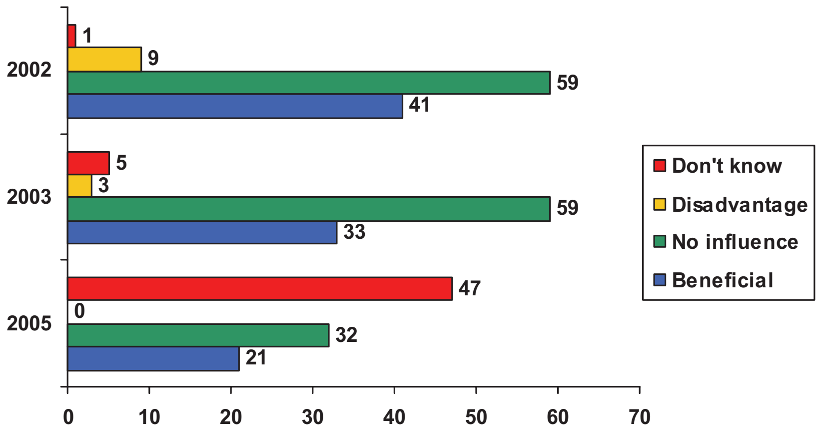

Figure 8.2.8: Comparison of responses (in percentages) of biotechnologists in 2002, 2003 and 2005 to the question "*Does public communication have an influence on your personal career?*"

In the last part of the questionnaire scientists were asked about their involvement in public communication activities and their possible training needs. Figure 8.2.9 shows the results in detail for the 2002, 2003 and 2005 questionnaire.

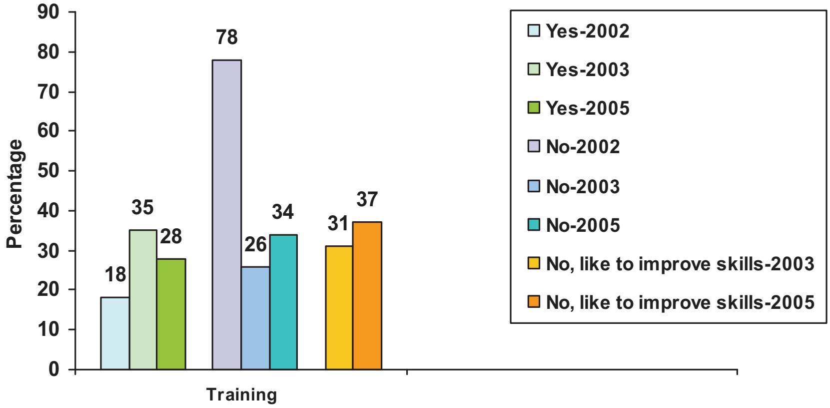

Figure 8.2.9: Comparison of responses (in percentages) of biotechnologists in 2002, 2003 and 2005 to the question "*Did you ever receive training in (science) communication?*". In 2003 and 2005 people could also chose the option "*No, but I would like to improve my skills*".

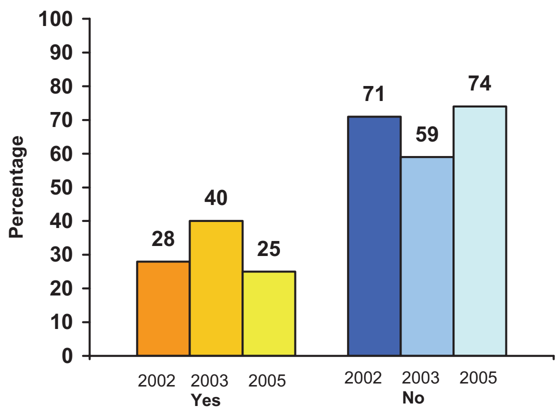

Figure 8.2.10: Comparison of responses (in percentages) of biotechnologists in 2002, 2003 and 2005 to the question "*Have you (over the past 5 years) been interviewed on your work by newspaper, radio or TV?*".

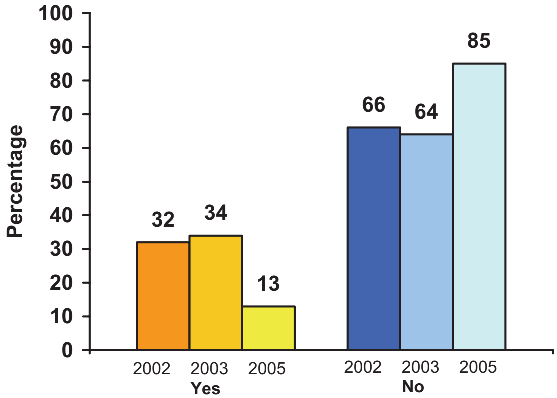

Figure 8.2.11: Comparison of responses (in percentages) of biotechnologists in 2002, 2003 and 2005 to the question "*Have you on your own initiative (over the past 5 years) published anything about your work for a general public?*"

The results show that not many scientists have been involved in communication activities. In 2002 and 2003 people were asked in a open question "*If you think the public perception of GMOs is presently too negative, could you give us any suggestions on how to improve this?*". Quite a number of suggestions were received, the majority suggesting increasing the provision of general scientific information and showing the benefits of new applications. The results on the question "*Does your employer allow you to spend time on public communication activities?*" in 2003 and in 2005 show a difference between industrial and academic scientists in 2005, but no significant difference in 2003 (Figure 8.2.12).

Figure 8.2.13 shows the responses of scientists in 2003 and 2005 to the question "*Do you think that the public sees scientists as a trustworthy source of information?*".

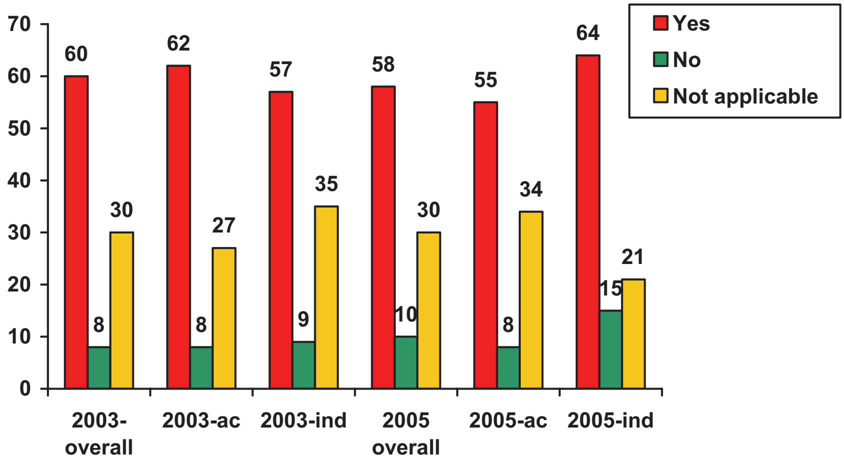

Figure 8.2.12: Comparison of responses (in percentages) to the question "*Does your employer allow you to spend time on public communication activities?*" in 2003 and 2005 with differentiation between respondents from industry and academia

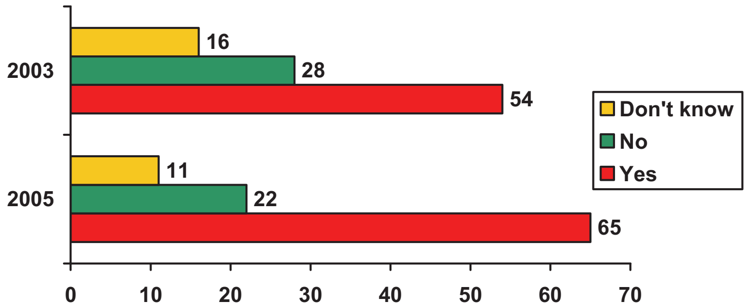

Figure 8.2.13: Comparison of responses (in percentages) to the question "*Do you think that the public sees scientists as a trustworthy source of information?*" in 2003 and 2005

In 2005, a list of criteria for communication were provided for three different target groups with the request to prioritise these for communication activities. The results presented in Table 8.2.1 show that there is a wide spread in responses as the standard deviation is at least 1.13 for a value between 1 and 5.

Question	Mean and Standard deviation	
27. What should be in your opinion the priority of the communication with politicians?		
(in priority 1 (high) –5 (low), please circle your choice)		
a. Explanation of science	**2.8**	**1.36**
b. Description of impact of technology to society	**2.0**	**1.35**
c. Building trust	**2.4**	**1.18**
d. Discussing ethical legal and social issues	**2.5**	**1.13**
e. Interest as many as possible	**2.7**	**1.36**
28. What should be in your opinion the priority of the communication with consumers and patients?		
(in priority 1 (high) –5 (low), please circle your choice)		
a. Explanation of science	**2.6**	**1.30**
b. Description of impact of technology to society	**2.2**	**1.34**
c. Building trust	**2.2**	**1.38**
d. Discussing ethical legal and social issues	**2.6**	**1.28**
e. Interest as many as possible	**2.5**	**1.37**
29. What should be in your opinion the priority of the communication with NGOs?		
(in priority 1 (high) –5 (low), please circle your choice)		
a. Explanation of science	**2.5**	**1.25**
b. Description of impact of technology to society	**2.1**	**1.25**
c. Building trust	**2.4**	**1.30**
d. Discussing ethical legal and social issues	**2.4**	**1.13**
e. Interest as many as possible	**2.8**	**1.43**

Table 8.2.1: Responses of biotechnologists on their views of priorities for communication with politicians, consumer and patient groups and non-governmental organisations (NGOs) in 2005

The results show that scientists say that all five criteria are quite important to address as all score a higher priority (< 3) than the mean (= 3) in the scale from 1-5. Discussing the impact of new technology for society and building trust score the highest for all three target groups, although the variation is quite considerable, as mentioned above.

8.3. Concluding remarks

It is interesting to see that a consistent group of 25% of the biotechnology scientist respondents indicated that they were not willing to eat any GM food products. More than 80% of respondents however supported the development of GM crops for food applications and the development of transgenic animals for pharmaceutical applications. At first sight this seems contradictory as at least a subset of respondents is willing to develop something they themselves are not going to use. However, these scientists may argue that they are happy for others to eat the products of their developments but just do not wish to eat them themselves.

The next interesting observation is that just under half of these scientists indicate that the introduction of GM micro-organisms in nature is not acceptable and more than 70% say that the use of GM is risky for our health and environment. Quite a considerable percentage (of 17 % for use of GM yeast in 2002 to 36 and 41 % for the use of GM in general in 2003 and 2005) also stated that in their own opinion they saw moral problems in using GM. The majority of the respondents worked with techniques for genetic modification and it may be concluded therefore that at least some scientists take some distance from their own opinions during their work which undoubtedly contributes to applications of GM technology. The majority indicates that public acceptance issues will arise from these developments and that scientists should be active in public communication. This in itself may provide a problem as that may result in scientists having to communicate about what they do which conflicts with what they believe.

These conflicting mindsets are referred to as cognitive dissonance (see Chapter 1). Festinger's cognitive dissonance theory (Festinger, 1957) suggests that people have an inner drive to hold all their attitudes and beliefs in harmony and to avoid disharmony or dissonance. When the mind holds two or more conflicting ideas at the same time, it will reduce the resulting tension by downgrading or repressing one of the ideas. The idea that will get repressed is the one which is most unfavourable to the self interest of the individual. The individual may be consciously unaware of this repression. However, to the external observer the resulting behaviour can be seen as conflict of interest (Knox and Inkster, 1968). It is this perception of conflict of interest that may hinder the scientist in his or her communication, especially when the communication becomes more two-way oriented. Scientists with a moral or intuitive problem on the applications of their work or part of it will try to avoid talking about these moral issues. It is suggested therefore that before scientists get involved in communication activities they reflect on their own opinions and develop a thorough understanding on the rational, intuitive and moral arguments they hold on the scientific activities they perform and on the applications of their research in general.

The responses show that in 2002, 2003 and 2005 a large majority of scientists (90%) agreed that it was important for scientists to be involved in public communication (Figure 8.2.7). A much lower proportion of less than 70% and in 2005 even less than 50% of these scientist respondents felt that it was their task to communicate to a larger public. The shift is totally due to the academic population where in 2003 71 % still indicated that it was their task to communicate while in 2005 this declined to 39 % of the academic respondents. This quite contradicts the statement by 92 % of the academics in 2005 that it is important for scientists to communicate to a larger public. If these results are compared with the activities of scientists in public writing and in interviews they show that only a minority of at most 40% say they have ever been involved in an interview and that even fewer say they have written something for the public on their own initiative in the five years previous to the questionnaire (32%, 34% and 13% in 2002, 2003 and 2005 respectively).

This therefore shows that although scientists think it is important that they communicate, they do not automatically view this as a task for themselves and they certainly do not all have the attitude to actually be involved. One could conclude from this that scientists feel that their tasks should be extended to include public communication activities. However only 8% of the academics in 2003 and 2005 indicate that their superior does not allow them time for these activities and only a very small percentage of 9% in 2002, 3% in 2003 and even 0% in 2005 indicated that they thought that being involved in public communication would harm their career. The majority therefore was not restricted by the person over them or their career prospects to include public activities in their tasks although it is interesting to note that a decreasing number of 41% in 2002 to 21% in 2005 indicated that involvement in public communication would be beneficial for their career. From this it could be concluded that academic scientists do not give priority to being active in public communication.

The Wellcome Trust/MORI and Royal Society surveys of UK scientists (MORI, 2000 and Royal Society, 2006) conclude amongst other findings that the vast majority believe it is their duty to communicate their research and its social and ethical implications to policy-makers and the public which correlates with the results of our international surveys. The conclusion in the Wellcome Trust/MORI and Royal Society studies that the overwhelming majority have not been trained to liaise with the media or to communicate with the public can also be confirmed by these three surveys as only 18% to 35 % said that they had ever received any training in communication. The UK studies however also concluded that UK scientists do feel restricted in being active in public communication while here it was concluded that the restrictions are not related to adverse career opportunities or by the time allowed by their superiors. The reasons for these restrictions must therefore be found elsewhere and may well be related to the lack of training of most scientists in this field. More than 30% of the responding scientists in 2003 and 2005 indicated their wish to improve their skills although this is not reflected in the attendance of communication courses as described in Chapter 5.

Conclusions Part III: Attitude and behaviour: Willingness to act

In order to be involved in science communication using the preferred dialogue model one needs to know about the societal issues that need to be addressed. Deliberation by leading scientists on future developments in science proved helpful in assessing the possible future societal issues in forthcoming areas of biotechnology as shown by the results of the European workshop on future issues in biotechnology in 1999. However, translating these rather general issues into practical public engagement activities remained a difficult task. These scenario forecasting meetings may be useful for designing pro-active public communication activities but more such meetings with adequate consideration about the objectives and approach of the public engagement need to be organised and analysed in order to confirm this.

Science Days for the public at large can offer opportunities for raising a number of societal issues in a variety of interactive communication activities. The Science Days organised by the Delft University of Technology showed that the informal interactive setting with entertaining activities worked best for adults. The introduction of science in a playful setting for six to twelve year olds can result in positive associations with science for the children as well as the adults.

The surveys into the views of scientists on their possible involvement in public communication revealed interesting observations relevant for the further institutionalisation of science communication. They showed that the majority of scientists are of the opinion that it is important that scientists communicate to a larger public. They also showed that scientists are not very active in public communication and engagement. Their attitudes towards the products or use of their own scientific research indicate that a large group of scientists do not reflect on their own involvement in scientific developments. This indicates a cognitive dissonance between the research objectives and the market aims and applications of their own scientific efforts. This may be due to the professional socialisation of scientists in a dominantly empiricist system. It is argued that this imbalance must first be resolved before these scientists start to engage in public communication to avoid a loss of trustworthiness in scientists with many direct and indirect effects on scientific developments and regulation.

Part IV: Institutionalisation: a new model for science communication

Delft, 1991

"No I am sorry madam, we do not have any specialist here who knows anything about sick snakes. Could you try the vet?" A few months later we were approached by a lady who asked how much ashes one could expect from a dead bunny, as she thought that a shoebox full was a bit much. "And could we perhaps analyse it then, to be sure?" Carla (Segaar), who received the calls at the secretariat suggested that we should inform people a bit better about what we do. That triggered a discussion on what, how and how much we should do and who should pay for it. This discussion is still continuing…

CHAPTER 9

Synthesis of drivers, objectives and costs for engagement in public communication activities

9.1. Introduction

As stated in Chapter 1, the general objective of science communication for a university department of biotechnology is not primarily to increase the acceptance of biotechnology but to inform the public about the science, its applications and its societal consequences, and to discuss the issues resulting from the implementation of the new technologies. The importance for a university department of biotechnology in doing so goes further than accountability for university funds received from society through taxes, it provides the basis for informed choices by the public for economic growth, health care, food security and safety and environmental protection. But what were the drivers for the Department of Biotechnology at the Delft University of Technology to become active in public communication? And did the costs of these activities influence the decisions?

This chapter addresses the questions *"What lessons can be learned from a series of communication activities within a university department of biotechnology over a period of fifteen years?"* and *"What drivers exist within the university organisation for a department to be active in public communication?"* Section 9.2 provides an analysis of the drivers, objectives and costs of the activities described in Chapters 2 to 8. Section 9.3 analyses the university organisation for drivers of public communication in the discipline of the Department and Section 9.4 provides concluding remarks.

9.2. Analyses of drivers, objectives and costs

In 1991 the anticipated negative public perceptions of biotechnology triggered the establishment of the European Federation of Biotechnology Task Group on Public Perceptions of Biotechnology in which the Department of Biotechnology was involved. Shortly afterwards the industrial partners of a European Commission-funded project on training needs concluded that scientists lacked appropriate training to deal with public perceptions and this recognition initiated the development of courses and skill training in biotechnology communication. Meanwhile the EFB Task Group sought support for addressing public perceptions and therefore lectures were organised to make the biotechnology science community aware of the needs for public engagement. By the end of the last century views on how to reach the public changed and the focus for one-way, information-driven activities shifted to public interaction and engagement, dialogue and debate. These new insights were included in the training courses which provided a continuous learning platform for the Department of Biotechnology. The new insights were tried in the organisation of Departmental public Science Days which offered an opportunity to engage in public communication. These drivers were all stemming from the scientific disciplinary network. The continuous involvement of the Department in the network provided an iterative learning process.

The following Table 9.2.1 shows the driving forces for the involvement of the Department in the activities described in this thesis. Figure 9.2.1 shows the interaction of the activities in the learning process.

Start time	Drivers	Objectives	Activities
1991-	- Anticipated negative public perception - Industry needs for public perception training	- Address public perception - Development of training modules	Involvement in EFB Task Group on public perceptions Courses
1994-	- Need for critical mass: organisation of involvement of scientists in communication	- Make (international) scientists aware of need for public engagement and their role in it	Lectures and sessions at international conferences
1998-	- Need for examples of public activities	- Show ways of public interaction	Media relations at conferences Public activities at conferences
1999-	- Need for pro-active communication	- Identify future issues and discuss possible activities	Workshop on future issues
2000-	- Trial of public activity	- Establish positive attitude to biotechnology	Science Days Court case role play in public debate on food

Table 9.2.1: Drivers, objectives and activities showing the involvement of the Department of Biotechnology, TU Delft, in public communication over the period 1991 - 2005

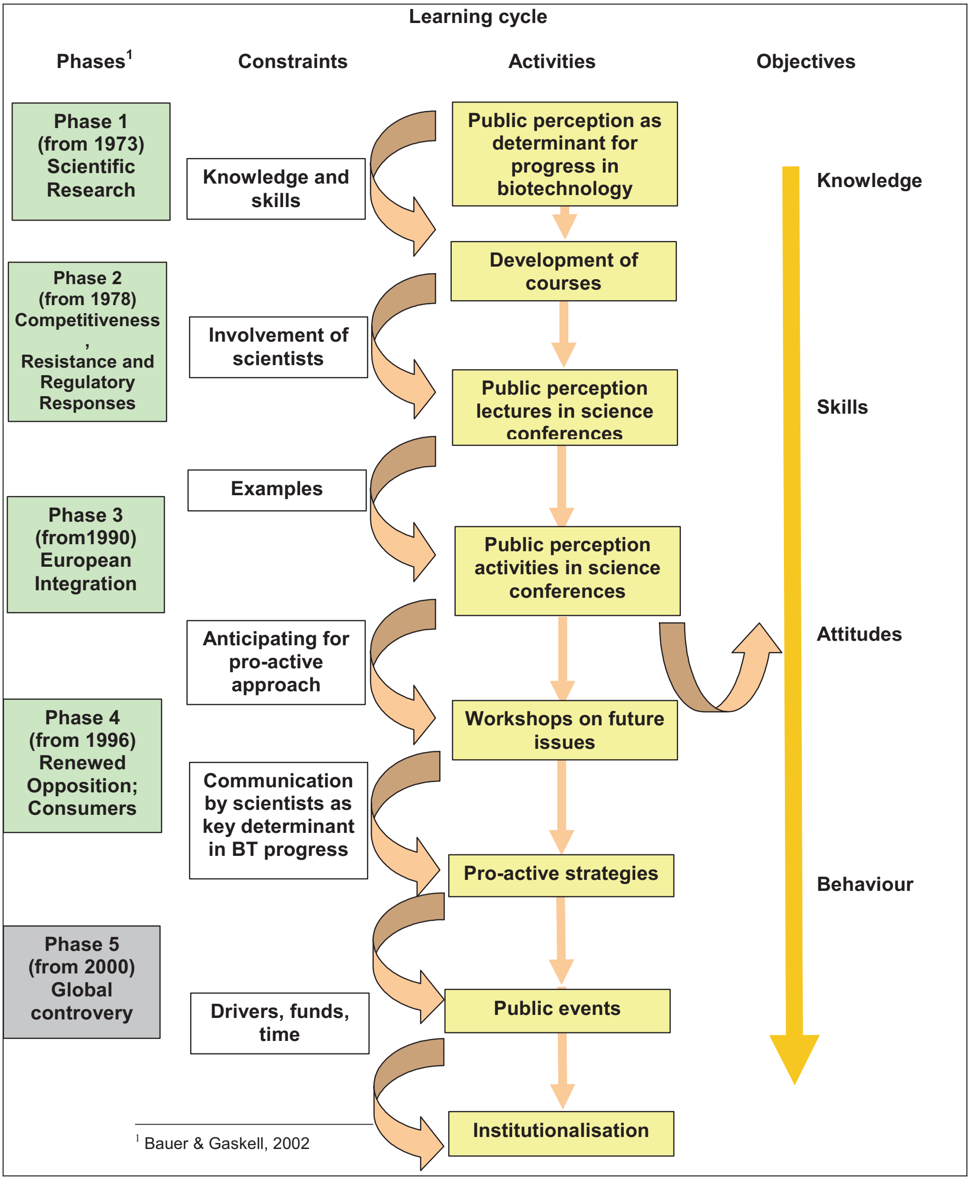

Figure 9.2.1: Iterative learning process for institutionalisation of science communication by the Department of Biotechnology, TU Delft, from 1991-2005. The constraints shown on the left-hand side of the activities influenced the content and focus of each of the next activity. The line on the right-hand side shows the increasing focus on behaviour, analogous to a higher degree of interaction between scientists and the public. To the left, a comparison with the phases relating to the social context as described by Bauer and Gaskell in 2002 is shown

The previous chapters described how a number of activities were maintained when funds became available from outside the Department to continue their organisation. How much do these activities cost and can we draw any conclusions from the evaluation of the communication criteria on which to build a communication strategy? Table 9.2.2 shows the costs in euros of a number of activities organised by the Department of Biotechnology. The Table specifies the direct costs for the organisation plus the indirect costs for personnel involvement based on the number of hours of staff time at average salary per staff category involved. The direct reach equals the number of participants and visitors to the event, the indirect reach sums the number of listeners, viewers and readers of radio, television and newspaper coverage of the activity. For the calculation of indirect reach, an arbitrary estimate of 10% of the average number of viewers, readers and radio listeners is taken in order to correct for the attention rates of the audiences. The indirect reach achieved by visitors who speak about the event to family, friends and colleagues is not included in this Table. A total cost for each directly and indirectly reached person is specified in the last two columns.

	direct costs*	total costs**	direct reach	indirect reach***	direct costs/ direct reach	total costs/ direct reach	total costs/ indirect reach
Open day 2000	**14835**	**45815**	**2000**	**171500**	**7.42**	**22,91**	**0.27**
demonstration lab	750	2670	1200	1200	**0.63**	2.23	**2.23**
information streets	4575	8655	2000	2000	**2.29**	4.33	**4.33**
fun lab	1550	6110	320	600	**4.84**	19.09	**10.18**
forum	2700	4620	100	100	**27.00**	46.20	**46.20**
workshop		300	20	20	**0.00**	15.00	**15.00**
brochures	1135	5935	1000	1000	**1.14**	5.94	**5.94**
lectures		1400	560	560	**0.00**	2.50	**2.50**
press		2400	5	169500	**0.00**	480.00	**0.01**
other costs, first aid	4125	13725	2000	2000	**2.06**	6.86	**6.86**
Open day 2001	**3850**	**14590**	**1600**	**10600**	**2.41**	**9.12**	**1.38**
fun lab	1250	4850	320	600	**3.91**	15.16	**8.08**
theatre	500	500	500	500	**1.00**	1.00	**1.00**
lectures		900	90	90	**0.00**	10.00	**10.00**
brochures	1100	3500	1000	1000	**1.10**	3.50	**3.50**
other costs	1000	3400	1600	1600	**0.63**	2.13	**2.13**
press		1440	4	9000	**0.00**	360.00	**0.16**
Role play court case 2001	**15500**	**22500**	**80**	**7500**	**193.75**	281.25	**3.00**
Open day 2004	**1100**	**7100**	**2500**	**7000**	**0.44**	**2.84**	**1.01**
fun lab	1100	4700	320	600	**3.44**	14.69	**7.83**
other costs		2400	2500	**2500**	**0.00**	0.96	**0.96**
Workshop Future issues 1999	**25000**	**136200**	**26**	**1000**	**961.54**	**5238.46**	**136.20**
event	25000	108200	26	26	**961.54**	4161.54	**4161.54**
preparation/after care		28000	26	**26**	**0.00**	1076.92	**1076.92**

	direct costs*	total costs**	direct reach	indirect reach***	direct costs/ direct reach	total costs/ direct reach	total costs/ indirect reach
Symposia sessions							
ESBES 1998		910	235	1000	**0.00**	3.87	**0.91**
ESBES 2000		1400	334	**1000**	**0.00**	4.19	**1.40**
ESBES 2002		1400	280	1000	**0.00**	5.00	**1.40**
ESBES 2002 newspaper	500	1900	280	**1000**	**1.79**	6.79	**1.90**
Yeast conference	**15000**	**27600**	**281**	**550281**	**53.38**	98.22	**0.05**
media	12000	14800	10	550000	**1200.00**	1480.00	**0.03**
panel	1500	4300	281	**281**	**5.34**	15.30	**15.30**
tasting event	1500	8500	281	281	**5.34**	30.25	**30.25**
Media presentation*							
interview newspaper regional		400	1	7000	**0.00**	400.00	**0.06**
interview newspaper national		800	1	50000	**0.00**	800.00	**0.02**
interview newspaper national, science		800	1	50000	**0.00**	800.00	**0.02**
interview journal		800	1	500	**0.00**	800.00	**1.60**
interview radio regional		400	1	50000	**0.00**	400.00	**0.01**
interview radio national		600	1	100000	**0.00**	600.00	**0.01**
interview tv regional		2400	1	2000	**0.00**	2400.00	**1.20**
interview tv national		4800	1	90000	**0.00**	4800.00	**0.05**
public lecture		1400	100	100	**0.00**	14.00	**14.00**
brochure		2240	1000	1000	**0.00**	2.24	**2.24**
stand/day	750	4110	500	500	**1.50**	8.22	**8.22**
stunt Biovision	500	6220	2500	2500	**0.20**	2.50	**2.50**
WWW surveys questionnaires	**9000**	**9000**	**500**	**500**	**18.00**	**18.00**	**18.00**
questionnaires	**100**	**2900**	**500**	**500**	**0.20**	**5.80**	**5.80**
Imagine, round 1****		**150000**	**500**	**200000**	**0.00**	**300.00**	**0.75**
Oxford course							
participation course	2500	4900	1	1	**2500.00**	4900.00	**4900.00**
organisation course	50000	55600	45	45	**1111.11**	1235.56	**1235.56**

** Direct costs in euros: all outgoing expenses; ** total costs: outgoing expenses + personnel costs based on marginal costs per hour for academic and support staff; *** indirect reach include audiences reached through the media. From the average numbers of audience (age 6 and higher for television; age 10 and higher for other media) 10% is taken as an arbitrary measure to correct for the attention of viewers, listeners and readers (sources: Stichting Kijkcijfers Nederland; www.radio.nl; media facts, ww.mediafacts.nl); ****Imagine is described in Section 9.3.*

Table 9.2.2: Costs of activities specified for direct and indirect costs (including personnel time) related to direct and estimated outreach in both preparation and organisation. Department of Biotechnology, TU Delft, 1998-2006

The Table shows that the total direct and indirect costs for organising a full programme at a public science day for 2,000 people are almost €46,000 which is equivalent, for example, to a year's salary for a starting postdoctoral researcher. Organising a course to train scientists in public communication costs over €50,000, while informing colleagues about the needs to address public perception issues costs about €1,000 to €1,500 per event. The latter can often be combined with scientific conferences by presentations and sessions which reduces the costs considerably.

The overview of costs gives some indication for event organisers which is important for their budget needs but does not indicate anything about the impact of the event in relation to the objectives of the activities. A general observation is that one-way activities are often much cheaper than dialogue and other interactive activities. Also the numbers for indirect reach do not give any indication of the reception people give to the information. Overall the retention and impact of the information provided is unknown except for the training courses which were evaluated on this as described in Chapter 5.

9.3. Synthesis of communication objectives, results, costs and evaluations

Table 9.3.1 provides an overview of the criteria for communication addressed by the courses, the workshop on future issues and the public activities in 2000 and 2001 organised by the Department of Biotechnology over a period of fifteen years. It shows that the attention for provision of information on the potential impact of biotechnology developments increases over the years and that the transparency for judgment and verification of scientific facts is addressed in the later courses but not yet in the public activities. The consideration for a strategy to encourage public interest was increasingly addressed in the courses and especially applied in the Science Day of 2000. The consideration of a strategy to understand and respond to ethical, legal and social issues was introduced in the courses since 1997 and applied in the public activities of 2000 and 2001. This strategy requires two-way communication methods. The way in which the elements of the public activities presented during the Science Day in 2000 achieved their original objectives is shown in Table 9.3.2.

Criteria for science communication		3-day industr. course '93-'95	3-day acad. course '96-'98	10-day course '97-'06	Future issues 1999	Science Day 2000	National debate 2001	Science Day 2001
Knowledge								
1	Scientific data	+	+	+	+++	++	++	++
2	Potential impact (cost and benefits)	+	++	+++	+++	+++	++	+++
3	Transparency for judgments	-	+	+++	+/-	+/-	+	-
Skills								
4	Scientists in two-way interaction	+	-/+	++	+/-	++	++	++
Attitude								
5	Respect for public interest	++	-	+++	-	+++	+	+++
6	Respect for ethical, legal, social (elsa) aspects	-	+	+++	+/-	++	+++	++

Table 9.3.1: Overview of criteria for biotechnologists' communication addressed in the activities organised by the Department of Biotechnology, TU Delft, 1993-2006 (+++ = very well addressed; ++ = well addressed; + = addressed; +/- = partly addressed; - = not addressed).

Objective	Strategy	Activity	Evaluation*
Inform visitors on science (I)	- Wide advertisement - Division in target groups - Motivation + interest through (their children's) entertainment - Address hot media subjects - Address local issues - Address home examples	- Press releases + relations - Local advertisement - Demonstration laboratory - Ancient laboratory - Fun laboratory - Information streets - Lectures	Well taken up Well taken up ++ ++ +++ ++ -
Create positive attitude (II)	- Discuss controversial issues reported in media - Involve known speakers and professors - Discuss local issues - Link to entertainment - Discuss benefits/problems through experience + life examples	- Interactive forum with known speakers linked to entertainment - Workshop on r-DNA - Information streets - Using taste/smell/touch and competitions	+/- +/- ++
Interest prospective students (III)	- Provide information study programmes + advice - Create nice atmosphere - Show employ - Make professors available	- Stand with study programmes + study advisor - Information streets with industrial participation - Involve professors	Not measured
* Key for table (n=164): -: a net proportion of answers referred to it as a least interesting activity; +/-: as many reported it as a most interesting and as a least interesting activity +: > 15% net proportion of answers to most interesting activity ++: > 30% net proportion of answers to most interesting activity +++: > 50% net proportion of answers to most interesting activity n.a.: not measured			

Table 9.3.2: Overview of objectives and evaluation of activities by visitors of Science Day 2000, Department of Biotechnology, TU Delft

At first sight the evaluation of objectives indicates that the first objective to inform visitors on science was especially appreciated by the visitors and that it is not easy to create a positive attitude. However, in looking closer at the activities, the most appreciated and popular one (also for the parents!) was the ‘fun’ laboratory organised for children. This activity used the strategy of linking with entertainment such as the ‘cartoon network’ diplomas which created a positive association with laboratory work in general. The national television covered this activity as a nice event giving a positive five minute impression to 1.1 million people. The evaluation further shows that in these general public events the ethical, legal and social issues may be better addressed in settings such as the “information streets” than in specially organised forum discussions, especially when the costs of these activities are considered, assuming that the impact and retention of the activity is the same. The ‘information streets” cost €8,655 and the forum €4,620, but when calculated per attendant these costs become €4.33 per visitor of the streets and €46.20 per visitor to the forum, a factor of ten difference.

Figure 9.3.1 gives an overview of the total costs of the components of the activities during the Science Day 2000 per visitor and per indirect member of the public reached and Figure 9.3.2 compares the way these activities addressed the criteria for communication.

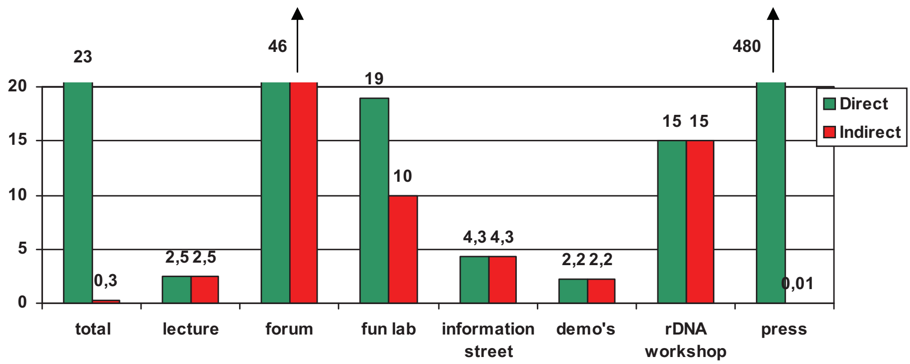

Figure 9.3.1: Comparison of costs in Euros per visitor (n=2000) and per person indirectly reached through the communication activities at the Science Day 2000, organised by the Department of Biotechnology, TU Delft

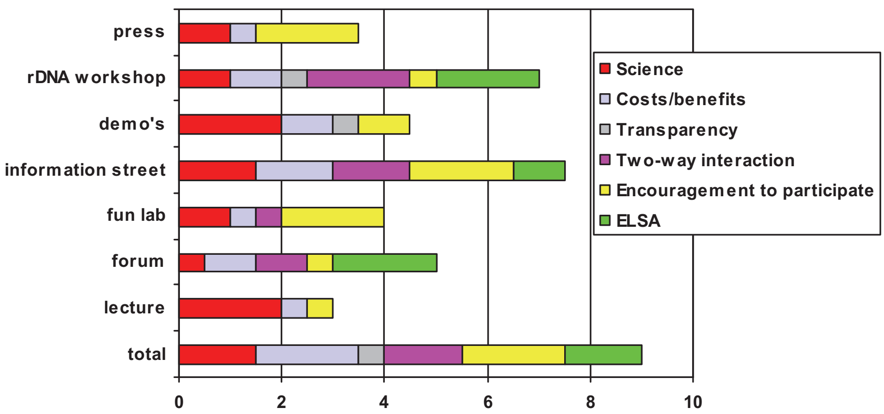

Figure 9.3.2: Comparison of number of criteria for communication addressed in the different activities organised during the Science Day 2000 by the Department of Biotechnology, TU Delft. (the measures of table 9.3.1 are translated as follows: -=0; +/-=0,5; +=1; ++=1,5; +++=2)

As shown by the two Tables, the "information streets" score very well as they combine most criteria for a reasonable cost per visitor. The interactive set-up of these "streets" provides opportunities for two-way communication and has a low threshold for people to attend.

The overall results show that it is possible to address science, the impact of the technological developments and the possible ethical, legal and societal issues. In order to do this one needs a number of skilled staff members, a strategy to reach as many as possible and a strategy to discuss the ethical, legal and social issues. Chapter 5 has shown that it is possible to train scientists to acquire the necessary skills to be involved in public communication and organise activities with the aim of understanding and responding to ethical, legal and social issues. The reluctance by the management of the Department to repeat the full set of activities organised in 2000 relates to the considerable financial and time investments which competed with research and education goals. This constraint is related to the organisation of the university as a whole and an analysis of the university setting is given in Section 9.4. Another constraint is the lack of a strategy to define which activities can best be organised and how. This will be discussed in Chapter 10 which presents a model for institutionalisation of science communication.

9.4. Analysis of drivers of the university organisation for departments to be active in public communication in their discipline

Up to now Dutch universities have received funds for research on a historical basis and funds for education on the basis of the number of students entering and receiving a degree.

Variation between universities is substantial and differs for research funds from 2% to 18% of the €935 million provided each year in the "Strategic Research Component" (SOC) budget for The Netherlands. University Boards decide on the internal distribution of these funds between the departments, often based on strategic choices together with administrative allocation models, weighing output in publications and number of PhD theses. The financial allocation for teaching also differs between universities.

In the Delft University of Technology the majority of the incoming finances are divided between the faculties (situation 2005). Each faculty receives a lump sum based on the relative scientific output, infrastructure (equipment necessary to do the research and teaching), and educational activities. A complex system of awarding points for scientific research output based on publications taking into account impact factors of journals, patents and completed PhD theses, is used to calculate each year's allocation to the faculty and a similar model is used for the allocation of educational funds. A relatively small budget for additional measures is used by the Board of the university, for example to encourage novel teaching methods or to initiate new research activities. Each faculty uses its own allocation model to divide the lump sum between its departments. The Faculty of Applied Sciences, to which the Department of Biotechnology belongs, divides its lump sum over its six departments using an allocation model based on teaching and research output and a fixed lump sum which has been set for a number of years based on the number of permanent staff in the department. The research output is calculated using the same model as the university and counts for 40% of the lump sum and the fixed amount counts for another 40% of the allocation while the educational output of each department makes up the remaining 20% based on a complex model with weighting factors for intensive teaching methods and student numbers. The majority of departments also receive income from externally financed projects, for example from the Netherlands Research Organisation (now), the European Commission and contract research with industry. In the allocation from the faculty no funds are received for science communication activities. This means that all activities which a department organises in this field without external funding directly decreases the income of the department as each hour by the staff not spent on teaching or research output will influence the allocation. Therefore not only the activities' direct costs need to be covered but also the indirect costs for personnel need to be incorporated. This negative driver greatly influences the willingness of the departments to be active in public communication activities.

There are some changes in our present society already discussed in Chapter 1 that may influence this negative driver for public communication. The constraints and incentives of past societal pressures and recent pressures for public communication are discussed below.

The Dutch government is presently taking an active role in implementing research innovation by stimulating technology transfer from academia to industry. With its innovation platform chaired by the Prime Minister, it aims to expand its export position as a knowledge provider[33]. The Netherlands, with its costly labour, infrastructure and highly educated population is increasingly viewing its economic future as dependent to a large extent on knowledge production and export.

The present Minister of Education and Research, Mrs Maria van der Hoeven, wishes to change this historical distribution and has proposed a new scheme called ‘Smart Mix’. The Smart Mix scheme will take €100 million from the SOC and match this with an extra €100 million taken from the budget of the Ministry of Economic Affairs[34]. This new policy for dynamic provision of government funding requires annual proposals from universities for specific projects. Novel elements in the evaluation procedure include the ‘*bonus-malus*’ provision[35] for university acquisitions in the external funding programmes, such as the Netherlands Science Foundation (NWO) and the European Commission.

This new policy can be seen therefore as a shift in decision-making power from university boards to government ministry-established evaluation committees. Hence it requires a more intensive commitment from universities to argue their choices for research. Up to now this has been carried out in small circles of politicians and academics without due attention to building commitment with other societal groups. As ministers are influenced by voters’ opinions, universities wishing to increase their influence on the research agenda-setting would be wise to obtain the support and endorsement of the electorate, which in turn would mean a higher level of involvement in public communication (incentive 1).

Industry aims to play an important role in setting the agenda for innovation and mainly relates to politicians and academics, stressing the importance of innovation for the economy. However, industry is viewed by the public as being rather untrustworthy (Eurobarometer, 2000). The biotechnology industry recognises that trust needs to be earned and maintained, and this requires interaction with society (Gaskell, 2001, 2003, Gutteling, 2003, Munnich, 2004). By means of scientific networks such as scientific expert societies and public-private partnerships they collaborate with scientists in public communication activities[36], aiming to build trust within the community.

Meanwhile pressure from society for involvement in the decision-making process is growing. Organised groups representing patients, farmers, environmentalists or activists attend debate sessions on new scientific developments in order to take part in the agenda-setting (Schenkelaars, 2004, Gaskell 2001). Some openly criticise the industry for pressing

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33 *“Sleutelgebieden for Nederlandse kennisinfrastructuur”*, Innovatieplatform, *(“Key Areas for Innovation Structure in The Netherlands”*, Innovation Platform), 2004

34 Oral presentation by Professor J. Fokkema, Rector, Delft University of Technology, 2004

35 From the Latin for “good-bad”: a system in which the participants are granted increases or reductions in their funding according to their positive or negative contributions.

36 Examples of these activities include science days, briefing documents, workshops, etc and the activities of the European Federation of Biotechnology Task Group on Public Perceptions of Biotechnology (1991-2006)

innovation forward. There are many examples of these interventions in the fields of nuclear energy and biotechnology (Gaskell 2001, 2003). However while companies have evolved strategies to deal with these demands from society, often based on stakeholder relationship practices or corporate responsibility strategies, universities as a whole have not responded in a similar professional way. It has been left largely to individual scientists to deal with these issues (incentive 2).

In addition, incentives for increased interaction between science and society come from the funding agencies with their recent objectives to this end. Both national research funding bodies and the European Commission are increasingly insisting that scientific programmes should address ethical, legal and social aspects (ELSA). The proposed approach is to use the dissemination of results to a wider audience as one of the evaluation criteria for research proposals. These research programmes often consist of multi-partner collaborations (incentive 3). Unfortunately most scientists who design the scientific programmes are often unfamiliar with dealing with these issues and experience shows that many refer to professional public relations agencies to fulfil this requirement[37]. The result is a separation of responsibility between the scientists involved in the research and the subcontracted agencies (constraint 1a). Politicians, journalists and members of the public much prefer to speak directly with the scientist in person as the expert rather than a public relations intermediary so this is not a satisfactory solution. Similarly it is scientists who are required for TV and radio programmes and other public events so public relations agencies are no substitute and if the scientist is not available when sought the opportunity for public communication is lost.

A similar situation can be seen within the Netherlands Genomics Initiative (NGI). The NGI was founded in 2002 by the Dutch government to establish and coordinate a national programme for genomics research. It aimed to establish a small number of national Centres of Excellence with a clear focus in research together with an integrated social programme addressing societal interaction and social and ethical research. During the thorough selection process it became clear that the proposed business plans did not comply fully with these intentions of the NGI. On the recommendation of the international evaluation committee[38], it was decided to establish a separate national Centre for Society and Genomics to focus its research on the societal issues and societal interaction. The four Centres of Excellence were requested to collaborate extensively with this separate Centre. Although the funds available provide an important incentive for scientists involved to increase their level of interaction with society, the separation also poses a division of responsibility (constraint 1b).

In many countries universities have relied by default on a reporting system of providing the required reports about their scientific strategies and efforts to the funding bodies. This is evaluated through quality assessments by scientific peers who base their assessment on a set of parameters including the number and quality of scientific publications. All these reporting

[37] Discussion of coordinators of European Commission Fifth Framework Programme Integrated Projects, Brussels, 2004

[38] Personal interview with members of international evaluation committee, 2003

systems remain therefore almost completely in the scientific domain. If the analogy with marketing is made, such a system would view the government as client and the university as provider, with the quality of the product assessed by other providers. Most universities do not have a strategic plan to inform a larger audience about their motives for their research programmes and neither do they provide any insight into the decision-making processes for these (constraint 2).

The peer review evaluation procedure and the financial allocation system results in stringent restrictions on the activities for scientists often referred to as "publish or perish". Moreover, these scientists are not trained nor rewarded for any involvement in public communication activities. Although some scientists are natural communicators, most hesitate about entering into a debate with opponents well-experienced in political and rhetorical skills. Although training courses were developed, the participation of scientists was very low which may be due to the fact that they were not rewarded by the institutional management (Osseweijer, 2004).

The surveys on scientists opinions carried out in 2002, 2003 and 2005 (Chapter 8) show a similar trend to the Welcome/Mori and Royal Society studies amongst UK scientists and confirm this view. For example in a questionnaire completed by one hundred and fifty-two participants of an international biotechnology conference, 96% stated that it was important for scientists to communicate to the public, of which 66% claimed that this was their own task. More than 80% indicated that the results of their research would raise public issues. However only 30% ever responded to a request for public communication and only 10% contributed on their own initiative. Similarly with the UK studies, the results of these small studies indicate that the lack of support by the employer inhibits scientists' involvement (constraint 3).

Until the 1970s the academic institutions in western societies rejoiced in the position of "*royal prerogative: above the law and beyond doubt*". Society was characterised as one of building power, with the family as a corner stone and education a great good. Research brought ever increasing numbers of products which made life easier, such as washing machines and vacuum cleaners. Harold Wilson, a UK Prime Minister of the period, famously spoke of *"the white heat of technology"* and *"electricity too cheap to meter"*. This unquestioned "*carte blanche*" for research became flawed however when people started to feel uneasy about the possible drawbacks of these developments. By this time western societies had an abundance of food, a safe house and an insurance for discomfort. In these modern developed post-industrial societies people were faced with a new dilemma (Bell, 1975; Pine, 1999; Piët, 2003). This "*everything can be made and bought*" society is referred to as the "new-economy", where everyone expects as a right to be healthy, well fed, housed and protected. When all our fundamental needs (as in Maslow's hierarchy of needs) are satisfied, it leads to fear of the threat of loss of the materialistic gains and to boredom (Csikszentmihalyi, 1975; Slovic, 1980).

Fear has contributed greatly in the debates about science and fuelled the growth of research on risk assessment, risk management, risk perception and risk communication (Beck, 1992; Adams, 1995; Rohrmann, 1999). It also brought about the reaction by groups who were openly questioning the benefits of scientific progress. This has especially hampered scientists in nuclear power research, and later in biotechnology. No wonder therefore that the first new interactions between science and society were often driven by academics within the scientific organisations of their particular field as these organisations provided advice, funds and experiences of best practice. It allowed for the development of science communication within some organised scientific societies. However governments also felt pressure and responsibility to become more active in science communication and this led to the establishment of governmental funded bodies such as the Foundation "Stichting PWT", later "Stichting WeTen" in The Netherlands and COPUS (Committee on Public Understanding of Science) by the UK Royal Society. Universities maintained their autonomous isolation as they saw responsibility for public communication moving to governmental funded institutes. This has recently changed however. A significant indication of the changing policy of The Netherlands government is the closure of the Dutch national science communication institute, "Stichting WeTen" in January 2005. The Minister has stated that "*universities are responsible for public communication of their research*" (incentive 4).

Table 9.4.1 summarises the incentives for more public communication by scientists and the constraints for scientists' active involvement.

Incentives	**Constraints**
1) Shift of financing from lump sum to programme financing decided by external research organisations with a need for universities to account for their activities 2) More requests of public groups to be involved in decisions on research allocations 3) More external funding programmes requesting attention for public communication 4) Shift of responsibility for communication from governmental organisation to universities	1) Financial allocation model of university[39] penalises disciplinary departments for involvement in public communication 2) Lack of training/experience on communication activities may lead to division of responsibility for communication and accountability 3) No evaluation procedure in use for public accountability of universities 4) Lack of rewards for scientists to be active in public communication

Table 9.4.1: Incentives and constraints for involvement in science communication by scientists in a university setting, 2006, Delft University of Technology

[39] This is valid for the Delft University of Technology. It is not assessed for other universities.

9.5. Concluding remarks

The results of the analysis of drivers, objectives and costs for public communication activities by scientists show that it is possible to address science, the impact of the technological developments and the possible ethical, legal and societal issues. This needs a number of skilled staff members, a strategy to reach as many as possible and a strategy to discuss the ethical, legal and social issues. The constraints for institutionalisation of profound public communication however are the lack of a strategy for the Department of Biotechnology at the Delft University of Technology to define which activities can best be organised and how, and the financial allocation model of the University which in effect penalises the Department for organising such activities. Therefore most activities were organised and continued for externally funded research activities. Although in itself this does not provide a problem, it does give a rather limited time span for the development of mid- and long-term strategies as most externally funded programmes are limited to three to five years duration. Neither does it solve the constraint of the lack of rewards for scientists as the university career progression system and the personnel assessment system are designed to stimulate research and teaching competences with some attention for managerial skills.

The current changes in society will affect the interaction between science and society. This, together with the increased emphasis on technology transfer requires an urgent evaluation of the relations between academia and society with respect to policy for science innovation and public communication. The universities have recently been given a greater task in public communication by the above-mentioned closure of the Stichting WeTen and the more onerous requirement for public accountability adds to that responsibility. This requires a change in organisational structure and an evaluation of the communication activities presently in place. Most universities have centrally steered strategies and public relations offices for attracting students and promoting the universities but public communication is much more than marketing and such offices are no substitute for scientists when they are required as experts in person by politicians, the media and for public events. Also the stimuli from funding agencies are research field-oriented and depend on limited project funding. The incentives for more public interaction through collegial networks and the discipline-oriented externally-funded programmes urgently need to be combined to central strategies for public accountability.

However, more is needed. The assessment procedures of scientific quality need to be evaluated for inclusion of these new tasks. There are presently already procedures available to assess this in the VSNU[40] self evaluation methodology but the universities are not yet structured to perform according to these criteria. All this puts emphasis on the question *"How can academia prepare itself for this new responsibility?"* Chapter 10 proposes an approach for institutionalisation of science communication taking these challenges into account.

[40] The VSNU (Vereniging van Samenwerkende Nederlandse Universiteiten; Association of Cooperating Dutch Universities)is presently responsible for the quality assessment of research in the Dutch universities. It recently launched a new procedure to assess public accountability entitled "SciQuest"

Somewhere between Delft and Prague, 1997

We (Karel Luyben and I) sit in a train to Prague. The waiter just brought another small bottle of sparkling wine and apologised, it is now 'finito'. We just have enough to complete our reorganisation of the Department and my role in it.

CHAPTER 10

A model for institutionalisation of science communication in a university setting

10.1. Introduction

The Department of Biotechnology of the Delft University of Technology has been involved in public communication activities since the early 1990s. The previous chapters have described the series of strategies that the Department has taken to address the growing unease in public perceptions about the developments of biotechnology applications. The results have shown that the involvement in an international network of industrialists, scientists, journalists, environmentalists and policy makers contributed to achieving a better insight into the societal context, and hence what to address and how to organise public communication activities.

The development of training courses over the period from 1993 to 2006 provided a valuable iterative learning process. The organisation of public activities gave further understanding about how two-way interaction can be achieved. The surveys amongst scientists and the analysis of drivers and costs highlighted the constraints for being active in public communication. They showed that most drivers to engage in public communication originate from the disciplinary field but that the present university allocation system hinders the institutionalisation of public communication by scientists. This resulted in the financing of public communication activities through short-term projects which inhibited the development of long-term strategies for public engagement and stimulated *ad hoc* activities.

However, new developments in the governmental allocation of finances and the societal interaction with universities may put greater pressure onto universities to become more active in public engagement both at the level of the university as a whole and at the level of the individual disciplinary departments. This requires a strategy for departmental engagement in public communication and a model for institutionalisation at the university level.

This chapter addresses the question *"What model (strategy) can be proposed to optimise public communication by scientists?"* and *"What can be suggested to remove the present constraints for public communication in the university setting?"*. Section 10.2 will propose a new disciplinary-oriented model for public communication and Section 10.3 will incorporate this into a university model addressing the removal of present constraints for scientists' involvement in public communication. Some concluding remarks are given in Section 10.4.

10.2. Introduction of a new model for disciplinary science communication: the "Three-E" model: Entertainment, Emotion and Education

As discussed in the introduction above, the incentive for organising public communication activities often lay in the adverse public opinions against new technological developments such as nuclear energy and indeed genetic engineering. Early on in the biotechnology public debate it was discovered that communication aimed at showing that concerned environmentalists are sometimes wrong on scientific data does put the communicator in a defensive position. It adds to the polarisation of public opinions which is not the objective of science communication. The introduction of the contextual or dialogue model responded to this point and put much emphasis on understanding and responding to ethical, legal and social issues. As was shown in Chapter 9 these kind of activities are costly and it is difficult to involve many people in them. However the ambition to reach a wider public still remains valid for reasons described in Chapter 1.

In order to engage a larger audience one can divide the public at large into a number of different groups with differing interests. For example genetic disability patients and their carers, farmers, shareholders, etc. can easily be involved in interactive activities because they have a direct interest. However, as pointed out by Adams (1995) and others, the majority of the public has no obvious interest at all. And this estimated 80% or more of the public with no direct stake cannot be forced to interact or attend workshops, debates or lectures. So how can we reach this large group of citizens? In marketing and television these audiences are reached by entertainment. When people are attracted to the entertainment and identify with the personalities and topics in the entertainment emotions are evoked and through the emotions people may be triggered to learn more.

This approach is followed in many television advertisements and is also used in television shows such as the Oprah Winfrey show and recently in BBC television programmes aiming to change attitudes to, for example, child-raising, eating behaviours and home water use. It makes use of the strategy described as the Entertainment-Education model[41]. The Entertainment-Education theory is a strategy that has been used and studied to maximise the reach and effectiveness of health messages through the combination of entertainment and education. It is most studied for its use to change behaviour and is based on Bandura's social learning theory (Bandura 1977, 1986). The studies on the effect of the Entertainment-Education model relate to one-way communication activities (through the Shannon-Weaver model of sender-channel-message-receiver) and are especially discussed in relation to their effectiveness to change attitudes in developing countries towards contraception and AIDS prevention such as in Africa (Rogers, 1999; Piotrow et al., 1992; Valente et al. 1994) and

[41] Research into the effectiveness of advertisement has extensively focussed on the validity of the so-called AIDA (Attention, Interest, Desire and Action) communication model (Strong, 1925). This model is based on the assumption of a simple hierarchy of effects. The order of the hierarchy, the role of emotions and the effect of involvement are highly debated. An overview article for further reading is published by Barry (1987). The Entertainment-Education model has elements of the AIDA model but focuses on education and attitude change.

unemployment such as in South America (Singhal and Rogers, 1999; Yoder et al. 1996; Westoff and Rodriguez, 1995). Bouman (Bouman, 1999) developed the Entertainment-Education model for its use in health education in The Netherlands and warned about the ethical issues of persuasion in this form of mass communication.

A similar approach using entertainment was also used by the Technical University of Delft Department of Biotechnology in their activities for the Science Day 2000, as described in Chapter 7, but in a more interactive setting. The entertainment of the visitors was achieved by organising competitions relating to TV cartoon network figures, young children's activities, and a forum in the format of a well-known television entertainment programme including a popular song. Emotions were evoked by showing the relations of animals to pharmaceutical products and also by the parents being proud about the achievements of their children in the "fun laboratories". Education was increased by the lectures, the demonstration laboratories and in the further interactions in the information streets. The evaluation showed that the visitors enjoyed the activities and many returned on subsequent Science Days, especially for the children's fun laboratory.

In retrospect, the link to emotions was rather thin and could be broadened. This is particularly important as emotions are linked to moral values and issues. As was shown by Gaskell, moral issues are important determinants of public support for new technologies. However they are often subconscious and unarticulated in peoples' minds (Durant called it the *"Yuk factor"*) and it is difficult to discuss the underlying values and principles that people hold. Emotions may reveal these moral issues and may provoke reflection. Two-way interaction on ethical, legal and social issues proved especially difficult to achieve. The specially organised forum on a hot topic with well-known moral issues such as cloning was not well attended. Also the people who attended the forum were not easily prepared to discuss their feelings or emotions on the subject. Similarly, the planned discussions on recombinant DNA were scarcely attended. This proved different in the "information streets" where people much more easily discussed what they liked and disliked and why, for example in the tasting events of the GM ingredients in bread products and the presentations on the local environmental accidental spills of molasses, showing their emotions and discussing their feelings.

In Chapter 1 it was argued that any consideration of approaches to communication activities should include strategies to encourage public interest in order to raise awareness and provoke involvement in the decision-making process. Both our observations and experiences of the link between entertainment and emotions in the Science Day 2000 and the observations in the media and in health education using the Entertainment-Education model lead to the suggestion of using this approach to encourage public interest in science. The approach is integrated in the resulting model for public communication by scientists and is presented here as the "Three-E" model for communication: Entertainment, Emotion and Education.

The model combines elements of the deficit model and the contextual or dialogue model[42]. It approaches the public as a single group in raising attention for science and technological developments. The model does not start from a differentiation into specific target groups but designs the communication plan based on consideration of the approach of the activities and relates in particular to the communicators' attitudes as discussed in Chapter 1:

1. an attitude to encourage public interest to raise awareness and provoke involvement in the decision-making process.
2. an attitude that shows understanding and guarantees responding to public interests and concerns, including ethical, social, safety and legal issues.

In practice the model approaches the public as a whole and then divides the audience into two broad types: the non-interested majority and the interested stakeholders. Because it does not otherwise characterise people it allows for the involvement of the large variability in audiences; the interested stakeholder group is a sub-set of the total public. As a result of the Three-E model approach people may develop an interest in a certain aspect of a technological development. At that point they become a stakeholder as they have a stake for whatever reason in the developments of the technology and become motivated to be engaged in interactive communication activities.

The objectives of the activities organised to show understanding of and responding to ethical, legal, safety and social issues define a dominant role for the contextual or dialogue model. On the other hand activities with the objective of encouraging public interest are preferably based on one-way communication through the media, internet and brochures because of their desired reach, and the high costs of two-way communication. However this one-way communication is also based on the principles of entertainment, emotion and education. The Three-E model approach provides the overall strategy using any desired combination of one-way science communication and various types of interactive communication such as dialogues, debates, workshops, interactive lectures, etc. The hypothesis is that the approach will help in affecting a broader audience, involving a larger number of stakeholders and initiating more discussion on moral issues.

The activities organised for both the one-way and two-way approaches ideally address the content criteria identified for communication in relation to knowledge:

1. provision of information on the scientific data;
2. provision of information on the potential impact of the implementation of the technology on society, including explanation of the benefits and costs and including a cost-benefit estimation if the technology were not to be introduced;
3. provision of transparency on how judgments are made, including explanation of the procedures in place to verify scientific findings.

[42] In this way it therefore essentially differs from the AIDA communication model which is developed for advertisement and does not specifically involve an approach to include a reflexive element. The emotions provoked are intended to make the underlying values more explicit.

Table 10.2.1 shows the elements of the proposed approach for science communication using the Three-E model: Entertainment (getting attention), Emotion (identification) and Education (information and skills for (future) decision-making)) and examples of activities.

Strategy	Dominant model type	Priority of criteria	Target group	Examples of activities
- Encourage public interest through Three-E-approach	One-way communication and mix of one-way and two-way communication	- Build trust by transparency - Information on potential impact of new technologies - Provision of scientific data	All, public at large, including youngsters, future students	- Science Days - Websites - Media activities, incl. television entertainment programmes - *Imagine* media - School visit programmes
- Understand and respond to ELSA issues through Three-E-approach	Two-way communication	- Information on potential impact of new technologies - Provision of scientific data - Build trust by transparency and verification of scientific data	Interested stakeholders; patient groups, farmers, NGOs, consumer organisations, industry, politicians, future students	- Workshops - Debates - Symposia - *Imagine* competition - School visit programmes - Science Days

Table 10.2.1: Elements of a strategic approach in science communication using the "*Three-E-model for science communication*", P. Osseweijer, 2006

The "Three-E"-model is an open approach to communication with the public at large. It does not start from the anticipated specific issues of different target groups. As such it therefore also facilitates the easier recognition of possible societal issues. As was concluded from the activities to identify future societal issues, it is difficult to identify new issues and new target groups. With the more open access of the Three-E model it is possible to create a learning process incorporating forthcoming issues from the public. For example, when the emotional reactions of the public are ventilated (e.g. either through commentaries on television programmes or reactions during public events) they can be responded to by scientists and other stakeholders. This approach also prevents the exclusion of new stakeholder groups such as NGOs or stakeholder groups that increase in importance in a decision-making process.

For example, a university department is inclined to pay most attention to the scientific peers and research funding agencies as they have a direct influence on the research agenda. Less influence is expected from the neighbours living opposite their laboratory so there is less inclination to address communication activities specifically to this group. This works both ways: the less a specific group expects to have possible issues with the research agenda of the scientific department, the less they are interested in the activities of the department. As a result it is more difficult to get attention for scientific developments and the social implications of these developments. Therefore, since their opinion does not immediately influence the research agenda, it is often decided not to address these groups. However, when a new application for approval of certain scientific experiments is required, local citizens are asked to give input in the decision for a permit. They have the opportunity to formally object to the permission. A communication strategy of the scientific department based on the Three-E-model provides a better guarantee that these groups are regularly reached and that their possible concerns are addressed earlier.

Another example is related to the unknown political drivers when a new technological development is implemented in society. The latest policy decisions to increase the use and production of biofuels has resulted in a complex of powerful political drivers to implement this new technology. This not only has a direct influence on the research agenda but also on many other organisations as the implementation progresses. Examples are companies presently working with fossil fuels as basic materials, the local petrol and diesel providers and the regional business development agencies. Their reactions may have influence on the interests of local citizens. For example, the city of Rotterdam can decide to push for a new use for its harbour facilities and develop the use of the present oil importation infrastructure into an infrastructure for biomass import and processing. This in turn may lead to issues in the local neighbourhoods which in turn may influence the research agenda. Early involvement of these citizens in interactive activities through a Three-E approach may result in early recognition and addressing of their possible issues.

The use of wood-like material for the production of bio-alcohol has become an interesting and possible alternative to fossil based oils to produce petrol now a novel yeast has been developed that can use wood-like materials for bio-alcohol production. This new and more economical route through industrial biotechnology may raise novel concerns in the public. Two-way interaction through Three-E approaches may clarify the possible issues that may arise in an early stage, which can then be discussed.

The model is also applicable to all other areas of science communication and is not restricted to the field of biotechnology alone.

10.3. Institutionalisation of science communication in a university

Removal of university constraints

In Chapter 9 the analysis of constraints revealed that there are presently four important factors that hinder the institutionalisation of science communication.

The first is related to the financial allocation system for university research and teaching. The Netherlands Government does not earmark any of the general finances given to universities for public communication activities and does not evaluate the performance of the university on them. Although separate programmes exist to encourage public interaction, these are often related to specific target groups or aimed at specific goals, such as the financial stimulus programme *"Platform beta en techniek" ("Natural Sciences and Technique")* which aims to motivate youngsters to choose studies in science and technology. Each university can choose its model for further allocation of the government funds. The Delft University of Technology has not incorporated public communication in its allocation model and neither has the Faculty of Applied Sciences to which the Department of Biotechnology belongs. This means that the involvement of Departmental scientists in public communication activities is not paid. In effect it costs the Department money as the scientist is temporarily unable to deliver research or education output which is rewarded by the allocation system.

The second restriction for scientists' involvement is motivation. The lack of a reward system in both direct rewards and rewards through the stimulation of competences results in the demotivation of staff from being involved in public communication activities. This indirectly also relates to the third constraint, the lack of skills. When competences for public interaction are not rewarded, scientists are also not motivated to follow courses or to send their PhD students or staff to courses.

So in order to institutionalise public communication universities needs to have a reward system in place for scientists who are willing to be active in public communication. The university also needs to either put science communication in its financial allocation model or put it on its strategic agenda which is translated into the strategic agendas of faculties and departments. The first necessitates a model for allocating points to communication activities, the second at least need SMART[43] goals to evaluate the achievements.

As there is at present a discipline-driven establishment of public communication activities it is necessary to align the communication programmes at the university level with the goals of the various disciplines. These all need to comply with the ambition and strategic objectives of the university as a whole.

In order to achieve an effective incorporation of public communication at all levels, the university needs to use a strategy to create motivation and commitment of staff. The strategy depends on the organisational structure of the university. Figure 10.3.1 summarises a strategy based on the Action Research Spiral described for case studies in institutionalisation which was presented in 2004 by Osseweijer and De Cock Buning (Zweekhorst, 2004). A more detailed description is provided in Appendix 6. The approach recognises the need for motivation of staff and combines a top-down with a bottom-up approach. Each phase represents an important objective:

[43] SMART: Specific, Measurable, Attainable, Result-focused, Time-oriented

- Phase 1 deals with the incorporation of the communication goals in the management model of the university and deals with the necessary adaptation of the financial allocation model or SMART goals.
- Phase 2 addresses the practical implementation in the different cultural settings of the faculties. In this Phase the focus is on awareness building and commitment creation. A translation of the incentives suggested by the Board of the University for rewards are evaluated for their use and impact on the Faculties' strategic management procedures.
- Phase 3 establishes the implementation of the recognised new tasks in the departmental units by deciding on the way scientists are selected and encouraged for the communication activities and how this is implemented in selection of new staff, assessment of staff competences and which strategy is followed to encourage scientists to implement the new tasks.
- Phase 4 establishes a cultural change in the departments to incorporate the new tasks including the implementation of the necessary knowledge, skills and attitudes. This Phase follows the decisions for the introduction of change and addresses the ideas and issues of staff members.
- Phase 5 implements the continuous evaluation procedure to allow for learning within the university.

Each phase has feed-back loops to ensure an iterative institutionalisation process. The whole process is supported by a committee of advisors consisting of scientists experienced in science communication. They can mediate between staff and management, enthuse staff and provide support in dealing with constraints, suggesting relevant training, selection and assessment procedures and reward options.

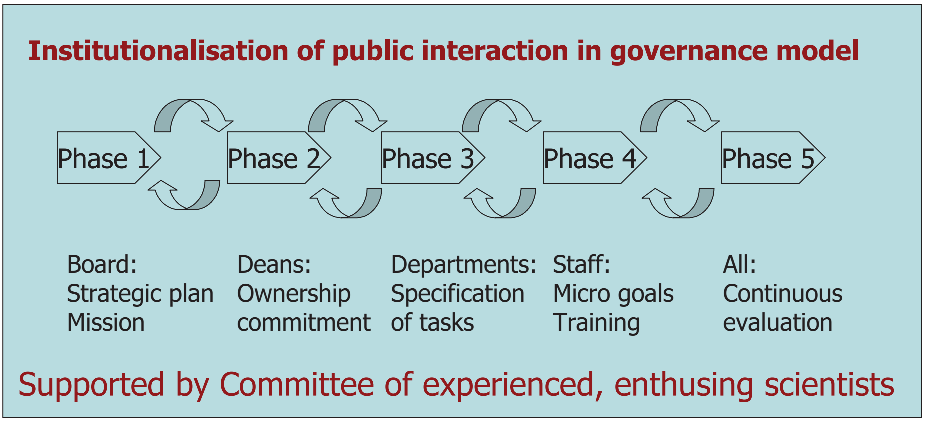

Figure 10.3.1: Iterative approach for institutionalisation of science communication in a university (Osseweijer and De Cock Buning, 2004)

Design of a communication plan for a department

Without the constraints addressed above a department can develop a strategic, long-term communication plan to engage in public communication. The plan needs to fit into the general ambitions of a department and comply with the university mission. The resulting suggested activities need to be assessed for availability of skills and time after which choices can be made by the management on who will be involved and when. A consideration of the motivation of the departmental staff needs to be made in order to decide if any strategies are necessary to increase this commitment.

In order to make a strategic communication plan for a scientific department it is important to first define the overall objectives of the department and the position in terms of evaluation or bench marking that the department has in that respect (Osseweijer, 1997, Kennedy, 2004). From these, the critical success factors can be deduced on which the communication objectives can be based. Following this the strategies are chosen to best achieve these objectives including the tactics to achieve the strategies. The Three-E model provides a proposal for the approach of the communication activities. The strategies are then prioritised for a certain time period, for example the subsequent year, on the basis of costs, urgency and available staff competences. The result is a series of communication activities that reflect the general aims of the department. Regular evaluation of the activities on their appropriateness to reach the critical success factors will provide a continuous learning environment (see Figure 10.3.2).

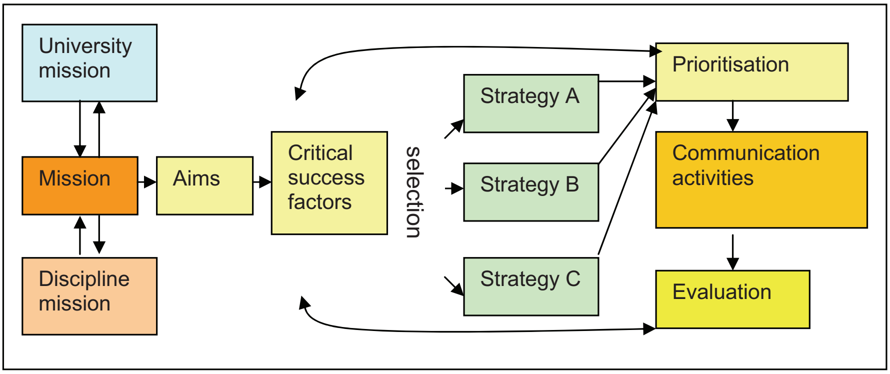

Figure 10.3.2: Schematic presentation of the relations between the elements of a communication strategy for a scientific department in a university setting combining discipline and university objectives for science communication. Osseweijer, 2006

The following description will illustrate this model based on the Department of Biotechnology of the Delft University of Technology in which it could be developed.

The mission of the Department is to excel in research and teaching. The aims of the Department are therefore to:

1. attract and keep good scientists, PhD and postdoctoral researchers;

2. attract funds;
3. attract new students.

These lead to the definition of the following critical success factors:

1. attracting and keeping good scientists, PhD and postdoctoral researchers
    1.1 interesting, cutting edge scientific programmes and progress
    1.2 good organisation and atmosphere
    1.3 state-of-the-art infrastructure
2. attracting funds
    2.1 public support for biotechnology research
    2.2 political support for Departmental research programmes
    2.3 industrial support for Departmental research programmes
3. attracting new students
    3.1 stimulating educational programmes
    3.2 good atmosphere
    3.3 excellent lecturers

These critical success factors are then evaluated for the present situation of the Department to decide on the goals for improvement and the priorities of the possible communication objectives.

For each of the critical success factors a strategy can be designed to improve or consolidate the present situation. In the strategy suggestions can be made for communication activities which are in line with the general objectives and which can be measured against the desirable situation. For example if the present situation shows that there is not enough political support for the research programmes, the Department can choose to prioritise communication activities that improve that objective, for example to make more professors available for representation in governmental committees or to organise meetings with political parties.

The critical success factor 2.1: "attract public support for biotechnology research" can now be further addressed. In order to achieve public support, this thesis has argued that this requires addressing the impact of the new developments in biotechnology, their scientific principles and the way the scientific data are verified. It also requires a strategy to encourage public participation and to address the ethical, legal, safety and social issues. Following the Three-E-model a series of activities can be chosen, such as Science Days, science art exhibitions, workshops for neighbours, school competitions, television shows, etc. These do not necessarily need to be stand-alone events, they can also collaborate with other events, other disciplines, etc. Each suggestion needs to be assessed for costs and its compliance with the Department's objectives and priorities. The strategy is to choose those communication activities that address the most objectives for the least costs, i.e. an optimisation strategy. For example, if the plans for the Science Day 2000 were checked for the inclusion of all the criteria that needed addressing, for costs, for compliance with the overall objectives and for the use of a Three-E approach it would score well on the objective to create public support for biotechnology research, to make young people enthusiastic for science and to help in team-building among the Department staff. The forum activity and recombinant DNA workshop would be removed and more interaction with more linkage to entertainment and emotions would be proposed to be carried out in the information streets. A recent example which fits several criteria is the school project "*Imagine*"[44] (Schuurbiers, Blomjous and Osseweijer, 2006) which addresses ethical and social issues of applications of biotechnology for developing countries.

The overall implementation of public communication therefore requires knowledge of the impact of the technological developments, skills to engage with the public, an attitude to interest as many as possible, an attitude and skills to respect ethical, legal and societal issues and creativity to design attractive and entertaining communication activities. The requirements can be provided by contributions from different people from the Department who are carefully selected, trained and rewarded for their input.

10.4. Concluding remarks

The current interactions between scientists and society show a range of different activities. Most of these interactions are not part of a strategic approach with a clear objective. Contrary to research publications and education, these communicative outputs are often based on opportunity, followed by *ad hoc* decisions with examples such as agreement for interviews, the organisation of a science day or the participation in a debate or a public lecture. In most cases the objective of the communication effort is not discussed with colleagues and not checked for compliance with the university. Sometimes it is used to "sell" biotechnology in order to achieve public acceptance for new research or new technological developments. These fragmentary efforts may harm the trustworthiness of the department and of the discipline as a whole. It may also even be counterproductive if two staff members give opposing messages. Taking the considerable costs for public engagement also into consideration, one sees the importance of developing a broadly carried plan and strategy for public communication.

This chapter proposes an approach and strategy for a scientific department and addresses the most important measures the university has to make to allow for the institutionalisation of science communication. The Three-E-model described here is flexible as it can be

[44] *"Imagine"* is a communication project involving scientists and school students working together which aims to:
- encourage scientists in applying their expertise to pressing problems in developing countries;
- involve young people to increase their awareness of global issues and help them to take action;
- carry out useful projects in developing countries building on capacities of local universities and NGOs;
- make young people enthusiastic about the life sciences and technologies;
- appeal to people's emotions and gain media coverage and public and governmental support.

superimposed onto any existing communication plan or any communication objective. It just requires another strategy for the approach to the objectives. It is especially designed to improve reach to the large majority of uninterested people and is also suggested for the approach of interactive two-way communication activities. The engagement with the larger audience does not necessarily need a two-way interaction which is laborious and costly. It can be achieved in one-way communication through emotions. When the attention of people is established, the opportunity to educate becomes greater. Their possible reactions may give insights into emerging societal issues.

The experiences of the Department with the model are quite recent but show interesting results. Smaller scale interactive activities using entertainment and emotions are more readily picked up by the media and hence get wider attention. This is because they provide stories rather than 'news' of scientific importance for which it is often more difficult to get media attention. The experiences with the school project "*Imagine*" are very positive as in two years it had over seventy newspaper and radio reports, the majority telling the story of the winning school team but also addressing the benefits of biotechnology applications for developing countries and several also dealing with economic and ethical issues. The approach is used in marketing and television and described in literature as the Entertainment-Education model and it is suggested to further study its usefulness for science communication. Special caution and hence attention should be given to the possible public perceptions of the emotional and entertaining approach. If it is viewed as persuasion to adopt the chosen research agenda rather than relevant information to discuss possible issues following from the research agenda the trustworthiness of the scientist may be put at stake.

The proposed design of a departmental communication plan is based on the experience in strategic communication in companies. The most important factors are a commitment of the highest authority and professors of the department including for finance and rewards for staff, compliance with the general goals of the department and a number of skilled and motivated staff. The general objective of public communication needs to be clear from the outset and it is advisable to have a plan ready for emergency situations. Each suggested activity can be checked for the general objectives, costs and priorities which gives flexibility for joint activities with other disciplinary fields or the university.

The Department of Biotechnology has chosen also to address the importance of science communication in the BSc and MSc teaching programmes, aiming to train and educate the new generation of scientists. In order to academically underpin this, a new working group has been established to study the role of researchers in public communication in the broadest sense.

A further detailed proposal for an approach to achieve a full institutionalisation of public communication in a university is briefly described and provided in more detail in Appendix 6. A similar institutionalisation approach is presently used for the implementation of the new

VSNU[45] Ethical Code of Conduct in the Delft University of Technology and several other universities in The Netherlands (personal communication with Professor Fokkema, rector of TU Delft). The introduction of the Ethical Code requires an ethical reflection from the university scientific staff on their scientific activities which is also recognised as a requirement for public communication. This process will therefore help both in providing experience with implementation of a new attitude and in laying the foundations for the sustainable implementation of effective science communication.

It is shown from several surveys that scientists themselves feel restricted in their wish to increase interaction with society. This indicates that the universities should facilitate the need for more interaction with society from a university-corporate level. Most universities do not have a strategy for disciplinary public communication in place and it is proposed to institutionalise this novel responsibility by an interactive learning process. However, several crucial issues have to be defined such as the model and content of corporate responsibility and governance including financial allocations, the assessment criteria for evaluation and the process to internalise the required competences among the scientific staff such as selection criteria for staff and stimulation of competence building (van Ruler, 2003). The skills for interactive communication also include the ability to reflect which links it to the efforts to institutionalise the general code of ethics. Here the available knowledge on this topic developed by the social sciences and philosophy of science will provide some answers. In addition, studies into new arrangements for public involvement in the decision-making processes, interactive communication methods, risk communication studies and technology assessment methods will provide other elements of the new tasks for the university.

The proposals given in this chapter may be used by any natural or social science department and are relevant for any university wishing to incorporate public communication in its prime objectives

[45] "Vereniging van Samenwerkende Nederlandse Universiteiten" ("Association of Cooperating Dutch Universities")

Conclusions Part IV: A model for institutionalisation in a university

Many recent case studies of public engagement by scientists use interactive engagement models based on the dialogue model of public communication. The development of insights about these models is very useful. However, a large majority of people cannot be easily interested in participating in these dialogue activities as they have no direct recognised stake in the issues addressed. New approaches to attract this majority are scarce in science communication. In this part of the thesis it is argued that the use of a different approach based on marketing practice can be effective to reach this group and increase public involvement in interactive communication. The proposed Three-E model: Entertainment, Emotion and Education is a universal approach applicable to all kinds of issues. Entertainment triggers attention, emotion is found in identification with the subject, education is achieved by the curiosity raised. This approach requires knowledge, skills and a certain attitude from the scientists involved in the activity which can be achieved as shown in the organisation of the Science Day activities in 2000 and the *Imagine* project in 2004 to 2006. Further research should investigate the broad validity of this approach for science communication which is expected to be valuable for all areas of science, both natural and social.

The analysis of constraints to successfully implement lasting public communication in a university department shows a relation to the financial allocation model and its implicit priorities. A lack of financial, career-related or other rewards for academic scientists and their departments for their investments in public communication hinders the development of competences such as communication skills as long as time and cost investments are in competition with the production of publications and teaching commitments. When research projects or programmes financed from sources external to the university call for scientists to be active in public communication these scientists are then likely to commit to the objectives of the outside funding organisation. This may create a public perception of suspicion. It may also conflict with the general objectives of the university and be counterproductive for the image and mission of the university. It influences the delicate balance of marketing and accountability in public perception, especially when industrial funds are used to finance scientists' activities and involvement in public communication.

The implementation of science communication in a university is therefore both urgent and reliant on a good system of objectives and rewards supported by recognised tasks and consequent assessment of results and competences through the organisation. This can be stimulated by career progression and financial rewards in the same way as research and education is rewarded. For the implementation of such a major change in the university organisation it is suggested to use the Action Research Spiral described in various case studies for institutionalisation processes (Zweekhorst, 2004).

Oxford, 2004

Bernard (Dixon) turns to me triumphantly. "You did ask me something didn't you?" "Yes", I reply, searching my mind. "Biotechnology and Harmonisation", he smiles. Ah, a suggested name for the new research and education group I'm starting in Delft. Mmm, I'll have to give it a think…

CHAPTER 11

General conclusions

11.1. From policy through strategy to practice and back

Introduction
When the Department of Biotechnology of the Delft University of Technology decided in 1991 to respond to the challenges of growing negative public perceptions of biotechnology it embarked on a long-term process of institutionalising science communication.

This started with the strategy to participate in an international multidisciplinary group of biotechnology experts belonging to different stakeholder organisations which led through its involvement in European funded projects to the development of training courses and the organisation of dedicated workshops. The organisation of these public communication activities provided a continuous learning process from an initial approach "teaching the naive public" towards finally "teaching the naive scientists". This was a learning experience which is relevant for other areas of innovative technologies.

Conclusions from fifteen years of involvement in biotechnology science communication for the Department of Biotechnology of the Delft University of Technology
Around 1990 it became clear that public perceptions of biotechnology in Europe were not altogether positive. Triggered by this development, the Department of Biotechnology of the Delft University of Technology became involved in an initiative to organise public communication and engagement initiated by a European scientific association, the European Federation of Biotechnology (EFB). The approach of bringing together a group of stakeholders to discuss the possibilities of addressing public attitudes proved a successful instrument for the identification and development of the required knowledge and skills as shown by the EFB Task Group on Public Perceptions of Biotechnology. The Group brought together knowledge about social research, interpretation of public opinion surveys and media relations together with experience from industrial approaches to deal with public perception issues, opinions from non-governmental organisations (NGOs) and knowledge of the scientific developments. This was complemented by expertise on policy making and lobbying. The exchange of tacit knowledge regarding positive and negative experiences and scientific knowledge provided a rapid, iterative learning process that was shared at conferences, meetings and in joint publications. As was shown by the example of a European project to assess public education, it is important that the expertise in such a group is well balanced to guarantee an effective exchange of complementary information. The instrument of the EFB Task Group provided a very good network of expertise that was used by the Department in many events and activities.

Raising the awareness of academic scientist colleagues throughout Europe to build a critical mass for public communication was well received but did not trigger a great deal of activity by them. The approach to increase public communication activities was picked up much more rapidly by industry where the sense of urgency to address negative public opinions on biotechnology was felt to be much more pressing. Its representatives were also the first to recognise the need for training of their R&D staff to deal with public communication in 1993. This resulted in the development of training courses by the Department to train biotechnology scientists in dealing with the public. With input from several speciality fields, i.e. public understanding of science, media relations, ethics, law, risk assessment and risk perception, communication theory, etc, the courses developed rapidly reflecting the accumulating knowledge and developing insights about these topics. The course development cycle showed a shift in focus from one-way communication approaches towards more two-way interactive approaches involving social science and addressing the attitudes of the public and scientists themselves which is an essential requirement for interactive public communication. The open learning approach adopted for the courses in combination with frequent reflection during the courses resulted in an effective didactic instrument for discussing and internalising the attitudes of participants. The extensive attention to ethics and moral systems proved helpful in encouraging reflection on participants' own values and moral socialisation. It is argued that this is an important factor for public engagement. The majority of the participants became more active in the organisation of, and involvement in, public engagement activities as was shown by the evaluation of the participants of the five courses from 1997 to 2004 carried out in 2006. This development provided a valuable input for the BSc and MSc degree programmes for the Department of Biotechnology. The continuous update of the course content by the expert lecturers and participation of the organisational staff also kept the Department well informed about new hypotheses and theories on public communication as they were developed.

The increasing preference for two-way communication activities demanded additional knowledge about the societal viewpoints on risks, regulations and moral values towards new biotechnologies. The deliberation by leading scientists on possible future technological developments and the consequent discussion about their possible resulting public issues proved helpful in providing the lead for the preparation of public interaction activities as was shown by the results of the European meeting on future issues in biotechnology in 1999. The organisation of similar workshops on forecasting technologies and public issues was included in the communication strategy of a Centre of Excellence in fermentation technology coordinated by the Department of Biotechnology where they will continue to be analysed for their usefulness in communication strategies.

The Science Days showed the possibility of raising a number of societal, legal and ethical issues in a variety of interactive communication activities. Their informal interactive setting together with entertaining activities worked best for adults while the introduction of science in a playful setting for six to twelve year olds resulted in positive associations with science for the children as well as the adults. The enthusiasm of the Departmental staff to participate showed that communication activities can also have an additional function in team building.

General conclusions related to the activities of the Department of Biotechnology in science communication

The international European Federation of Biotechnology Task Group on Public Perceptions of Biotechnology was successful for many years in exchanging valuable tacit and scientific knowledge and in organising international activities. However the constraints of time availability and funds of the international members hindered the achievement of a sustainable implementation of public interaction.

The low participation in the courses on *'Bioethics and public perceptions of biotechnology'* indicate either the existence of major constraints for participation or a lack of agreement on the need for public communication of this kind by biotechnology scientists and their seniors.

The future societal issues related to biotechnology developments which were identified by scientists and other experts from the media and NGOs in a dedicated workshop proved difficult to translate into public engagement activities. Further consideration of the programme and the expected outcome of such meetings is required to increase their use for pro-active communication.

The surveys into the views of scientists about their possible involvement in public communication revealed some interesting observations that are relevant for the further implementation of science communication. Their attitudes towards the products or use of their own scientific research indicate that a large group of scientists do not reflect on their own involvement in scientific developments. This indicates a cognitive dissonance between the research objectives and the market objectives of their own scientific efforts. It is argued that this dissonance should be addressed before these scientists engage in public communication. Otherwise there is a risk that the public loses trust in scientists in general with many indirect effects on scientific development and regulation.

The analysis of the constraints to successfully implement sustainable public communication in a university department shows a relation to the financial allocation model and its implicit priorities. A lack of financial, career-related or other rewards for academic scientists and their departments for their investments in public communication hinders the development of competences such as the training of skills as long as time and cost investments are in competition with the production of publications and teaching commitments. When the funds for public engagement are provided by other organisations with possibly conflicting interests, their financial origin may create among the public a perception of suspicion. This may conflict with the general objectives of the impartial knowledge claims of the university and may be counterproductive for the image and mission of the university. It influences the delicate balance of marketing and accountability especially when industrial funds are used to finance scientists' activities and involvement in public communication.

11.2. Reflecting on the process and forthcoming hypotheses: recommendations for further research

One of the first conclusions of the European Federation of Biotechnology Task Group on Public Perceptions of Biotechnology was that to influence public perception scientists need to communicate. So why, except for a small minority, did they not do so until then?

Several reasons underlie this omission such as the lack of awareness of, or disagreement with, this task and the lack of skills and rewards for such tasks. It is shown that awareness can be built, that skills can be trained and that scientists in an overwhelmingly majority agree about the necessity for them to communicate. The analysis of constraints has shown that the lack of rewards in the universities provides a major explanation for the absence of science communication strategies in university departments and reluctance of scientists to be active in public communication. The implementation of science communication in a university is therefore reliant on an adequate system of objectives and rewards which is supported by recognised tasks and consequent assessment of results and competences through the organisation. This can be stimulated by career progression and financial rewards in the same way as research and teaching is rewarded in an overall financial allocation model. In order to implement this a system for quality assessment of public communication is needed similar to quality assessment for research and teaching. The development of such a system is presently being discussed.

The difficulties in evaluating the effects of public communication both in qualitative and in quantitative ways present interesting research questions such as *"To what extent can we measure the impact of public interaction by scientists?"* and *"Which options provide an indication for effective public communication"* and *"How are these credited and capitalised?"*. Additionally, the implementation of science communication by a university as a prime task needs consideration of competence building by staff and redefinition of the organisation of departmental efforts. This leads to the following research questions: *"Which and how many scientists need to be involved?"*, *"How can scientists be selected for competences in science communication?"* and *"How can universities stimulate the building of competences for science communication?"*. Additional consideration is also needed for the processes and objectives for public communication when the rewarding incentives are provided by externally funded research programmes.

It was argued that scientists have a democratic and moral responsibility to discuss their science but their socialisation into the profession of science directs them otherwise. While industrial colleagues aim to market their biotechnology products this is not the task of academic biotechnologists except in the sense of publications and patents. They are expected to critically evaluate their discoveries and increasingly the social and ethical consequences of applying them in new technological applications. This "objective" information is needed as "impartial" input for the decision-making process with its needs enhanced by the increasing complexity of the science. It is important that scientists provide this input themselves as they are the ones who have the knowledge to do so. However, as was argued before, many are reluctant to critically evaluate the ethical and social consequences of their scientific discoveries.

This is perhaps why it is so difficult to understand the trust relationships between scientists and society although we know it is an important factor for the continuous support for science. In order to realise effective science communication Munnich suggested giving greater insight in the process of critical evaluation of scientific papers (Munnich 2004). However the objective is not to create "blind" trust in the messages but to show the democratic role of scientists and create trustworthiness in scientists based on the traditions of scientific consistency of peer refereed publication and reflection. Trust that is given in return by the receiving audience also reflects an emotional aspect that is additional to the mere belief in the ”trueness" of the information provided such as in the form of scientific data. Trust relates to the feeling of confidence in the messenger regarding the way he or she came to that information and a sympathetic impression of the messenger him- or herself. In order to be trustworthy as a messenger requires the understanding of, and adequate responding to, the ethical and social issues presented by the subject being communicated about, i.e. the new technology.

The closed practice of scientists needs therefore to be opened up. This attitude requires skills and knowledge by the scientist communicators that include reflection on their own value systems, their professional socialisation and the public culture. The relation of trust with governmental regulation and psychological risk perception needs to be understood by scientists, while the methods of communication to reach the required exchange of information need training. In Chapter 1 it is argued that the institutionalisation of science communication relies on:

Availability of knowledge:

1. Provision of information on the scientific data
2. Provision of information on the potential impact of implementation of the technology on society, including explanation of the benefits and costs and including a cost-benefit estimation if the technology were not to be introduced
3. Provision of transparency on how judgments are made, including explanation of the procedures in place to verify scientific findings

Availability of skills:

4. The involvement of scientists who wish to be involved and who are skilled to perform the interaction

Availability of attitude:

5. An attitude to encourage public interest to raise awareness and encourage involvement in the decision-making process
6. An attitude strategy that shows understanding and guarantees responding to public interests and concerns, including ethical, social, safety and legal issues

Over the years attention for two-way interaction in science communication has grown. Many recent case studies of public engagement by scientists therefore use interactive engagement models based on the dialogue model of public communication. The development of insights about these models is very useful. However, a large majority of people cannot be easily interested in participating in these dialogue activities as they have no direct recognised stake in the issues addressed. New approaches to attract this majority are lacking in science communication. In the final part of this thesis it has been argued that the use of a different approach based on marketing practices and attitude change models can be effective to reach this group and increase public involvement in interactive communication. The Three-E model: Entertainment, Emotion and Education is a universal approach applicable to all kinds of issues not necessarily limited to biotechnology. Entertainment triggers attention, emotion is found in identification with the subject, education is achieved by the raised curiosity. This requires knowledge, skills and a certain attitude from scientists involved in the activity which can be achieved as shown in the organisation of the Science Day activities in 2000 and the *Imagine* project in 2004-6. The use of societal trends such as referred to in marketing and social psychology (see Chapter 1.2.4) may help in the creativity required to design the activities. Some elements in this model are contentious, such as the balance between persuasion and information provision. This requires further research into the public perceptions of science communication activities using this model. Additionally the model needs further quantitative and qualitative verification leading to questions such as: *"To what extent does the Three-E-model increases the willingness of citizens to participate in dialogue on scientific issues?", "What are the structural constraints for university departments in the use of this model?", "To what extent does the model increases discussion of ethical, legal, safety and societal issues?"*.

The institutionalisation process of science communication in a university proves to be a matter of long-term attention and research closely interacting with the societal context. The case studies described here for the Department of Biotechnology of the Delft University of Technology have shown that incentives from the international scientific field have initiated the enthusiastic involvement of a group of scientists. Their experiences and conclusions have value for all scientists who are eager to increase their involvement in science communication.

I hope that my descriptions and conclusions will inspire social scientists in their scientific curiosity to address the new research questions, managers in their drive to help the implementation of science communication in academia, colleagues in their efforts to bridge social and natural sciences and scientists in their work as a scientist.

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A heavy storm dashed through my room and my mind. It lasted for a while. I start to pick up the unfinished tasks scattered around with an enriched anticipation for new challenges to come. The thesis is finished!

Summary

Modern biotechnology has long been viewed as a key technology promising better quality of life for all world citizens. Its development however has been accompanied by concern and criticism about the methods it uses. There were early technical concerns about, for example, the use of antibiotic markers in the development of transgenic crops and moral issues about the principles of genetic engineering leading to the charges of *"playing God"* and *"patenting life"*. Later there were worries about the potential risks and the opportunities for consumer choice in genetically modified (GM) food. They then extended to such as GM crops and their possible effects on biodiversity and organic farming, "bio-piracy" of genetic material from developing countries, the production of tissues and organs from embryonic stem cells, invasion of privacy from DNA-profiling and the replacement of commodity materials previously provided by Third World countries. Environmental and animal welfare groups tried to block development by generating media coverage focussing on possible, often vague and unspecified risks and the lack of benefits for consumers. Political opinion in Europe spread to the USA and elsewhere, including to the developing world. The concerns were taken seriously resulting in reduction of support for scientific development in Europe, especially in the agricultural and food sector.

It was in this context that realisation grew among the scientific community that it was necessary to involve themselves in public communication[46]. The increased involvement of biotechnology scientists in public communication developed out of defence in the face of opposing negative public opinions from the early 1990s. It was soon realised that pro-active involvement of scientists in public engagement would perhaps prevent the rise of scientifically unfounded negative perceptions. This would necessitate a much broader involvement of scientists in public engagement than the then current practice and requires institutionalisation in academic settings. And as this would also be pertinent for the introductions of all new sciences and technologies in society, now occurring for example with nanotechnology and synthetic biology, it is valuable to learn from the experiences of biotechnologists.

In addition to reacting in defence to negative opinion and in support of a pro-active involvement of scientists in science communication it can also be argued that scientists have a responsibility to explain their science. Innovation, specialisation and institutionalisation have made science ever more complex, distant from and less understood by the majority of people while scientists alone remain expert and knowledgeable about their science, its technological applications and our dependence upon them. There is therefore a democratic imperative for all scientists to explain their science and its findings so that citizens and government can make

[46] In this thesis the terms "science communication" and "public communication" refer to both one-way, so-called "deficit model", and two-way communication while "interaction", "involvement" and "engagement" are used synonymously for activities using the two-way "dialogue" or "contextual model" of science communication.

informed decisions. They also have a moral obligation as public sector scientists paid by the rest of the population via taxes and government, for which they are accountable. Additionally it is also in their own interest to maintain the level of funding of their research.

This thesis consequently describes the ways in which biotechnologists did contribute to informing the societal decision-making processes about their research and its applications. It analyses the degree to which these efforts were successful. Thence it derives a set of criteria required for public communication activities and analyses the constraints and necessary competences for involvement of scientists. Further and finally it deals with the empowerment of scientists and their institutional settings for engagement in public communication. The approach is multidisciplinary and utilises and evaluates the relevant concepts from a number of disciplines such as science communication, fundamental epistemology, sociology, social psychology and organisation theory as well as biotechnology. The public debate accompanying the development of biotechnology during the last fifteen years is well known from the media and there have been many studies of it. This thesis is the first study however that describes the internal discussions and activities of biotechnologists in Europe in relation to the debate and maps their search to give an adequate response to it.

The study is structured along the following main research questions:

1. Why is an increased use of (bio)technology in everyday life and products not related (but contrarily) to an increased public support for research?
   - To what extent can the cause of this be found in the closed practices of scientists?
   - What competences (knowledge, skills, attitudes) would hamper or facilitate an open practice?
   - What institutional practice and structures would hamper or facilitate the required competences?
2. What institutional management is required to earn public support for scientific developments?
   - What is the relationship between personal competences and institutional practice, structures and constraints?
   - What kind of changes need to be made to adjust competences of scientists to their societal role?

The arguments for scientists' involvement in communication with the public lead to the following requirements for the content of communication, namely provision of:

1. *Information on the scientific data and*
2. *Information on the potential impact of implementation of the technology on society, including explanation of the benefits and costs and including a cost-benefit estimation if the technology were not to be introduced.*

Several scholars in science communication have shown that it is also important to create a trust relationship which leads to the third criterion:

3. *Transparency on how judgments are made, including explanation of the procedures in place to verify scientific findings.*

However, these criteria need to be supported by skills for interaction, which leads to the need to consider for public communication:

4. *Involvement of scientists who wish to be involved and who are skilled to perform the interaction.*

Additionally, it is argued that it is important to address the availability of attitudes conducive to:

5. *encouraging public interest to raise awareness and provoke involvement in the decision making process and*
6. *showing understanding and guarantee responding to public interests and concerns, including ethical, social, safety and legal issues*

Institutionalisation of science communication needs to facilitate the implementation and continuous development of these six requirements together with the availability of resources in terms of finances and staff time.

The study described in this thesis took place over a period of fifteen years from 1991 to 2005. During these years a paradigm shift in science communication occurred replacing one-way communication, often referred to as the *"deficit model"*, by the more interactive, two-way model referred to as the *"contextual"* or *"dialogue model"*, or with due respect to the importance of the many kinds of input in the process the *"transdisciplinary"* or *"Mode Two"* model. The activities described in this thesis reflect and confirm the desirability of the new model and analyses the ways in which scientists are facilitated or constrained by the present academic infrastructure in being engaged in public communication. It gives an analysis of a series of strategies initiated and organised by the author which have been implemented in the Department of Biotechnology of a Dutch university, the Delft University of Technology (TU Delft), to institutionalise public communication within an academic institution. The thesis is divided into four parts: Part 1 deals with the process of increasing awareness for the need for public communication; Part 2 describes the empowerment of scientists through the development and delivery of training; Part 3 analyses the public communication activities of the Department and reflects on the skills and knowledge that scientists need for increased public interaction and, finally, Part 4 provides a new strategy for public communication and institutionalisation in a university setting.

Part 1: Raising awareness

At the end of the 1980s it was becoming clear that public perceptions of biotechnology in Europe were not altogether positive. Within the framework of their scientific organisation, the European Federation of Biotechnology, a small group of scientists who had recognised this started an initiative to organise science communication activities to respond to the early negative perceptions based on their belief in the science. The Department of Biotechnology became involved in the initiatives of the European Federation of Biotechnology (EFB) Task

Group on Public Perceptions of Biotechnology (1991 to date), the EFB Working Party on Education later renamed the EFB Task Group on Education & Mobility (1990 to date) and a European Commission-funded project on public education (1999-2002).

The EFB Task Group on Public Perceptions of Biotechnology brought together some fifty European experts in public opinion survey research and social sciences, science, industry, politics, journalism and media relations, patient and consumer organisations, and other non-governmental organisations (NGOs). The group's general aim was, and still is, to increase public awareness and understanding of biotechnology and the life sciences throughout Europe. By adopting the policy of maintaining an independent position between science, industry, government, public interest groups and the media, they aimed to position themselves as a trustworthy partner to become a source of information and advice for all parties, and to be a neutral organiser of public events. The exchange of tacit knowledge in the Group regarding positive and negative experiences and scientific knowledge provided a rapid iterative learning process which was shared at conferences, meetings and in joint publications.

Much effort was put into raising the awareness of scientist colleagues throughout Europe by providing presentations and sessions on public perception and ethical issues at international scientific conferences. Although these received good reception, this did not trigger a great deal of activity in public communication from academic scientists. Hence more interactive activities at conferences were tried to increase the uptake and desired change in attitude by scientists which are described in this thesis.

One of the studies conducted in the context of the Task Group was a survey aiming to determine the need for information on public perceptions issues by biotechnology scientists, the perceived view of scientists on their role in public perceptions and the need for knowledge on public perceptions as viewed by industrial employers. A questionnaire survey carried out in 1997 using the internet indicated that scientists were of the opinion that they should participate in discussions on public perception of biotechnology and that they should be involved in determining governmental policies, legislation and safety regulations. This was used as input for the development of international courses on public perceptions and for the attitudinal studies carried out in 2002 to 2005, both of which are detailed in Parts 2 and 3 respectively of this thesis.

The EFB Task Group was a useful vehicle for the Department of Biotechnology providing knowledge through its meetings and publications, skills through its contribution to training of lecturers and young scientists of the Department and encouragement of the organisation of public communication activities. This is also reflected in the adaptation of the education modules on "*Biotechnology and Society*" developed for and implemented in BSc and MSc curricula at TU Delft, the attention given to public relations activities by the Department described in this thesis and the recent establishment of a research group on *"Biotechnology and Society"* in the Department responsible for education and research in this field.

A European Commission (EC) FORCE programme project coordinated by the TU Delft Department of Biotechnology from 1991 to 1994 aimed to determine and to define the needs of biotechnology companies for continuing training of their staff. Public perception and the management of the interface between R&D and marketing were identified by the companies as priorities for training. Part of the reason was because no such training was available at that time. In close consultation with the experienced biotechnology company senior personnel and R&D managers, a course programme was developed which treated public perception issues as an integral part of the company management approach. It consequently included coverage of public opinion surveys, strategies and training for media relations, preparation of scenarios on the handling of emergency situations and linking planning for product launches with communication activities.

This project showed that companies recognised public perception issues as important topics to address for biotechnology business development in 1993. Its endorsement of the proposed course programme also showed that the institutionalisation of public communication was taken up by biotechnology companies by that time. The recommendations for the course programme also demonstrated the desired strategy for institutionalisation with an embedding of such approaches within the senior management accompanied by close interaction through internal communication between all departments. The Department used these results for their MSc curricula while the course programme on public perceptions was further developed and later integrated in a course for its own academic members as described in Part 2.

During 1999 to 2002 the author represented The Netherlands in another European Commission project with the objective of comparing the information on biotechnology available for the public in the various European countries. The project was designed on the premise that providing biotechnology information would increase understanding and hence acceptance of biotechnology. The gathering of information materials showed a considerable difference between countries. Overall, it was observed that little attention was paid to biotechnology education to the under-16 year olds, that there were few biotechnology books for a lay audience in the local language and that the media paid little attention to biotechnology. The project consortium members recommended in 2002 that the European Council should put education about biotechnology on its agenda. This education should be treated in a multidisciplinary manner including the social science perspective to reflect the situation in which decision-making takes place within our society. A system for rewarding scientists for communication activities and media training for scientists should be complemented with Internet and television use to increase the dialogue on biotechnology issues.

It emerged from all of these activities that short term efforts to address public perceptions at a European level would not provide a lasting effect on public opinions. The observations within the Task Group as well as within the European public education project showed that a macro-level approach could be extremely useful in testing new methods of communication, exchange of good practices etc, but lacks resources for implementation and hence continuity. The organisation of public communication events on this macro-level may exclude explicit ownership by institutions and is therefore vulnerable to erosion of responsibility. It is therefore concluded that the institutions themselves should implement the expert knowledge and skills for a sustainable result and the way in which this may be achieved is addressed in Part 4 of the thesis.

Part 2: Skill development

From 1993 to 2006 a series of courses was organised on public perceptions and biotechnology ethics by the TU Delft Department of Biotechnology. Their contents were based on the results of the first course on "Public Perceptions of Biotechnology" carried out under the EC FORCE programme and benefited from the input of the EFB Task Group on Public Perceptions of Biotechnology. In 1993 and 1995 two international three-day courses were primarily aimed at industry managers. The course was adapted in 1996 for Dutch PhD students followed by a critical review of the course programme in 1997 which led to the total review of the concept of the course to include biotechnology ethics. The new ten-day programme was financially supported through the Framework IV Biotechnology Research programme by the European Commission in 1997, 1999, 2001 and 2002, and later by the Dutch Centre of Excellence "Kluyver Centre for Genomics of Industrial Fermentation".

Through a continuous evaluation and with input from the expert lecturers the courses developed rapidly, reflecting the accumulating knowledge and developing insights on societal, legal and ethical topics. The open learning approach adopted for the courses in combination with frequent evaluation during the courses resulted in an effective didactic instrument for discussing and internalising the attitudes of participants.

A survey amongst the participants of the extended programme courses held from 1997-2004 showed that the majority of the participants became more active in the organisation of, and involvement in, public engagement activities. The extensive attention for ethics and moral systems proved helpful in encouraging reflection by the participants on their own values and moral socialisation. It is argued that this is an important factor for public engagement. The major constraint observed is the lack of priority given to such training shown by the low participation in the courses. This indicates either the existence of a major other constraint or a lack of agreement on the need for public communication and training in it by biotechnologists.

Part 3: Attitude and behaviour

In order to be pro-active in science communication it is necessary to know which societal issues to address. Together with the EFB Task Group on Public Perceptions of Biotechnology and the European Molecular Biology Organisation (EMBO) the TU Delft Department of Biotechnology organised a workshop on future issues in biotechnology. The aim of the workshop was to discuss expected future scientific developments for their societal impact and derive from that the possible resulting societal issues. The further objective of the meeting was to formulate pro-active communication activities anticipating these identified issues. The deliberation by leading scientists proved helpful in assessing possible future societal issues in forthcoming biotechnologies. However, translating these rather general issues into practical public engagement activities remained a difficult task. These scenario forecasting meetings may well be useful for designing pro-active public communication activities but more such meetings with adequate consideration to the objectives and approach of the public engagement need to be held and analysed in order to confirm this.

By now, in the early part of 2000, the Department of Biotechnology was ready to be involved in some large scale public communication activities. Encouraged by the author it opted to organise a public science day at its premises in 2000 which was followed by a second one in 2001 and a public activity with school students as part of the Dutch national debate on *"Genes and Food"* in 2001. Both Science Day's attracted around 2,000 visitors. The objectives were to interest people in biotechnology developments, create a positive association with biotechnology and stimulate young people to consider a career in biotechnology. A range of different activities including demonstrations, competitions, discussions, tasting opportunities, lectures and children's laboratories was organised to entertain the public. This approach of dividing the general public into a number of different target groups was based on the premise that messages and activities could then be better designed to meet the interests of the different groups. In line with one of the recommendations of the workshop on future issues in biotechnology, the information provided for adults was focused on showing the benefits of the activities in the Department, with emphasis on the possible uses of the products from our research. Risk perception theory had demonstrated that people tend to feel more threatened by vague, intangible abstractions than by real, concrete things. Therefore it was decided to show as many actual products as possible so people could see, feel, smell and, if relevant, taste them. The visitors appreciated it, with many participating in discussions on how they felt about these products and the technology behind it.

Science Days for the public at large therefore seem to offer the opportunity to raise a number of societal issues in a variety of interactive communication activities. It was shown that the informal interactive setting with entertaining activities worked best for adults while the introduction of science in a playful setting for six to twelve year olds can result in positive associations with science for the children as well as the adults.

In 2001 a role play in the form of a citizens' court with secondary school students was linked with the national Science Day 2001 and the *"Genes and Food"* national debate. The evaluation by means of questionnaires completed by the student participants, before, during and after the event showed that support for the use of biotechnology for food production declined as more information and opinions were provided. The activity clearly demonstrated a further polarisation resulting from the theatre play which was offered before the role play and dialogue during the citizens' court.

In order to ascertain the views and attitudes of scientists towards their involvement in public engagement activities three surveys were conducted. The surveys aimed to reveal the constraints of further institutionalisation of science communication and at the same time provide an indication of the willingness of scientists to be involved in it. The three surveys were carried out amongst European biotechnology researchers in 2002, 2003 and 2005. They showed that the majority of respondents was of the opinion that it is important that scientists communicate to a larger public. They also revealed that the respondents were not very active in public communication and engagement. An interesting observation was that a considerable number of scientists do not reflect on their own involvement in scientific developments as shown by their attitudes towards applications of their own scientific research. This indicates a cognitive dissonance between the research objectives and the possible objectives for societal applications of their own scientific efforts which may be due to the professional socialisation of scientists in a dominantly empiricist system. It is argued that this imbalance must first be resolved before these scientists engage in public communication to avoid a loss of trustworthiness in scientists with many indirect effects on science developments and regulation.

Part 4: Institutionalisation

As stated before, the general objective of science communication for a university department of biotechnology is not to increase the acceptance of biotechnology but to inform the public on the science, its applications and its societal consequences, and to discuss the resulting issues from the implementation of the new technologies. But what were the drivers for the Department of Biotechnology of the Delft University of Technology to become active in public communication? And did the costs of these activities influence the decisions? The driving forces for the involvement of the Department in the institutionalisation process were the anticipated negative public perceptions and the industrial needs for training in this area. This was followed by the drive to increase the involvement of colleagues and the wish to provide good examples of communication activities. This led to trials of pro-active public communication activities which started in 2000. From 2002 onwards externally funded programmes increasingly demanded attention for public engagement activities

A detailed analysis of activity costs and expected audience reach showed a very considerable difference between one-way and two-way oriented activities. In comparison with the criteria for communication set out before a few activities were assessed as being cost-effective for both reach and addressing a majority of the criteria. This resulted in a proposal for a public communication strategy in research departments which is described in Chapter 10.

The comparative evaluation of the activities shows the influence of the social context in the learning cycle process of biotechnologists' engagement in public communication with increasing input from social sciences and hands-on experience. However, for the last step within the institutionalisation process, the integration within the working practice of scientists, changes were identified which have not yet been achieved.

The results of the analysis of drivers, objectives and costs for public communication activities by scientists show that it is manageable in a cost-effective manner to address science, the impact of the technological developments and the possible ethical, legal and societal issues. This needs a number of skilled staff members, a strategy to reach as many members of the public as possible and a strategy to discuss the ethical, legal and social issues. The constraints for institutionalisation of profound public communication however are (I) the lack of a strategy for the Department to define which activities can best be organised and how, and (II) the financial allocation model of the Delft University of Technology which actually penalises the Department for organising such activities. Therefore most activities were organised and continued for externally funded research activities. Although in itself this does not provide a problem, it does give a rather limited time span for the development of mid- and long-term strategies as most externally funded programmes are limited to three to five years of duration. It also does not solve the constraint on the lack of rewards for scientists as the university career development system as well as the personnel assessment system are designed to focus on the stimulation of research and educational competences together with limited attention to managerial skills.

The current changes in society will effect the interaction between science and society. This, together with the increased emphasis on technology transfer from research to industry requires an urgent evaluation of the relations between academia and society with respect to policy for science and innovation and public communication. The Dutch universities have been given recently a greater task in public communication by the closure of the Governmental institute for science communication, the "Stichting Weten" and the more onerous request for public accountability. Universities need to take this new responsibility on board. However, this requires a change in organisation structure and an evaluation of the communication activities presently in place. Most universities have centrally steered strategies and staff for attracting students or promoting the universities but public science communication is essentially different from marketing and promotion and puts a higher demand on research staff. The stimuli from funding agencies are also field-oriented and depend on limited project funding. The incentives for more public interaction through the Government and the incentives from the discipline-oriented externally-funded programmes urgently need to be combined into central strategies for public accountability.

The implementation of this new responsibility requires an adaptation of the assessment procedures of scientific quality in order to include these new tasks. Presently there are already procedures available to assess science communication in the VSNU[47] self evaluation methodology, but the universities are not yet structured to perform according to these criteria. All this puts emphasis on the question: *"How can academia prepare itself for this new*

[47] The VSNU: Vereniging van Samenwerkende Nederlandse Universiteiten (Association of Dutch Universities) is presently responsible for the quality assessment of research in the Dutch universities. It recently launched a new procedure to assess public accountability, *"SciQuest"*

responsibility?" This thesis therefore concludes with a proposal for a sustainable institutionalisation of public communication that takes these challenges into account.

One important problem is reaching the large majority of people which cannot be easily interested in participating in the now favoured dialogue activities as they have no directly recognisable stake in the issues addressed. New approaches to attract this majority are scarce in science communication. In the last part of the thesis it is argued that the use of a preparatory step based on entertainment can be effective to reach this group and increase public involvement in interactive communication. The proposed Three-E model: Entertainment, Emotion and Education is a universal approach applicable to all kinds of issues. Entertainment triggers attention, emotion is found in identification with the subject while education is achieved by the raised curiosity. This approach requires knowledge, skills and a certain attitude from the scientists involved in the activity, which can be achieved as shown in the organisation of the Science Day activities in 2000 and the more recent *Imagine* project[48]. Further research should investigate the efficacy of the approach for science communication which is expected to be valuable for all areas of science.

The analysis of constraints to successfully implement sustainable public communication in a university department shows a relationship between its financial allocation model and its implicit priorities. A lack of financial, career-related or other rewards for academic scientists and their departments for their investments in science communication hinders the development of competences such as the training of skills as long as time and cost investments are in competition with research, publication and teaching commitments. When projects financed from external sources request scientists to be active in public science communication these scientists are then likely to commit to the objectives of the external funding organisation. This may create scepticism and suspicion about the scientists' motivations among the public. It may also conflict with the general objectives of the university and be counterproductive for the image and mission of the university. It influences the delicate balance of marketing and accountability[49] in public perception, especially when industrial funds are used to finance scientists' activities and involvement in science communication with the public.

The implementation of science communication in a university is therefore urgent and reliant on an effective system of objectives and rewards which is supported by specified tasks and consequent assessment of results and competences through the organisation. This can be stimulated by financial rewards in a similar way to that by which research and education is

[48] *Imagine*: a school competition involving scientists and school students in creating biotechnology projects for developing countries (see www.imagine-foundation.org)

[49] Marketing is used here for communication with the purpose to sell a product or education programme; science communication is used in this thesis for any interaction with the purpose of increasing knowledge of at least one party. The delicate balance is due to the dependence of academics on the university's funding mechanisms which in turn depend on student participation in educational programmes, contract research and non-earmarked governmental funds

rewarded. For the implementation of such a major change in the university organisation it is proposed using the Action Research Spiral described in various case studies for institutionalisation processes.

In conclusion

It is difficult to fully answer the first of the research questions set out at the beginning. There are undoubtedly many circumstantial reasons for a lack of correlation between the increasing use of a technology and public support for research. What is clear though is that biotechnology scientists have not been engaged very much in public communication. One of the reasons for their reluctance can indeed be found in the closed practices of science resulting from their professional socialisation as this thesis has argued. The competences needed for public interaction are knowledge about the science, the societal impact of its possible applications and ethical, legal social aspect (ELSA) issues together with skills in two-way interaction and motivation to understand and respond to the ELSA issues. Perhaps the overarching and most needed competence however is reflection. Reflection on their own research and reflection on their own opinions about its possible applications as a citizen, consumer or patient.

In order to facilitate the development of these competences, the professional practice of scientists has to open up to and acknowledge the importance of science communication. University curricula have to incorporate the training and their finance allocation systems the costs while research leaders have to allow time for training and involvement in public interaction. Scientists need rewarding, not penalising, for such activities and perhaps most importantly of all, the approval, encouragement and example of their senior colleagues and peers.

This requires a different type of institutional management. The main constraints for scientists' engagement in public communication are presently based in the financial or other allocation system. Science communication is not recognised at the same level as research and education. Therefore personal competences for public interaction are not stimulated or selected for. The changes needed are to:

1. include the task of science communication in the university (financial or goal oriented) allocation system;
2. select and award personnel for public interaction skills;
3. implement appropriate training and reflection in curricula and departments;
4. link science communication to university strategies.

If these are in place public support for science and technology may rise given that there is indeed a positive correlation between science communication by 'empowered scientists' and public support.

Samenvatting

Over Biotech Gesproken

Vijftien jaar van opbouwend actie onderzoek in de institutionalisering van de betrokkenheid van wetenschappers in publieke communicatie

Moderne biotechnologie wordt al geruime tijd beschouwd als een sleutel technologie welke een hogere levenskwaliteit voor alle wereldburgers belooft. Haar ontwikkeling is echter vergezeld gegaan van zorg en kritiek over de gebruikte methoden. Zo waren er technische discussiepunten over bijvoorbeeld het gebruik van antibiotische markers in de ontwikkeling van transgene gewassen en morele standpunten tegen de principes van genetische manipulatie die leidden tot de aanklacht dat wetenschappers "voor God spelen" en "leven patenteren". Dit werd gevolgd door zorgen over de mogelijke risico's en de beperking van keuzemogelijkheden voor consumenten door de introductie van genetisch gemodificeerde (GM) voedingsmiddelen. Deze zorg breidde zich uit tot GM gewassen en hun mogelijke effecten op biodiversiteit en organische landbouw, "bio-piraterij" van genetisch materiaal uit ontwikkelingslanden, de productie van weefsels en organen uit embryostamcellen, inbreuk op de privacy door DNA-profilering en de vervanging van goederen die voorheen werden geleverd door ontwikkelingslanden. Milieu- en dierenbeschermingsgroeperingen probeerden de ontwikkelingen te stoppen door media-aandacht te trekken voor de mogelijke, vaak vage en ongespecificeerde risico's en het gebrek aan voordelen voor de consument. De politieke opinies uit Europa breidden zich uit naar de VS en andere landen, inclusief ontwikkelingslanden. De zorgen werden serieus genomen hetgeen resulteerde in een reductie van de steun voor wetenschappelijke ontwikkelingen in de biotechnologie in Europa, en in het bijzonder in de agro-food sector.

In deze context groeide het besef binnen de wetenschappelijke gemeenschap dat het nodig was dat men zich ging bezighouden met publieke communicatie[50]. De verhoogde betrokkenheid van biotechnologen in publieke communicatie groeide vanuit een verdediging tegen negatieve publieke opinies. Men realiseerde zich snel dat een proactieve betrokkenheid van wetenschappers in publieke interactie mogelijk een toename van wetenschappelijk ongefundeerde negatieve meningen zou kunnen voorkomen. Dit zou echter een veel bredere maatschappelijke betrokkenheid van wetenschappers vereisen dan tot dan toe gebruikelijk was en bovendien een institutionalisering in de wetenschappelijke praktijk noodzakelijk maken. Omdat deze constatering relevant is voor de introductie van alle nieuwe technologieën in de maatschappij, zoals aangetoond in de huidige discussie over nanotechnologie en synthetische biologie, is het waardevol om te leren van de ervaringen van de biotechnologen.

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[50] In deze thesis refereren de termen "wetenschapscommunicatie" en "publieke communicatie" beiden naar zowel de "eenrichtingsverkeer" (het zogenaamde "deficit-model") als naar de "tweerichtingsverkeer" wijzen van communiceren. De termen "interactie" en "betrokkenheid" worden hier gebruikt als synoniemen voor activiteiten die refereren aan het model voor "tweerichtingsverkeer" communicatie, aangeduid met het "dialoog"-model" voor wetenschapscommunicatie.

Eigenlijk kan een proactieve betrokkenheid van wetenschappers in wetenschaps-communicatie, als beter alternatief voor defensieve reacties op negatieve opinies, ook ondersteund worden door de argumentatie dat wetenschappers een verantwoordelijkheid hebben om hun wetenschap nader te verklaren. Innovatie, specialisatie en institutionalisering hebben wetenschap complexer en afstandelijker gemaakt, waardoor de meerderheid van het publiek er minder begrip van heeft, terwijl alleen wetenschappers de expertise bezitten over hun vakgebied met de daaruit voortvloeiende technische toepassingen en onze afhankelijkheid daarvan. Zij dienen tevens verantwoording af te leggen aan de maatschappij die via belasting en overheidsfinanciering haar deze taak oplegt.

Deze dissertatie beschrijft de wijze waarop biotechnologen een bijdrage hebben geleverd aan het informeren van het maatschappelijke besluitvormingsproces inzake onderzoek en toepassingen. Het analyseert hoe succesvol deze activiteiten zijn geweest. Er worden een aantal criteria afgeleid waaraan publieke wetenschapscommunicatie activiteiten zouden moeten voldoen en er wordt een analyse van de (institutionele) beperkingen en benodigde competenties voor de betrokkenheid van wetenschappers gegeven. Bovenal behandelt dit proefschrift de "empowerment" van wetenschappers en hun institutionele omgeving voor hun betrokkenheid in publieke wetenschapscommunicatie. Ofwel de voorwaarden voor het mondig maken van wetenschappers en het versterken van hun instituten teneinde een intensievere en kwalitatief hogere bijdrage van wetenschappelijke onderzoekers aan publieke interactie te creëren.

Terwijl de media uitvoerig aandacht heeft geschonken aan het publieke debat rondom de ontwikkeling van biotechnologie over de laatste vijftien jaar en er vele studies over dit debat zijn verschenen is dit de eerste studie die de interne discussies van de biotechnologen in Europa beschrijft en de zoektocht in kaart brengt van onderzoekers om een adequaat antwoord op de publieke discussie te geven.

Het onderzoek is gestructureerd rond de volgende hoofdvragen:

1. Waarom is een toegenomen gebruik van (bio)technologie in het dagelijks leven en in producten niet gerelateerd (maar tegengesteld) aan een toename in de publieke steun voor onderzoek?
   - Tot op welke hoogte kan de oorzaak hiervan gevonden worden in de gesloten praktijk van wetenschappers?
   - Welke competenties (kennis, vaardigheid en houding) hinderen of bevorderen een open praktijk?
   - Welke institutionele praktijken en structuren zullen de benodigde competenties hinderen of bevorderen?
2. Welke institutionele managementstructuur is noodzakelijk voor het verkrijgen van publieke steun voor wetenschappelijke ontwikkelingen?

- Wat is de relatie tussen personele competenties en institutionele praktijk, structuren en beperkingen?
- Welke wijzigingen zijn noodzakelijk voor de aanpassing van de competenties van wetenschappers aan hun maatschappelijke rol?

De argumentatie voor het betrekken van wetenschappers in communicatie met het publiek leidt tot de volgende criteria voor de inhoud van communicatie, te weten de levering van:

1. *Informatie over de wetenschappelijke data en*
2. *Informatie over de potentiële impact van de technologische implementatie in de maatschappij, inclusief een uitleg over de voor- en nadelen en inclusief een afweging van voor- en nadelen wanneer de technologie niet geïntroduceerd wordt.*

Een aantal wetenschappers in wetenschapscommunicatie heeft aannemelijk gemaakt dat een onderlinge vertrouwensrelatie eveneens belangrijk is, hetgeen leidt tot het derde criterium:

3. *Transparantie over de wijze waarop oordelen worden gevormd, inclusief uitleg over de gebruikelijke procedures voor het verifiëren van wetenschappelijke bevindingen.*

Echter, deze criteria dienen ondersteund te worden door vaardigheden voor interactie, hetgeen leidt tot de noodzakelijke overweging van:

4. *Het involveren van wetenschappers die betrokken wensen te zijn en die de vaardigheden bezitten voor de interacties.*

Bovendien is er beargumenteerd dat het belangrijk is aandacht te hebben voor de houding inzake:

5. *het opwekken van publieke interesse voor een verhoogde erkenning van het belang van wetenschap en de voortvloeiende discussiepunten leidend tot een verhoogde publieke betrokkenheid in het besluitvormingsproces en*
6. *het tonen van begrip en het geven van aandacht aan publieke interesse en zorgen, juist ook ten aanzien van ethische, maatschappelijke, veiligheids en legale kwesties.*

Institutionalisering van wetenschapscommunicatie dient de implementatie en continue ontwikkeling van deze zes criteria en de beschikbaarheid van financiën en andere benodigdheden, zoals staf, te faciliteren.

De studie vond plaats over een periode van vijftien jaar, van 1991 tot 2005. Tijdens deze jaren heeft een verschuiving plaatsgevonden in de mening over de wijze waarop communicatie dient te gebeuren. Het gebruikelijke “eenrichtingsverkeer” model, aangeduid als het “deficit” model is daarbij vervangen door het meer interactieve “tweerichtingsverkeer” model, ook wel “dialoog” model genoemd, of, met respect voor de inbreng van vele vormen van kennis in het proces, het “transdiciplinaire”of “Mode Two” model. De activiteiten die hier zijn beschreven reflecteren en bevestigen de wenselijkheid van deze verschuiving. De thesis analyseert de wijze waarop wetenschappers in hun betrokkenheid in publieke communicatie worden gehinderd of gefaciliteerd door de huidige academische infrastructuur. Het geeft een analyse van een serie strategieën die door de auteur zijn geïnitieerd en georganiseerd en door de Afdeling Biotechnologie van een Nederlandse universiteit, de Technische Universiteit Delft, zijn geïmplementeerd teneinde wetenschapscommunicatie in een academische omgeving te institutionaliseren. De thesis is opgebouwd uit vier delen: Deel 1 behandelt het proces van de vergroting van erkenning van het belang van publieke communicatie; Deel 2 beschrijft de "empowerment" van wetenschappers door middel van de ontwikkeling en verzorging van training; Deel 3 analyseert de publieke communicatie activiteiten van de Afdeling en reflecteert op de vaardigheden en kennis die wetenschappers nodig hebben voor verhoogde interactie met het publiek, en tenslotte geeft Deel 4 een nieuwe strategie voor publieke wetenschapscommunicatie en voor de institutionalisering van wetenschapscommunicatie in een universiteit.

Deel 1: Aandacht verhogen

Tegen het einde van de jaren tachtig werd duidelijk dat de publieke perceptie van biotechnologie in Europa niet bijzonder positief was. Een kleine groep wetenschappers die deze trend had herkend is daarop binnen het kader van hun wetenschappelijke gemeenschap, de Europese Federatie van Biotechnologie (EFB), een initiatief gestart met het doel wetenschapscommunicatie activiteiten te organiseren teneinde een antwoord te geven op de negatieve perceptie van biotechnologie. De Afdeling Biotechnologie raakte betrokken bij de initiatieven van de EFB Task Group on Public Perceptions of Biotechnology (vanaf 1991 tot heden), de EFB Working Party on Education - later hernoemd als de EFB Task Group on Education & Mobility (1990 tot heden) - en een project gesponsord door de Europese Commissie over publieke educatie (1999-2002).

De EFB Task Group on Public Perceptions of Biotechnology bracht ongeveer vijftig Europese experts samen op het gebied van onderzoek naar de publieke opinie en sociale wetenschappen, natuurwetenschappen, industrie, politiek, journalistiek en media relaties, en patiënten, consumenten en andere "non-gouvernementele" organisaties (NGO's). De doelstelling van de groep was, en is nog steeds, het bevorderen van de publieke aandacht voor en kennis van biotechnologie en levenswetenschappen in Europa. Doordat de groep een onafhankelijke positie innam ten opzichte van industrie, wetenschap en politiek, positioneerde zij zich als een betrouwbare partner voor informatievoorziening en advies aan alle partijen en als een neutrale organisator van publieke evenementen. De uitwisseling van "verborgen" kennis ten aanzien van positieve en negatieve ervaringen en wetenschappelijke kennis zorgde voor een snel opbouwend leerproces waarvan de resultaten werden uitgewisseld in conferenties, bijeenkomsten en in gezamenlijke publicaties.

Met presentaties en sessies over publieke perceptie en ethische kwesties in internationale conferenties werd veel tijd besteed aan het verhogen van de aandacht onder collega wetenschappers in heel Europa. Hoewel deze sessies goed werden ontvangen resulteerde dit niet in een substantiële verhoging van publieke communicatie door wetenschappers. Dit leidde tot pogingen tot meer interactieve activiteiten op conferenties om de aandacht van de wetenschappers te vergroten en de gewenste verandering van houding onder wetenschappers te bewerkstelligen.

In samenwerking met de Task Group werd in 1997 een enquête uitgevoerd met als doel de informatiebehoefte over publieke perceptie issues bij biotechnologen in universiteiten en in de industrie te peilen. Tevens werd de mening van wetenschappers over hun eigen rol in publieke perceptie gevraagd. De resultaten van deze, met het internet uitgevoerde, kleinschalige studie toonden aan dat wetenschappers vinden dat zij zouden moeten participeren in de publieke discussie over biotechnologie en dat zij betrokken dienen te zijn bij de bepaling van overheidsbeleid, regel- en wetgeving, inclusief op het gebied van veiligheid. Deze resultaten zijn gebruikt als input voor de ontwikkeling van internationale cursussen op het gebied van publieke perceptie en voor latere studies naar de houding en mening van wetenschappers welke uitgevoerd zijn in 2002, 2003 en 2005 wat is beschreven in respectievelijk Deel 2 en Deel 3 van deze thesis.

De EFB Task Group was een bruikbaar instrument voor de Afdeling Biotechnologie. De groep leverde kennis door haar bijeenkomsten en publicaties, vaardigheden door haar bijdragen aan het onderwijs van docenten en jonge wetenschappers van de Afdeling en zij inspireerde de organisatie van publieke communicatie activiteiten. Dit is weerspiegeld in de aanpassingen in de onderwijsmodules voor “Biotechnologie en Maatschappij” ontwikkeld voor de BSc en MSc curricula in de TU Delft, de verhoogde aandacht voor communicatie activiteiten zoals beschreven in deze thesis en de recente oprichting (2005) van een onderzoeksgroep op het gebied van “Biotechnologie en Maatschappij” in de Afdeling, welke verantwoordelijk is voor onderwijs en onderzoek op dit gebied.

Van 1991 tot 1994 coördineerde de Afdeling Biotechnologie een project, gefinancierd door het Europese Commissie (EC) FORCE programma, met als doelstelling de specifieke behoefte aan permanente educatie van biotechnologie bedrijven in kaart te brengen. Onderwijs op het gebied van “*Publieke Percepties*” en “*Management van de relatie tussen R&D en marketing*” werd geïdentificeerd door de bedrijven als prioriteit voor training van hun staf. Dit was mede omdat er op dat moment geen educatie op die gebieden bestond. In goed overleg met de ervaren leiding van de betrokken biotechnologie bedrijven en hun R&D managers werd een cursusprogramma ontwikkeld waarin de kwesties rondom publieke perceptie als een integraal onderdeel van de bedrijfsaanpak werden gezien. Het programma besteedde aandacht aan onderzoek naar publieke opinies, training en strategie ontwikkeling voor media relaties, ontwikkeling van plannen voor noodsituaties en het stroomlijnen van communicatie activiteiten met product lanceringen.

De resultaten van het project lieten zien dat de industrie publieke perceptie in 1993 erkende als belangrijk fenomeen voor bedrijfsvoering en ontwikkeling. De waardering voor het voorgestelde cursusprogramma liet tevens zien dat de institutionalisering van publieke communicatie binnen biotechnologie bedrijven al was opgepakt. De aanbevelingen voor het cursusprogramma demonstreerden bovendien de gewenste strategie voor institutionalisering met een sterke verankering binnen het topmanagement in samenhang met goede interne communicatie tussen alle afdelingen. De Afdeling Biotechnologie gebruikte deze resultaten voor haar MSc curricula. Daarnaast werd het cursus programma voor "*Publieke percepties*" verder ontwikkeld en later geïntegreerd in een cursus voor haar eigen academische staf zoals beschreven in Deel 2.

Van 1999 tot 2002 was de auteur betrokken als Nederlandse vertegenwoordiger in een ander project van de Europese Commissie dat als doel had de publieke beschikbaarheid van biotechnologische informatie tussen Europese landen te vergelijken. Het project ging uit van de gedachte dat het aanbieden van biotechnologie informatie het begrip en dus de acceptatie van biotechnologie zou vergroten. Het verzamelde informatiemateriaal toonde een groot verschil tussen de landen aan. In het algemeen werd geobserveerd dat er weinig aandacht werd besteed aan biotechnologie onderwijs voor jongeren onder de 16 jaar, dat er weinig boeken over biotechnologie voor het algemene publiek beschikbaar waren in de nationale taal en dat de media slechts weinig aandacht besteedde aan biotechnologie. In 2002 bevolen de consortiumleden van het project aan dat de Europese Raad onderwijs over biotechnologie op haar agenda zou moeten zetten. Dit onderwijs zou op een multidisciplinaire wijze moeten worden samengesteld met aandacht voor de inzichten geboden door de sociale wetenschappen inzake de sociale besluitvormingsprocessen. Een systeem voor beloning van wetenschappers voor communicatie activiteiten en mediatraining zou aangevuld dienen te worden met het gebruik van Internet en televisie, teneinde de dialoog over biotechnologische issues te bevorderen.

Uit deze activiteiten kon worden afgeleid dat korte termijnaandacht voor publieke percepties op Europees niveau niet een blijvend effect op de publieke opinie zou leveren.
De observaties binnen the Task Group en binnen het Europese project over publieke educatie toonden aan dat een macroniveau aanpak bijzonder nuttig kan zijn voor het testen van nieuwe methoden van communicatie, het uitwisselen van geslaagde initiatieven enz., maar dat het de noodzaak voor implementatie en continuïteit ontbeert. De organisatie van evenementen op het gebied van publieke communicatie op dit macroniveau kent geen expliciete "eigenaren" in de vorm van instituten die zich verantwoordelijk voelen en is daarom ontvankelijk voor erosie.

Daarom wordt geconcludeerd dat de instituten zelf de expertise, kennis en vaardigheden dienen te implementeren voor een duurzaam resultaat. De wijze waarop dit bereikt kan worden is beschreven in Deel 4 van deze thesis.

Deel 2: ontwikkeling van vaardigheden

Van 1993 tot 2006 zijn negen internationale cursussen georganiseerd op het gebied van publieke percepties en ethiek van de biotechnologie. De inhoud werd in eerste instantie gebaseerd op de aanbevelingen voor de eerste cursus "*Publieke Percepties van Biotechnologie*" uitgevoerd onder het EC FORCE programma. De cursus profiteerde van de expertise van de leden van de EFB Task Group on Public Perceptions of Biotechnology. In eerste instantie werden in 1993 en 1995 twee internationale driedaagse cursussen ontwikkeld voor industriële managers. Het programma werd in 1996 aangepast ten behoeve van Nederlandse promovendi en werd in 1997 kritisch herzien teneinde aandacht te besteden aan de ethische aspecten van biotechnologie. De ontwikkeling, organisatie en evaluatie van de nieuwe tiendaagse cursus werd in 1997, 1999, 2001 en 2002 financieel gesteund door het Biotechnologie Programma van het Vierde Kader Programma van de Europese Commissie, daarna werd de cursus ondersteund door het Nederlandse Centre of Excellence "Kluyver Centre for Genomics of Industrial Fermentation".

De cursussen maakten een snelle ontwikkeling door dankzij een continue evaluatie en consistente terugkoppeling met de ervaren docenten, hetgeen weerspiegeld werd in de behandeling van toegenomen kennis en inzichten over concepten inzake sociale, legale en ethische aspecten. De gebruikte open leermethode in combinatie met de frequente evaluatie tijdens en na afloop van de cursussen resulteerde in een effectief didactisch instrument voor het internaliseren en bespreekbaar maken van de gewenste attitude van cursisten voor interactieve wetenschapscommunicatie.

Een evaluatie onder de deelnemers van de tiendaagse cursussen, aangeboden van 1997 tot 2004, liet zien dat de meerderheid van de deelnemers een toegenomen activiteit toonden in de organisatie van en betrokkenheid met publieke participatie. De deelnemers beschouwden de uitgebreide aandacht voor ethiek en morele systemen in het cursusprogramma als waardevol voor het bevorderen van reflectie over hun eigen waarden en morele socialisatie. Het wordt beargumenteerd dat dit een belangrijke factor is voor interactie met het publiek. De belangrijkste beperking die is geobserveerd voor het gebruik van deze cursussen in de institutionalisering van wetenschapscommunicatie is het gebrek aan prioriteit dat gegeven wordt aan deze trainingen. Het indiceert dat er ofwel een andere grote beperking is voor het volgen van deze training danwel dat er geen bevestiging is voor de noodzaak voor publieke communicatie en training op dit gebied door biotechnologen.

Deel 3: Attitude en gedrag

Teneinde pro-actief betrokken te zijn in wetenschapscommunicatie is het noodzakelijk om te weten welke maatschappelijke issues men moet adresseren. Samen met de Task Group on Public Perceptions of Biotechnology en de European Molecular Biology Organisation (EMBO) heeft de Afdeling Biotechnologie een workshop georganiseerd in 1999 over de "*toekomstige issues in biotechnologie*". Het doel van de workshop was om de verwachte wetenschappelijke ontwikkelingen te bespreken in het licht van hun afgeleide maatschappelijke issues. Een tweede doelstelling van de bijeenkomst was het formuleren van proactieve communicatie activiteiten die anticiperen op deze geïdentificeerde issues. Een uiteenzetting van toekomstverwachtingen door leidende wetenschappers bleek goed bruikbaar voor het bepalen van toekomstige maatschappelijke issues op het gebied van opkomende biotechnologische ontwikkelingen. Het vertalen van deze redelijk algemene issues naar praktische activiteiten met publieke betrokkenheid bleef echter moeilijk. Deze scenario-voorspellende bijeenkomsten kunnen mogelijk een bijdrage leveren aan de ontwikkeling van proactieve publieke communicatie activiteiten. Meer onderzoek is echter nodig naar het gebruik van zulke bijeenkomsten, waarin voldoende aandacht wordt besteed aan de methoden van publieke participatie teneinde dit te kunnen bevestigen.

Rond deze tijd, in het begin van 2000, was de Afdeling Biotechnologie gereed om betrokken te worden bij een aantal grootschalige publieke communicatie-evenementen. Zij koos voor de organisatie van een publieke wetenschapsdag in de Wetenschapsweek in 2000 hetgeen gevolgd werd door de organisatie van een tweede wetenschapsdag in 2001 en een publieke activiteit met scholieren als onderdeel van het Nederlandse nationale debat "*Eten en genen*" in 2001. Beide dagen trokken circa 2000 bezoekers. De doelstellingen waren 1) het publiek te interesseren in biotechnologische ontwikkelingen, 2) het creëren van een positieve associatie met biotechnologie en 3) het stimuleren van jongeren om een carrière in biotechnologie te overwegen. Een scala aan verschillende publiektrekkende activiteiten werd opgezet waaronder demonstraties, wedstrijden, discussies, proeverijen, lezingen en experimenten voor kinderen (in een zogenaamd "pret-lab"). Deze aanpak van een opdeling in verschillende doelgroepen was gebaseerd op het idee dat boodschappen en activiteiten beter aansluiten op de interesses van de verschillende doelgroepen. Overeenkomstig één van de aanbevelingen van de workshop over "*toekomstige issues in biotechnologie*" werd de informatie voor volwassenen gericht op het laten zien van de voordelen van het onderzoek in de Afdeling Biotechnologie voor de maatschappij, met nadruk op de mogelijke toepassingen van dat onderzoek in producten. Onderzoek over risico perceptie had aangetoond dat mensen zich meer bedreigd voelen door vage, ongrijpbare abstracties dan door reële concrete zaken. Daarom werd besloten zo veel mogelijk concrete producten te tonen zodat mensen deze konden zien, ruiken, voelen en indien mogelijk proeven. Het publiek waardeerde deze opzet en velen participeerden in discussies waarbij zij hun mening over de producten en de achterliggende technologie bespraken.

Wetenschapsdagen voor het grote publiek lijken daarmee een mogelijkheid te bieden voor het bespreken van een aantal maatschappelijke issues in een scala van interactieve communicatie activiteiten. Aangetoond werd dat de informele interactieve setting met amusementsactiviteiten het beste werkte voor volwassenen, terwijl de introductie van wetenschap in een speelse setting zoals in het "pret-lab" bedoeld voor kinderen van 6-12 jaar kan resulteren in positieve associaties met wetenschap voor zowel de kinderen als de volwassen bezoekers.

In 2001 werd een rollenspel in de vorm van een rechtszaak met middelbare scholieren gekoppeld aan de nationale Wetenschapsdag 2001 en het nationale debat "*Eten en genen*". De evaluatie door middel van enquêtes ingevuld door de scholieren voor, tijdens, en na afloop van het evenement liet zien dat de steun voor het gebruik van biotechnologie voor voedselproductie in Derde Wereld landen afnam naarmate er meer informatie en opinies werden aangevoerd. De activiteit demonstreerde duidelijk een opbouwende polarisatie volgend op het theaterstuk dat was aangeboden voor het rollenspel en de dialoog tijdens de "*rechtszaak*".

Teneinde de mening en attitude van wetenschappers voor hun betrokkenheid in publieke interactie te bepalen, werden drie enquêteonderzoeken uitgevoerd in 2002, 2003 en 2005. Het doel van deze onderzoeken was te bepalen of er beperkingen geïdentificeerd kunnen worden in de institutionalisering van wetenschapscommunicatie en tevens om een indicatie te krijgen van de bereidheid van wetenschappers om betrokken te zijn in wetenschapscommunicatie. De vragenlijsten werden voorgelegd aan deelnemers van drie internationale biotechnologie congressen waarop de resultaten werden gepresenteerd. De resultaten lieten zien dat de meerderheid van de respondenten van mening was dat het belangrijk is dat wetenschappers communiceren met het grote publiek. Daarentegen bleek ook dat deze wetenschappers zelf niet erg actief waren in wetenschapscommunicatie en publieke interactie. Een interessante observatie was dat een flink aantal wetenschappers niet reflecteert op hun eigen inbreng in wetenschapsontwikkeling zoals aangetoond door hun attitude ten aanzien van toepassingen van hun eigen wetenschappelijke onderzoek. Dit duidt op een cognitieve dissonantie tussen onderzoeksdoelstellingen en de mogelijke maatschappelijke toepassingen van hun eigen wetenschappelijke inspanningen. Dit kan een gevolg zijn van de professionele socialisatie van natuurwetenschappers in een dominant empirische traditie. Het wordt beargumenteerd dat deze onbalans moet worden opgelost alvorens deze wetenschappers zich zullen bezig houden met publieke communicatie teneinde een verlies aan vertrouwen in wetenschappers, met alle indirecte gevolgen voor wetenschapsontwikkeling en regelgeving vandien, te voorkomen.

Deel 4: Institutionalisering

Zoals hierboven gesteld, is het algemene doel van wetenschapscommunicatie voor een universitaire biotechnologische afdeling niet het bevorderen van de acceptatie van biotechnologie, maar het informeren van het publiek over de wetenschap, haar toepassingen en de maatschappelijke consequenties daarvan en het bespreken van de issues volgend uit een implementatie van de nieuwe technologie. Maar wat waren de drijfveren voor de Afdeling Biotechnologie van de Technische Universiteit Delft om actief te raken in publieke communicatie? En hebben de kosten van deze activiteiten de besluiten beïnvloed? De drijvende kracht voor de betrokkenheid van de Afdeling in het institutionaliseringproces was de geanticipeerde negatieve publieke perceptie en de industriële behoefte aan training op dit gebied. Dit werd gevolgd door de behoefte om de betrokkenheid van collega's te vergroten en de wens om goede voorbeelden van communicatie activiteiten te leveren. Dit leidde tot het uitproberen van proactieve communicatie activiteiten welke in 2000 zijn gestart. Vanaf 2002 werd de druk van extern gefinancierde programma's groter met daarin een toenemend verzoek om aandacht voor publieke communicatie activiteiten.

Een gedetailleerde analyse van de kosten van activiteiten in vergelijking met het verwachte resultaat liet een behoorlijk verschil zien tussen de een- en tweerichtingsverkeeractiviteiten. Wanneer dit afgezet wordt tegen de criteria voor communicatie zoals hierboven beschreven kan een aantal activiteiten geselecteerd worden, dat zowel de meerderheid van de criteria adresseert als een groot deel van het publiek bereikt tegen niet al te hoge kosten. Dit resulteerde in een voorstel voor een strategie voor publieke communicatie in onderzoeksafdelingen zoals beschreven in Hoofdstuk 10.

De vergelijkende evaluatie van de uitgevoerde activiteiten toont de invloed aan van de sociale context in het cyclische leerproces van de betrokkenheid van biotechnologen in publieke communicatie, met toenemende invloed van kennis op het gebied van sociale wetenschappen en praktijkervaringen. Voor de laatste stap in het institutionaliseringproces, de integratie binnen de werkpraktijk van wetenschappers, zijn echter noodzakelijke veranderingen geïdentificeerd die nog niet gerealiseerd zijn.

De resultaten van de analyse van drijvende krachten, doelstellingen en kosten voor de incorporatie van publieke communicatie door wetenschappers toont aan dat het mogelijk is op een kosteneffectieve wijze wetenschappelijke ontwikkelingen, de impact van de daaruit voortvloeiende technologische toepassingen en de mogelijke ethische, legale en sociale issues te adresseren. Dit benodigt een aantal vaardige stafleden, een aanpak voor het bereiken van een groot publiek en een strategie voor de discussie van ethische, legale en sociale issues. De beperkingen voor institutionalisering van degelijke wetenschapscommunicatie zijn echter (I) het gebrek aan een methode en strategie voor de Afdeling om te bepalen welke activiteiten het beste kunnen worden opgezet, en (II) het financiële allocatie model van de Technische Universiteit Delft, wat de Afdeling feitelijk straft voor het organiseren van zulke activiteiten. Daarom werden de meeste activiteiten georganiseerd en gecontinueerd met externe middelen. Hoewel dit op zichzelf geen probleem vormt, geeft het toch een limiet aan de tijdspan voor de ontwikkeling van midden- en lange termijn strategieën omdat de meeste extern gefinancierde programma's (zogenaamde tweede- en derde geldstroom programma's) gelimiteerd zijn tot 3- tot 5-jarige perioden. Het lost ook het probleem niet op van het gebrek aan beloning voor wetenschappers omdat het universitaire carrière systeem en het personele aanname beleid slechts ingericht zijn op de stimulering van onderzoeks- en onderwijscompetenties met beperkte aandacht voor managementvaardigheden.

De huidige veranderingen in de maatschappij zullen een effect hebben op de interactie tussen wetenschap en maatschappij. Samen met de verhoogde focus op technologie transfer en valorisatie van onderzoek naar industrie vereist dit een urgente evaluatie van de relaties tussen academia en maatschappij met betrekking tot het beleid voor wetenschap en innovatie en publieke communicatie. De universiteiten hebben recentelijk een grotere taak gekregen in publieke communicatie dankzij de sluiting van het overheidsinstituut voor wetenschapscommunicatie, de "Stichting Weten", en de meer indringende behoefte aan verantwoording aan het publiek. Universiteiten moeten deze nieuwe verantwoordelijkheid op zich nemen. Dit vereist echter een verandering in de organisatiestructuur en een evaluatie van de huidige aandacht voor wetenschapscommunicatie. De meeste universiteiten hebben een centraal gestuurde strategie voor het aantrekken van studenten of het profileren van hun universiteit, maar publieke wetenschapscommunicatie is essentieel verschillend van marketing en profilering en doet een hoger beroep op de onderzoeksstaf. De stimulans van externe geldschieters is eveneens veldgeoriënteerd en afhankelijk van beperkte financiering. De incentives voor meer publieke interactie door de overheid en de incentives vanuit de discipline gerichte externe programma's dienen urgent gecombineerd te worden tot centraal en decentraal gedragen strategieën voor maatschappelijke verantwoording.

De implementatie van deze nieuwe verantwoordelijkheid vereist een aanpassing aan de evaluatieprocedures van wetenschappelijke kwaliteit voor deze nieuwe taak. Op dit moment zijn er procedures beschikbaar voor de evaluatie van wetenschapscommunicatie in het VSNU[51] zelfevaluatie protocol, maar de meeste universiteiten zijn nog niet ingericht om op deze criteria te scoren. Dit alles maakt de vraag belangrijk: *"Hoe kunnen academia zichzelf voorbereiden op deze nieuwe verantwoordelijkheid"*. Deze thesis besluit daarom met een voorstel voor een duurzame institutionalisering van publieke communicatie waarin deze uitdagingen aangepakt worden.

Een ander probleem is het bereiken van een groot publiek dat niet snel geïnteresseerd is in het participeren in de nu geprefereerde dialoog, omdat men er geen direct herkenbaar aandeel in heeft. Nieuwe aanpakken om deze meerderheid te bereiken zijn zeldzaam in wetenschapscommunicatie. In het laatste deel van de thesis is beargumenteerd dat een voorbereidende stap gebaseerd op amusement effectief kan zijn in het bereiken van deze groep en het verhogen van de publieke participatie in interactieve communicatie. Het voorgestelde "*Three-E model: Entertainment, Emotion and Education*" is een universele aanpak die toepasbaar is op allerlei maatschappelijke kwesties. Het "*entertainment*" (amusement) stimuleert de aandacht, "*emotion*" (emotie) volgt uit de identificatie met het onderwerp, terwijl "*education*" (educatie) bereikt wordt door de verhoogde nieuwsgierigheid. De aanpak vereist kennis, vaardigheden en een bepaalde attitude van wetenschappers betrokken in de activiteit, hetgeen bereikt kan worden, zoals aangetoond in de Wetenschapsdagactiviteiten van 2000 en het meer recente *Imagine* project[52]. Nader onderzoek moet uitmaken of de aanpak, waarvan verwacht wordt dat die bruikbaar is voor alle vakgebieden, valide is voor de doelstellingen van wetenschapscommunicatie.

De analyse van beperkingen voor het succesvol implementeren van duurzame wetenschapscommunicatie in een universitaire afdeling laat zien dat er een relatie bestaat tussen het financiële allocatiemodel en de impliciete prioriteiten van de universiteit. Een gebrek aan financiële, carrière georiënteerde of andere stimuli voor academische wetenschappers en hun afdelingen voor investering in wetenschapscommunicatie hindert de ontwikkeling van competenties. Vooral omdat tijd- en andere investeringen concurreren met

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[51] De VSNU: Vereniging van Samenwerkende Nederlandse Universiteiten is momenteel verantwoordelijk voor de kwaliteitscontrole van onderzoek in Nederlandse universiteiten. Zij hebben recentelijk een nieuwe procedure voor het evalueren van gelanceerd, *"SciQuest"*

[52] *Imagine*: een school competitie waarin wetenschappers en scholieren samenwerken aan biotechnologie projecten voor ontwikkelingslanden (zie www.imagine-foundation.org)

onderzoeks-, publicatie- en onderwijstaken. Zolang externe bronnen communicatie activiteiten van wetenschappers financieren, zullen die wetenschappers geneigd zijn zich te richten naar de algemene doelstellingen van die externe bronnen. Dit kan sceptisch ontvangen en zelfs verdacht opgevat worden door het publiek. Bovendien kan deze oriëntatie van wetenschappers conflicteren met de algemene doelstellingen van de universiteit en averechts werken op het imago en de missie van de universiteit. Het beïnvloedt de delicate balans van marketing[53] en verantwoording in publieke perceptie, vooral wanneer industriële fondsen gebruikt worden om de wetenschapscommunicatie activiteiten van wetenschappers te financieren.

De implementatie van wetenschapscommunicatie in een universiteit is daarom urgent en afhankelijk van een effectief systeem van doelstellingen en beloningen ondersteund door gespecificeerde taken en consequente evaluatie van resultaten en competenties binnen de organisatie. Dit kan gestimuleerd worden door financiële beloningen op analoge wijze aan de beloning voor onderzoek en onderwijs. Voor de implementatie van zo'n grote verandering in de universiteitsorganisatie wordt voorgesteld de methode van de "Action Research Spiral" te gebruiken, zoals beschreven in diverse case studies voor institutionaliseringsprocessen.

Conclusie

Het is niet gemakkelijk de eerste onderzoeksvraag zoals deze in het begin gesteld is, volledig te beantwoorden. Er zijn ongetwijfeld vele redenen aan te voeren voor een gebrek aan correlatie tussen het toegenomen gebruik van een technologie en de publieke steun voor onderzoek. Duidelijk is echter dat biotechnologen niet erg actief zijn geweest in publieke communicatie. Een van de redenen kan zeker worden gevonden in de gesloten praktijk van wetenschap hetgeen een resultaat is van de professionele socialatie zoals dit proefschrift beargumenteert. De competenties die nodig zijn voor publieke interactie zijn kennis over de wetenschap, de maatschappelijke impact van haar mogelijke toepassingen en de ethische, legale en sociale issues en vaardigheden voor interactieve communicatie. Tevens moet men beschikken over een motivatie om maatschappelijke issues te begrijpen en te beantwoorden. De belangrijkste competentie is echter reflectie. Reflectie op het eigen onderzoek en reflectie op de eigen waarden en opinies voor de mogelijke toepassingen, in de rol van burger, consument of patiënt.

Teneinde de ontwikkeling van deze competenties te faciliteren dient de professionele praktijk van wetenschappers te openen en dient het belang van wetenschapscommunicatie onderkend te worden. Universiteiten moeten training in hun curricula inbouwen en dienen

[53] Marketing wordt hier gebruikt voor communicatie met als doel de verkoop van een product of onderwijsprogramma; wetenschapscommunicatie is gebruikt in deze thesis voor elke interactie met als doel het vergroten van kennis van tenminste een partij. Dit kan zowel een- als tweerichtingsverkeer interactie zijn. Publieke communicatie wordt gebruikt als aanduiding voor wetenschapscommunicatie met of naar een groot publiek. Publieke interactie wordt gebruikt voor tweerichtingsverkeer in communicatie. De delicate balans tussen marketing en wetenschapscommunicatie is het gevolg van de afhankelijkheid van academici van de universitaire financieringsmechanismen, welke op hun beurt afhangen van het aantrekken van studenten, contract onderzoek, prestaties en niet geoormerkte overheidsgelden.

wetenschapscommunicatie een plaats te geven in de financiële allocatiesystemen, terwijl onderzoeksleiders tijd moeten vrijgeven voor deze training en voor de betrokkenheid in publieke interactie. Wetenschappers en hun afdelingen dienen te worden beloond en niet gestraft om aan zulke activiteiten deel te nemen en hebben behoefte aan de voorbeelden en aanmoedigingen van hun leiders.

Dit vereist een ander type institutioneel management. De grootste beperking voor de betrokkenheid van wetenschappers in publieke communicatie kan momenteel gevonden worden in het financiële of anderszins georiënteerde allocatiesysteem. Wetenschaps-communicatie wordt niet erkend op hetzelfde niveau als onderzoek en onderwijs. Daarom wordt er niet geselecteerd voor personele competenties voor publieke interactie. De noodzakelijke veranderingen zijn:

1. betrek de taak van wetenschapscommunicatie in het universitaire (financiële of doelstelling georiënteerde) allocatie systeem;
2. selecteer en beloon personeel voor vaardigheden in publieke interactie;
3. implementeer toereikende training en reflectie in curricula en in afdelingen;
4. link wetenschapscommunicatie met universitaire bedrijfsstrategieën.

Als deze zaken in orde zijn kan de publieke steun voor wetenschap en technologie mogelijk stijgen, gegeven dat er een positieve correlatie bestaat tussen wetenschapscommunicatie door “empowered” wetenschappers en publieke ondersteuning van wetenschap.

Patricia Osseweijer, 2006

Acknowledgements

The words sung by “Blood Sweat & Tears” perfectly express what I feel; “*Thank you baby. Every day of my life I want to thank you*”[54].

The whole experience started back in 1991 and has without exception been a joyful and happy path of events. However much I would like to, it is impossible to thank everybody personally though as so many hundreds of people were involved in the numerous activities. And at times these were pretty challenging and ambitious. After the idea was born to write a thesis about the experiences it was the great drive of people such as Karel Luyben, Gijs Kuenen and presently Han de Winde as chairmen of the Department of Biotechnology at the Delft University of Technology that made me stick to it. But it could never be done without the encouragements of Joske Bunders and Tjard de Cock Buning from the Free University of Amsterdam Department on Biology and Society. Joske made me enthusiastic for the idea. Together they took me by the hand and made me think hard through their critical reflections. A lovely and most learning experience especially as they made sure to give me confidence in myself during these sessions. Also the interactions with other members of the group were always very helpful and enthusiastic. I thank you all and especially Tjard for your cheerful support and wish you a great and successful time together. I also thank the reading committee for their time in going through this thesis so carefully and their helpful suggestions in the final phases of the book’s preparation.

I consider myself a very lucky person. I have met so many interesting people through the numerous international projects and events. I will, for example, never forget the great discussion with the Spier family during our stay to prepare a course on ethics and public perceptions in 1997! The Task Group members naturally all contributed to my learning curve as public communication was also near to their heart. Thank you John Durant and Richard Braun for keeping the group so lively and active! But it was also great to see how many other people whom I met in (inter)national science projects and events were always interested in discussing public communication and eager to give me their experiences and share their insights. I am most obliged and hope to be able to give you all something back with this thesis.

My colleagues in the Department of Biotechnology deserve a special word of thanks. Most activities started as yet another idea for a ‘great event’ for which I was highly enthusiastic. And I more or less expected that everybody would also like the idea and would be happy to put their backs into it. Amazingly that is what often happened. I only realise now, seeing it all together in retrospect, how much difference that made. It made the Department an active one that can be proud of their track record in communicating biotechnology. I really hope that together we can keep it going! “Thank you babies!”

[54] Song title: *“You’ve made me so very happy”*, Blood Sweat & Tears (Holloway, Wilson, Gordy and Holloway; Jobete Music (UK) Ltd. 1968)

This is where normally some more personal “thank yous” show. I cannot and would not wish to escape from that tradition. And while I have already said that I am most grateful to many, I wish to especially thank those who were so close in making it such a wonderful experience. Piet Bos, Elly Muilman, Sjaak Lispet, Jenny Boks, Carla Segaar and Ank Voskuil were in it from the early days and were really instrumental to everything. Thanks ever so much! They were joined by Daan Schuurbiers, Marije Blomjous, Kim Meulenbroeks, Jennifer Achterhof, Kim van de Sande, Joris van der Ahe, Roald Verhoeff, Julian Kinderlerer and Klaus Ammann. I greatly valued your contributions! I would also like to acknowledge the support and ideas of the Management Team and Board of the Department and the Management Team of the Kluyver Centre. Gijs Kuenen, Sef Heijnen and Jan Wallaart, thank you very much indeed for your encouragement and support, Hans van Dijken for the many ideas, and Jack Pronk and Luuk van der Wielen for your time and commitment!

Finally I come to my closest friends, my daughter and my husband. Thank you Juliette for putting up with a multi-tasking ‘wanna-be’ mum and David for keeping so well the one promise you made when we married that I’d never be bored. I was certainly not bored and hope to keep it that way!

Patricia Osseweijer, 2006

Appendices

Appendix 1(a)

1. Short resumé

Patricia Osseweijer was born in 1958 in Dordrecht. After her secondary school (atheneum) she studied biology (MSc) with majors in molecular genetics and didactics at Utrecht University. During her study she volunteered to work with the Netherlands genetic patient organisation (VSOP) for which she developed a nationally introduced series of lessons on prenatal diagnostics for secondary schools. After her graduation in 1984 she worked at Nijmegen University where she designed a curricula for Master degrees in applied bio(techno)logy and medical biology. Her professional experience in curriculum development led to the appointment of study advisor and curriculum coordinator for the Sub Faculty of Biology from 1986 to 1990. This was followed by a management position for an international network in biotechnology for course development and student exchanges. In 1991 Patricia moved to the Delft University of Technology where she was put in charge of fund acquisition and management of (inter)national research and education projects (including a number of EU projects). Additionally she developed and coordinated international advanced short courses in biotechnology. In 1999 she was appointed Managing Director of the Department of Biotechnology and Executive Secretary for the Research School Biotechnological Sciences Delft Leiden. She initiated a new research and education group on society issues in biotechnology which is closely collaborating with Leiden University. She has organised many international workshops and courses in this field, such as the international "Advanced Workshop on Bioethics and Public Perceptions" in Oxford, recently for the sixth occasion. She chairs the Working Group on Biotechnology Research and Higher Education of the European Federation of Biotechnology (EFB) Task Group on Public Perceptions and has initiated many multi-stakeholder events. Patricia is former Secretary of the EFB Section on Biochemical Engineering Science, former Board member of the Netherlands Society for Biotechnology (NBV) and present Treasurer of the "Netherlands Biotechnology Foundation". In 2002 she was appointed Managing Director of the National Centre of Excellence "Kluyver Centre for Genomics of Industrial Fermentation", funded under the Netherlands Genomics Initiative, and Programme Leader of its Society and Genomics Programme. As Programme Leader she is responsible for the coordination of the societal research projects in several universities as well as for the integration of these projects in the communication strategy of the Kluyver Centre. Following the success of the communication project "Imagine" for secondary schools in 2005 she initiated the Foundation Imagine Life Sciences, which she chairs. In 2006 she received the NBV education and communication award for the "Imagine" project. Just before going to press it was announced that she is nominated for the European Descartes Prize for Science Communication. She has published over 30 articles, reports and papers and delivered more than 40 invited presentations. She contributed to a number of national debates, radio interviews, newspaper articles and television presentations.

Appendix 1(b): List of publications of the author

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Appendix 2

Questionnaire on public perception and management training in biotechnological companies

Introduction

The FORCE project "Pilot models for continuing vocational training in biotechnology", in which a number of European biotechnological companies participate, aims at a better understanding of the training needs in biotechnological companies in Europe. During a Workshop on this subject in Delft (March 19-20, 1992), where research and personnel managers from industry exchanged views with curriculum developers from the educational institutes, it was decided that the project should further focus on training needs in two specified areas. Public Perception of biotechnology and dedicated Management in biotechnology were considered most important by the participants of this workshop.

In preparation for the development of the requested training for the participating companies we would like to ask some specific questions about common needs. We focus especially on courses designed for the biotechnology industry which do not (yet) exist and for which internal resources are usually not available. The ultimate aim of this approach is to develop with you and for you these courses on a shared costs basis with the financial support of the EC FORCE programme.

The questionnaire is in multiple choice format to enable easier interpretation of the responses but please add any further comments which you feel are relevant.

Part I : For Personnel Department
Part II: For the other Departments/Groups

Part I: For Personnel Department

1. Please indicate your name and the name of the company
   Name : ....
   Company : ....

2. For what courses in Biotechnology is there a specific need within your company? (More answers are possible)
   ☐ Courses on matters concerning public perception
   ☐ Biotechnology-specific management training
   ☐ ....

3. How many people are employed by your company?
   ☐ < 50
   ☐ 50 - 250
   ☐ 250 - 500
   ☐ > 500

4. Does your company have a dedicated budget for training?
   ☐ Yes budget : ....
   ☐ No
   Do you foresee an increase in the amount spent on training in specific biotechnology subjects within your company?
   ☐ Yes
   ☐ No

5. Is a certificate of successful completion of the course important?
   ☐ Yes
   ☐ No
   Remarks :
   ....

Public Perception

6. Please indicate below why it is important for your company to train personnel in matters concerning public perception?

Please indicate level of priority	low		high
- marketing of own products	☐	☐	☐
- influence public opinion	☐	☐	☐
- avoid unnecessary negative publicity	☐	☐	☐
- improve the personnels' understanding	☐	☐	☐
- improve communication with local community	☐	☐	☐
- influence government policy	☐	☐	☐
-	☐	☐	☐

7. Please indicate whether it is important for your company that the following public perception-related topics are covered in the course:

Please indicate level of priority	low		high
- regulation, biosafety, risk and environmental			
- impact assessment	☐	☐	☐
- patenting and licensing	☐	☐	☐
- food labelling	☐	☐	☐

8. We presume that the core of the course must be the improvement of communication skills. Which of the following items do you consider as most important?

Please indicate level of priority	low		high
Improvement of personal presentation techniques:			
* within the company (e.g. within project team, with marketing and management)	☐	☐	☐
* in group discussions with environmental and consumer organizations etc.	☐	☐	☐
* to journalists	☐	☐	☐
* on radio	☐	☐	☐
* on television	☐	☐	☐
* at school presentations	☐	☐	☐
* on paper	☐	☐	☐

9. Some suggestions for further topics in the course (to be integrated with the above mentioned sections).

Please indicate level of priority	low		high
- Invitation for lecture and discussion with:			
* journalists, TV and radio presenters	☐	☐	☐
* policy makers, politicians	☐	☐	☐
* experts in the field of public perception (risk communication, communication and survey researchers, etc.)	☐	☐	☐
- Discussion on newspaper and magazine articles	☐	☐	☐
- Case-studies (e.g. of good and poor practice, parallels with nuclear energy)	☐	☐	☐
- Discussions of recent books, articles etc bearing on public perception of biotechnology	☐	☐	☐

10. In what form should the course(s) preferably be given?
☐ Full time
☐ One day per week
☐ ....

11. What length of the course would you prefer?
☐ less than one week (full time equivalent)
☐ between one and three weeks (full time equivalent)
☐ more than three weeks (full time equivalent)

12. At what level should the course be targeted? (More answers possible) Please indicate for each selected level whether you prefer a course oriented to national or international groups of participants.

	national	no preference	international
☐ post doctoral	☐	☐	☐
☐ first degree	☐	☐	☐
☐ junior technician	☐	☐	☐
☐ senior technician	☐	☐	☐
☐ administrative	☐	☐	☐
☐ marketing	☐	☐	☐
☐	☐	☐	☐

Many companies throughout Europe are interested in educating their personnel about the subjects you have just indicated. It could be advantageous for different reasons (i.e. cost, input of ideas, etc.) to collaborate with them.

13. Which of these options do you prefer?
☐ A course solely for your employees without any collaboration with other companies.
☐ on-site
☐ off-site
☐ no preference for location
☐The basic part of the course covered in classes with personnel from different collaborating companies and part of the course with more specific subjects for the benefit of your personnel only.
☐ at local venue (to share facilities in one company)
☐ international (central) location
☐ a course presented to classes comprised of personnel from the collaborating companies.
☐ at local venue (to share facilities in one company)
☐ international (central) location
☐ other,...
....
....

Biotechnology management

Since we are focusing on management courses for the biotechnology industry which are not yet in existence we would like you to specify your needs in further detail.

14. Could you please indicate which areas you would like to focus on in this biotechnology-oriented course.

Please indicate level of priority	low		high
Human recourses development and management	☐	☐	☐
Leadership in a changing environment	☐	☐	☐
Survivor approach	☐	☐	☐
Innovation	☐	☐	☐
Technology transfer from research to development	☐	☐	☐
Technology transfer from development to manufacturing	☐	☐	☐
Safety	☐	☐	☐
Technology forecasting	☐	☐	☐
Technology push --> market pull	☐	☐	☐
Coaching skills	☐	☐	☐
Networking	☐	☐	☐
Regulation	☐	☐	☐
New biotechnology (i.e. involving recombinant DNA technology) versus traditional biotechnology	☐	☐	☐
....	☐	☐	☐
....	☐	☐	☐
....	☐	☐	☐

15. In what form should the course(s) preferably be given?
☐ Full time
☐ One day per week
☐ ....

16. What is in your opinion the maximum time that can be spent on such a course?
☐ less than one week (full time equivalent)
☐ between one and three weeks (full time equivalent)
☐ more than three weeks (full time equivalent)

17. At what level should the course be targeted? (More answers possible) Please indicate for each selected level whether you prefer a course oriented to national or international groups of participants.

	national	no preference	international
☐ post doctoral	☐	☐	☐
☐ first degree	☐	☐	☐
☐ junior technician	☐	☐	☐
☐ senior technician	☐	☐	☐
☐ administrative	☐	☐	☐
☐ marketing	☐	☐	☐
☐	☐	☐	☐

Many companies throughout Europe are interested in educating their personnel about the subjects you have just indicated. It could be advantageous for different reasons (i.e. cost, input of ideas, etc.) to collaborate with them.

18. Which of these options do you prefer?
☐ a course solely for your employees without any collaboration with other companies.
☐ on-site
☐ off-site
☐ no preference for location
☐ the basic part of the course covered in classes with personnel from different collaborating companies and part of the course with more specific subjects for the benefit of your personnel only.
☐ at local venue (to share facilities in one company)
☐ international (central) location
☐ a course presented to classes comprised of personnel from the collaborating companies.
☐ at local venue (to share facilities in one company)
☐ international (central) location
☐other,...
....
....

Part II: For the other Departments/Groups

1. Please indicate your function and the name of the department/group
   Function : ....
   Dept./group : ....

2. In what kind of courses is your department/group interested? (More answers are possible)
   ☐ Courses on matters concerning public perception
   ☐ Biotechnology specific management training
   ☐...

3. How many people are employed at your department/group?
   ☐ < 20
   ☐ 20 - 50
   ☐ 50 - 100
   ☐ > 100

Public Perception

4. See question 6, part I and replace 'company' with 'department/group'

5. See question 7, part I and replace 'company' with 'department/group'

6. See question 8, part I

7. How many employees from your department/group would you like to participate in this course?
   ....

8. See question 10, part I

9. What is in your opinion the maximum time that can be spent on such a course?
   ☐ less than one week (full time equivalent)
   ☐ between one and three weeks (full time equivalent)
   ☐ more than three weeks (full time equivalent)

10. See question 12, part I

Many companies throughout Europe are interested in educating their personnel about the subjects you have just indicated. It could be advantageous for different reasons (i.e. cost, input of ideas, etc.) to collaborate with them.

11. See question 13, part I

12. Are there specific topics which you feel should be dealt with in the course?
    Topics:..
    ....

13. Do you have authority to decide over a course budget?
    ☐ Yes
    ☐ No

    If Yes. Although development and attendance of the course will be in part funded by the EC FORCE programme, there will have to be a fee to participants for the balance of the full costs.
    A. What would you be prepared to pay as part-fee per employee for this type of course? (please state currency)

....
B. What would you be prepared to pay as fee per employee for a similar course not funded by the EC?
....

Biotechnology management

Since we are focusing on management courses for the biotechnology industry which are not yet in existence we would like you to specify your needs in further detail.

14. See question 14, part I

15. How many employees from your department/group would you like to participate in this course?
....

16. See question 15, part I

17. See question 16, part I

18. See question 17, part I

Many companies throughout Europe are interested in educating their personnel about the subjects you have just indicated. It could be advantageous for different reasons (cost, input of ideas, etc.) to collaborate with them.

19. See question 18, part I

20. Do you have authority to decide over a course budget?
☐ Yes
☐ No

If Yes. Although development and attendance of the course will be in part funded by the EC FORCE programme, there will have to be a fee to participants for the balance of the full costs.
A. What would you be prepared to pay as part-fee per employee for this type of course? (please state currency) ....
B. What would you be prepared to pay as fee per employee for a similar course not funded by the EC? ....

Appendix 3-a

Workshop Course on Public Perceptions of Biotechnology, Communication and Company Strategy

Programme

Location: Kluyver Laboratory for Biotechnology, Julianalaan 67, 26 28 BC Delft, NL
College Room BPT

Wednesday 28 June 1995

09.30 **Introduction to the course**
Prof. Karel Luyben, Dr David Bennett

10.00 **Science communication**
Prof. John Durant

10.45 Coffee

11.15 **Research on science communication in biotechnology**
Eric Marlier

12.15 **The different forms of communication - for and against**
Prof. John Durant

13.00 Lunch
Restaurant Dish, Kanaalweg 3, Delft

14.30 **Introduction to written communication**
Dr Bernard Dixon

15.30 **Reviewing of participants prepared pieces**
Dr Bernard Dixon

17.30 Drinks

18.00 **Discussion and commencement of campaign planning exercises**
Drs Patricia Osseweijer

21.00 Dinner
't Keldertje, Kluyver Laboratory

Thursday 29 June 1995

08.30 **Introduction to oral communication**
Peter Evans, Dr David Bennett

10.30 Coffee

11.00 **Participants presentations and feed back**
Peter Evans, Dr David Bennett

12.15 **Discussion and review of written and oral communications exersises**
Dr B. Dixon, Peter Evans, Dr D. Bennett

13.00 Lunch
't Keldertje, Kluyver Laboratory

14.30 **Task I, Developing a Communication plan**
Working in groups

17.00 **Presentations of Communication plans**

18.00 Drinks

18.30 **Introduction to Task II, Developing a Company Strategic Plan**
Drs Patricia Osseweijer

20.30 Dinner
Restaurant "de Prinsenkelder", Schoolstraat 11, Delft

Friday 30 June 1995

08.30 **Company strategies**
Continuation of group work

10.30 Coffee

11.00 **Company Strategy: Novo Nordisk experience**
Lise Kingo

12.30 Lunch
Restaurant hotel Dish, Kanaalweg 3, Delft

14.00 **Task III, Testing of plans, "Nasty situations"**
Working in groups

16.00 Coffee

16.15 **Presentation and panel review of campaign plans, strategies and responses to "nasty situations"**
Panel: Prof. Karel Luyben, Eric Marlier, Dr Bernard Dixon, Peter Evans, Dr David Bennett, Lise Kingo

18.15 Drinks

18.30 Evaluation closure

19.30 Dinner & Party
Botanical Garden, Kluyver laboratory

Appendix 3-b

Programme

ABON-AIO Cursus
“Maatschappelijke aspecten van biotechnologie”
29-31 januari 1996
Kluyver laboratorium Delft

Board of the Course:
Prof.ir. K.Ch.A.M. Luyben (BSDL)
Prof.dr.ir. A.J.J. van Ooyen (VLAG)
Prof.dr. H.O. Voorma (vz. ABON)

Cursusleiders:
Ir. A. de Haan (VLAG)
Drs. P. Osseweijer (BSDL)
Drs. T. Pieters (Project “Maatschappelijke en ethische aspecten van Biotechnologie (MEAB), RUG).

Locatie: Kluyverlaboratorium voor Biotechnologie, Julianalaan 67, Delft

Deze cursus heeft tot doel AIO’s bekend te maken met de maatschappelijke aspecten van biotechnologie.
Het inzichtelijk maken van de problematiek van perceptie en acceptatie van biotechnologie vormt de rode draad van de cursus. Zaken als risico-analyse en perceptie met de daaruit voortvloeiende wetgeving, vergunningsprocedures en octrooi problematiek worden behandeld naast ethische aspecten, beroepscode en eigen verantwoordelijkheid. Ook analyse technieken zoals Constructive Technology Assessment zullen worden behandeld. Tevens wordt er aandacht besteed aan communicatie en bedrijfsstrategie. Veel van de cursus onderdelen worden in de vorm van groepswerk, werkcollege, simulatie- en rollenspelen en discussiesessies verzorgd.

Maandag 29 januari 1996

09.30	Welkom Inleiding doelstellingen en inhoud cursus
09.45	Overzicht van toepassingsgebieden van biotechnologie Prof.dr.ir. J. Tramper (VLAG)
10.30	Koffie
10.45	Cases uit de industrie Prof.dr. G. Van Beynum (NIABA)
11.15	Praktijkvoorbeelden Constructive Technology Assessment Dr. J. Jelsma (TU Twente)
12.15	Lunch
13.00	Oefening Consumenten enquête SWOKA
13.30	Consumenten onderzoek Ir. A. Hamstra (SWOKA)
14.15	Analyse verloop maatschappelijke discussie rond moderne biotechnologie Drs. T. Pieters (MEAB, RUG)
15.00	Koffie
15.15	Vervolg analyse maatschappelijke discussie
17.00	Drs. T. Pieters (MEAB, RUG)
19.30	Cogem simulatiespel
21.30	Dr. J.A.A. Swart (RUG)

Dinsdag 30 januari 1996

09.00 Regelgeving rond voedselveiligheid van Novel Foods
Ir. E.J. Kok (Rikilt-DLO)
09.45 Risico's en regelgeving voor milieu, COGEM
Dr. J.E.N. Bergmans (COGEM)
10.45 Koffie
11.00 Octrooi op leven, theorie en praktijk
Mr. H. Raven (Gist-brocades)
12.00 Lunch
13.00 Vervolg octrooi op leven
Mr. H. Raven (Gist-brocades)
14.00 Voorbereiden communicatieplan
Drs. P. Osseweijer (BSDL)
20.00 Tussenrapportage en commentaar
-21.30

Woensdag 31 januari 1996

09.00 Inleiding ethiek
Drs. F. Brom (Centrum Bio-ethiek)
10.00 Koffie
10.15 Ethische analyse
Drs. F. Brom
10.45 Bespreking ethische analyse
Drs. F. Brom
12.00 Beroepscode biotechnoloog
Dr.ir. C. Van der Beek (NBV)
12.45 Lunch
13.45 Afronden communicatie- en bedrijfsplan
19.30 Presentaties bedrijfsplannen en paneldiscussie
Mr. G.H. Schipper (Unilever), Dr. A. Schram
(S&G Seeds), Prof. K. Luyben (BSDL), Drs. M. Zijlstra (DLO), Drs. F. Brom (LNV)

Appendix 3-c

Advanced Workshop Course on Biotechnology Ethics and Public Perceptions of Biotechnology

Programme

Sunday 28 March 2004

Evening arrival of the participants
19.00-19.45 Opening lecture
19.45 Welcome buffet

Monday 29 March 2004

THEME: Introduction

- welcome
- introduction of course aims, general rules applying
- chairman of the day schedule
- watchdog of the day schedule
- rules for interruptions, code of the programme
- participants' personal objectives
- introduction on ethics

09.00-09.30	**General introduction** *Drs Patricia Osseweijer, Kluyver Centre for Genomics of Industrial Fermentation, The Netherlands*
09.30-10.30	**10 min presentations by participants** International participants present an overview of their work and/or interests or the results of a project they undertook related to the course programme. Each participant also presents one statement, which could be a prioritised problem they either foresee or encounter in a societal context, and one prime personal objective for this course. At the end of the day a listing of problems, statements and objectives will be discussed and agreed, which will be used as reference during later evaluations of the course.
10.30-11.00	Coffee
11.00-13.00	**10 min presentations by participants**
13.00-14.00	Lunch
14.00-16.00	**10 min presentations by participants**
16.00-16.30	Tea
16.30-18.00	**What are ethics/morals? Introduction** *Drs Henriette Bout, Vrije Universiteit Amsterdam, The Netherlands*
19.00	Dinner

Tuesday 30 March 2004

THEME: Issues in relation to ethics and biotechnology

- why is ethics important?
- why are public perceptions important?
- the concept of truth
- facts and values
- ad-hoc committees and knowledge institutes
- process issues and product issues
- misrepresentation, plagiarism, interference, non-disclosure, conflict of interest
- data selection

09.00-10.30	**Ethical systems** *Prof. Tjard de Cock Buning, Vrije Universiteit Amsterdam, The Netherlands*
10.30-11.00	Coffee
11.00- 12.30	**Case study on rational decision making in ethics** *Prof. Deryck Beyleveld, University of Sheffield, United Kingdom*
12.30-13.30	Lunch
13.30-15.00	**Respecting cultural values, the New Zealand case** *Prof. Tjard de Cock Buning, Vrije Universiteit Amsterdam, The Netherlands*
15.00-15.30	Coffee
15.30-17.30	**Ethical issues in biotechnology, an evolutionary approach** *Prof. Raymond Spier, University of Surrey, United Kingdom*
19.00-20.30	Dinner
20.30-22.00	**The moral status of the human embryo, foetus and stem cells** **Case study and consensus exercise on human cloning** *Prof. Deryck Beyleveld, University of Sheffield, United Kingdom*

Wednesday 31 March 2004

THEME: Ethics and Society

- ethics in bio-industry
- consideration for developing countries
- participation
- biodiversity issues
- privacy and patients driven

09.00-10.15	**Business and ethics** *Ms. Lise Kingo, Novo Nordisk, Denmark*
10.15-10.30	Coffee
10.30-11.45	**Participative strategies for implementing biotechnology innovations in developing countries** *Prof. Joske Bunders, Vrije Universiteit Amsterdam, The Netherlands*
11.45-13.00	**Ethics cases and games** *Drs Henriette Bout, Vrije Universiteit Amsterdam, The Netherlands*
13.00-13.45	Lunch
13.45-15.00	**Biodiversity as context of food production** *Prof. Klaus Ammann, Botanical Garden University Bern, Switzerland*

Rest of the afternoon off

Prepare for next day
Prepare patenting

19.00-20.30 Dinner
20.30-22.00 Using genetic information to make personal health decisions
Mr. Alistair Kent, Genetic Interest Group London, United Kingdom

<u>Thursday 1 April 2004</u>

THEME: Biotechnologists and regulatory issues

- Law and biotechnology, why?
- EC directives, GMOs, guidelines/regulations
- Implementation
- Why institute laws to control biotechnology at all?
- What makes the products of modern biotechnology more susceptible to legal control compared to products of traditional technology?
- What should be controlled if anything - microbes, plants, animal, humans?
- Define the legal instruments, including the European Directives (EC90/219, EC2001/18, Medical devices, patents)
- Religion and biotechnology

09.00-10.30 Law in biotechnology
Prof. Julian Kinderlerer, University of Sheffield, United Kingdom
10.30-11.00 Coffee
11.00-11.45 Regulatory Committees, the practice of risk assessment and the precautionary principle
Prof. Julian Kinderlerer, University of Sheffield, United Kingdom
11.45-12.30 Integrated ethical assessment frame for GMO licensing
Prof. Tjard de Cock Buning, Vrije Universiteit Amsterdam, The Netherlands
12.30-13.30 Lunch
13.30-15.00 Field trial assessment, role play exercise
Prof. Julian Kinderlerer, University of Sheffield, United Kingdom and Prof. Tjard de Cock Buning, Vrije Universiteit Amsterdam, The Netherlands
15.00-15.30 Tea
15.30-18.00 Evaluation, role-play and discussion
Prof. Julian Kinderlerer, University of Sheffield, United Kingdom and Prof. Tjard de Cock Buning, Vrije Universiteit Amsterdam, The Netherlands

19.00-20.30 Dinner
20.30-22.30 Religion and biotechnology
Dr Donald Bruce, Church of Scotland, United Kingdom

<u>Friday 2 April 2004</u>

THEME: Risk assessment and perception

- law and risk assessment, risk perception, application of the precautionary principle in risk assessment

09.00-10.30 Risk assessment - what is it, and how is it done

	The assessment of risk is the foundation for the safe use of the technology *Prof. Julian Kinderlerer, University of Sheffield, United Kingdom*
10.30-11.00	Coffee
11.00-12.30	**Risk perception** Theory of risk compensation; risk attitudes *Dr John Adams, University College London, United Kingdom*
12.30-13.30	Lunch

THEME: Public Perceptions of biotechnology: how are attitudes linked to behaviour?

- who are the stakeholders?
- survey results
- what is the value of information?
- what are the issues?
- how do the media show this?
- can we spot any trends?
- what are the economical consequences?
- company EU-US
- role and function NGO
- evaluation of first week

13.30-15.00	**Introduction, surveys, Eurobarometer, stakeholders and issues in Europe** *Dr George Gaskell, London School of Economics, United Kingdom*
15.00-15.15	Tea
15.15-16.15	**Comparison and contrast of US/EU human-subjects research protection.** *Dr John J. Gillon, Attorney at Law, United States*
16.15-17.00	**Perspectives of an environmental organisation** *Mr. Douglas Parr, Greenpeace, United Kingdom*
17.00-17.30	**Introduction group work on integral communication** *Drs Patricia Osseweijer, Kluyver Centre for Genomics of Industrial Fermentation, The Netherlands*
17.30-18.15	**With drinks: mid-term evaluation, feed back on participants involvement, discussion on expectations and statements of day one**
19.00	Dinner

Saturday 3 April 2004

Day off

Sunday 4 April 2004

THEME: How do the media work?

- newspapers, journals, radio and TV
- who are the gatekeepers?
- timing of information and press releases
- debates, lectures and interview techniques
- training in written and oral communication

09.00-10.30 **Press conference simulation**
Dr Bernard Dixon, American Society for Microbiology, United Kingdom and Dr Peter Evans, BBC Science Unit, United Kingdom
10.30-11.00 Coffee
11.00-11.45 **How do the media work?**
Dr Bernard Dixon, American Society for Microbiology, United Kingdom and Dr Peter Evans, BBC Science Unit, United Kingdom
11.45-12.30 **Writing about science for non-scientists**
Dr Bernard Dixon, American Society for Microbiology, United Kingdom and Dr Peter Evans, BBC Science Unit, United Kingdom
12.30-13.30 Lunch
13.30-15.00 **Reviewing participants' prepared pieces**
Dr Bernard Dixon, American Society for Microbiology, United Kingdom and Dr Peter Evans, BBC Science Unit, United Kingdom
15.00-15.30 Tea
15.30-17.30 **Writing exercises**

19.00 Dinner

Monday 5 April 2004

09.00-10.30 **Oral communication, radio and TV**
Dr Bernard Dixon, American Society for Microbiology, United Kingdom and Dr Peter Evans, BBC Science Unit, United Kingdom
10.30-11.00 Coffee
11.00-12.30 **Exercises: radio interviews, presentations**
Dr Bernard Dixon, American Society for Microbiology, United Kingdom and Dr Peter Evans, BBC Science Unit, United Kingdom
12.30-13.30 Lunch
13.30-15.00 **Exercises continued: talks**
15.00-15.30 Tea
15.30-17.45 **Feed-back**

19.00-20.30 Dinner
20.30-21.15 **The role of scientists in communication– campaign planning**
First presentations, group work
Drs Patricia Osseweijer, Kluyver Centre for Genomics of Industrial Fermentation, The Netherlands

Tuesday 6 April 2004

THEME: Science communication

- evaluation of various communication approaches and their effectiveness
- case studies on good and bad examples
- what can companies learn from this?
- what is the role of scientists?

09.00-09.45 **Communication strategy: institute or university**
Prof. Heinz Saedler, Max-Planck-Instituut, Germany
09.45-10.30 **Communication strategy: National Bioindustry Association**
Drs Rob Janssen, Nederlandse Biotechnologie Associatie, The Netherlands
10.30-11.00 Coffee
11.00-12.30 **Discussion**

12.30-13.30 Lunch
13.30-17.30 Communication Strategic Plan: group work; nasty situations given to groups
what is the importance of networking?
pro-active initiatives and emergency handling
internal and external communication
developing a strategic plan
Drs Patricia Osseweijer, Kluyver Centre for Genomics of Industrial Fermentation, The Netherlands

19.00 Formal course dinner

Wednesday 7 April 2002

THEME: Company and research institute strategies

- examples of strategies
- handling of nasty situations
- panel review
- course evaluation

09.00-09:45 Communication strategy: Agrobiotech companies, how to set up GM and non-GM chain of production
Dr Sofia Ben Tahar, Limagrain, France
09:45-10:45 Communication strategy: the United States approach
Dr Theresa Kennedy, Hill and Knowlton, Canada
10.45-11.00 Coffee
11.00-12.30 Presentations to panel
12.30-13.30 Lunch
13:30-14.30 Presentations to panel
14.30-14.45 Panel review
14.45-15.30 Course evaluation and close
15.30 Drinks and departure

Appendix 3-d

Evaluation Form
Workshop Course on Public Perceptions of Biotechnology
Communication and Company Strategy (1993, 1995);
Bioethics and Public Perceptions of Biotechnology(1997, 1999, 2001, 2002, 2004); Strategic Communication in Biotechnology (2006)

OVERALL PROGRAMME

A1: Did the course come up to your expectations you had on the basis of the information you received beforehand? If not, please explain why.

A2: Is there any topic which you would like to see added to / deleted from the programme? Which?

A3: Were the main fields in the course well balanced or not?
a) too much related to Pharma/diagnostics?
b) too much related to Plant/agriculture?
c) too much related to Food/drink?
d) too much related to Chemical/energy/environment?
e) a good balance?

A4: Were the main subjects in the course well balanced or not?[55]
a) too much on bioethics
b) too much on regulations & laws
c) too much on risk assessment/perception?
d) too much on public perception?
e) too much science communication theory?
f) too much communication training?
g) too much company strategy?
h) too much group work?
i) a good balance?

A5: Is there a good balance between examples (cases) and theory, or not?
Please specify.

A6: Is there a good balance between group work and theory, or not?
Please specify.

A7: Which final judgement would you give the course as a whole?
(Please award a score in the range 1 (unacceptable) to 5 (outstanding)

THEORETICAL PROGRAMME

B1: Would you like to receive part of the reading material as preparatory texts before the course? Which chapters?

[55] Question A4-a-d were added from 1997 onwards

B2: What is your opinion about the content of the reading material?
a) too extensive? Which parts?
b) too concise? Which parts?
c) good?

B3: What is your opinion about the level of the presentations:
a) too general? Which?
b) too detailed? Which?
c) good?

B4: What is your opinion about the relevance of the presentations?
a) indicate three presentations of special interest for you
b) indicate three presentations of little relevance to you.

B5: Was there sufficient time for discussion?

PRACTICAL PROGRAMME

C1: Were any exercises / group work
a) too easy? Which?
b) too difficult? Which?

C2: Was there enough assistance during the exercises / group work, or not?
Please specify at which.

C3: Was the time allocated for the exercises / group work:
a) too much? Which?
b) too little? Which?

GENERAL

D1: How were you informed about the course?
a) by a colleague
b) by the leaflet
c) by an advertisement? In which journal?
d) by a short announcement? In which journal?
e) other?

D2: Did the course fee present a problem?

D3: Would you have preferred a longer / shorter course?
What should be the optimal duration?

D4: Did the time to be absent from your organization / company present a problem?

D5: Did you encounter other problems? Please specify.

D6: Are you content with the lunches, dinners and accommodation?
If not, please specify.

D7: How do you judge the preparation and organization of this course?
(Please award a score in the range 1 (unacceptable) to 5 (outstanding)

D8: Do you have further comments? (please use other side of this paper)

Appendix 3-e

Evaluation Form
Advanced Course on Bioethics and Public Perceptions of Biotechnology
1997, 1999, 2001, 2002, 2004

1. Which course did you attend?
   a) 1997
   b) 1999
   c) 2001
   d) 2002
   e) 2004

2. What were you doing professionally when you attended the course?

3. What are you doing now?

4. Did you
   a) use any of the course book material afterwards?
      Yes
      No
   b) use any (parts) of the presentations afterwards?
      Yes
      No
   c) contacted any of the lecturers (whom you met in the course) afterwards?
      Yes
      No
   d) contacted any of the participants (whom you met in the course) afterwards?
      Yes
      No
   e) use any of the materials, contacts or skills provided in a way you did not anticipate?
      If yes, please explain:

5. Which parts of the course proved most valuable? (Please indicate your priorities: 1=very valuable to 5 not valuable at all)

	topic	*Priority (1-5)*
a	bioethics	
b	regulations & laws	
c	risk assessment/perception	
d	public perception	
e	science communication theory	
f	communication training	
g	company strategy	

6. Which contributions proved most valuable? (Please indicate your priorities: 1=very valuable to 5 not valuable at all)

	topic	*Priority (1-5)*
a	contributions by scientists	
b	contributions by industry	
c	contributions by NGOs (patient organisations, Greenpeace, etc)	
d	contributions by social scientists	

7. In hindsight, which exercise(s) did you find most useful, i.e. you applied the things you picked up in your later work? (*more than one answer is possible*)
    a) Role Play Case study GM release
    b) Case study in law
    c) Press release writing
    d) Article writing
    e) Interview training
    f) Presentation training
    g) Making communication plan
    h) Dealing with nasty situation
    i) Other:

8. Did you change (*in any way*) your attitude to communication after the course?
   If yes, can you please explain?

9. Have you ever organized any activities after the course, based on (part) of the course ? (*multiple answers are possible*):
    a) press release
    b) organized debate
    c) participated in debate
    d) demonstration to public group
    e) public talk
    f) education on any topic of course
    g) presentation on any topic of the course
    h) other:

10. Which final judgement would you give the course as a whole if you would score the applicability of the contents and training?
    (*Please award a score in the range 1 (not very useful) to 5 (extremely useful*)

11. How does the applicability of the Oxford course compare to other courses you have attended? *(1= much less useful to 5= much more useful)*

12. To what extent did attending the course influence your job content or career?
    a) slightly
    b) considerably
    c) not at all
    If a or b, please explain further

13. Would you recommend this course to colleagues?
    a) yes, I have done
    b) yes, I will do
    c) no

Do you have any further comments?

Appendix 4

Questionnaire to biotechnology scientists attending the International Specialised Symposium on Yeasts (2002), the European Congress on Biotechnology-11 (2003) and the BIOTRANS symposium (2005)

This questionnaire will be treated as confidential and anonymous

Some questions about yourself (Please be assured that anonymity will be respected!)

0. I am presently based in:
   a. Europe
   b. Asia
   c. Africa
   d. Northern America
   e. Southern America
   f. Australia

1. How long do you work in biotechnology?
   a. less than five years
   b. five to ten years
   c. over ten years

2. Is your job in
   a. industry
   b. academia
   c. other:

3. Are you interested in the applications of research[56]
   a. I like to focus on fundamental research
   b. I am interested in application, but do not actually contribute to it
   c. I am interested in application and have projects related to application
   d. I am only working in applied research

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[56] In 2005 this question was replaced by the question: "Does your work include (now or in the future) the use of Genetic Modified Organisms?"
In 2002 the following questions were added:
i Do your work with: a. DNA-arrays; b. Fermentor studies; c. Genetically Modified materials; d. other.
ii If c. applies, on which scale? a. Petri-dish; b. 0-100 ml; c. 100 ml – 1 litre; > 1 litre.
iii How many yeast species will be sequenced in the next decade? a. 1-5; b. 5-50; c. 50-250
iv Which developments do you foresee in your expertise area of research?
v The applications of these developments are most beneficial for: a. food/beverage industry; b. chemical industry; c. pharmaceutical industry; d. other
vi Which specific applications do you foresee?

Own opinion on applications and benefits of the use of GM[57]

4. When will food products based on GM be introduced into the (global) market ?
   a. Within 1 year
   b. Within 5 years
   c. Within 10 years
   d. Within 20 years
   e. Never
   f. Already on market

5. When will the chemical industry provide products based on GM?
   a. Within 1 year
   b. Within 5 years
   c. Within 10 years
   d. Within 20 years
   e. Never
   f. Already on market

6. When will the pharmaceutical industry provide products based on GM?
   a. Within 1 year
   b. Within 5 years
   c. Within 10 years
   d. Within 20 years
   e. Never
   f. Already on market

7. Which GM application is most appealing to you and why?[58]

Some questions <u>on your own opinion</u> on GMO applications[59]

8. Is the use of GM animals (based on transgenesis, cloning, stem cell technology, etc) acceptable for the production of pharmaceuticals?
   a. Yes
   b. No

9. Are (parts of) genetically modified plants/crops acceptable as food ingredients?
   a. Yes
   b. No

10. Will developing countries profit from the introduction of GM food and crops?
    a. Yes
    b. No

11. Do you eat GM food products yourself or would you be willing to eat them if they were available?
    a. Yes
    b. No, If no: Why not?

---

[57] In 2002, this section related to the use of **GM Yeast** and had two additional questions:
"When will beverages based on GM yeast be introduced to the market?" and "Which are the most evident benefits of using GM yeat according to you?"
[58] This question was not used in 2005
[59] In 2002 this section had the additional questions: "Does yeast play a role as (model) organism in the development of GM food products?" and "Will yeast in future be preferable as production organism for pharmaceutical proteins above fungi and bacteria?"

12. Is the introduction in nature of GM micro-organisms acceptable?
    a. Yes
    b. No, If no: Why not?

13. Are the regulations for handling GM[60] research sufficient in your country?
    a. Adequate
    b. Too stringent
    c. Too lose
    d. Not existing
    e. Not applicable

14. Do you see any risks for health and environment in the use of GM?
    a. Yes
    b. No
    c. Please explain your answer:

15. Do you see any moral problems in using GM?
    a. Yes
    b. No

16. Are you aware of the public opinion on GMOs and its consequences?
    a. Yes, sufficiently
    b. Yes, but I like to know more
    c. No, but I like to know more
    d. No, I do not need to know

17. Do you think new applications of GM will lead to issues in public acceptance?
    a. Yes
    b. No
    c. No opinion

Some questions on your own communication

18. Did you ever receive training in (science) communication?
    a. Yes
    b. No
    c. No, but I would like to improve my skills

19. Have you (over the past 5 years) been interviewed on your work by newspaper, radio or TV?
    a. Yes
    b. No

20. If yes, can you mention some positive or negative experiences?[61]

21. Have you **on your own initiative** (over the past 5 years) published anything about your work for a general public?[62]
    a. Yes, if yes what:
    b. No

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[60] In 2002, this question related to **GM Yeast** research
[61] This question was deleted in 2005
[62] The phrase on your own initiative was added in 2003

22. Do you think it is your task to communicate to a larger public about your work?
    a. Yes
    b. No

23. If No: Who is responsible?[63]

24. If Yes:
    a. What kind of activities are you involved in?
    b. Does public communication have an influence on your personal carreer?
       aa. Yes, beneficial. Why?
       bb. Yes, disadvantageous. Why?
       cc. No
       dd. Any further comments?:

25. Does your employer allow you to spend time on public communication activities?
    a. Yes
    b. No
    c. Not applicable

26. Do you think it is important that scientists communicate to a larger public?
    a. Yes
    b. No
    c. If Yes, which are the most important target groups?

27. Do you think that the public sees scientists are a trustworthy source of information?
    a. Yes
    b. No
    c. Do not know/comments

28. Does your organisation employ PR people who indeed inform a general public on research/GM applications?
    a. Yes
    b. No

29. If you work in academia: Do you pay attention to public perception issues in your teaching?
    a. Yes
    b. No
    c. Not applicable

30. If you think the public perception of GMOs is presently too negative, could you give us any suggestions on how to improve this? (Please provide some clear ideas/examples)[64]

31. Do you think Scientific Symposia should pay attention to public acceptance of science and science applications? (more answers possible)
    a. Yes
    b. If yes:
       aa. lectures for participants
       bb. public events
       cc. communication training for participants
       dd. Press facilities/media relations
       ee. other:
    c. No

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[63] This question was deleted in 2005
[64] Questions 30 and 31 were not used in 2005, in stead question 32-34 was added

32. What should be in your opinion the priority of the communication with **politicians?** (in priority 1 (high) –5 (low), please circle your choice) ?
    a. 1 – 2 – 3 – 4 – 5 Explanation of science
    b. 1 – 2 – 3 – 4 – 5 Description of impact of technology to society
    c. 1 – 2 – 3 – 4 – 5 Building trust
    d. 1 – 2 – 3 – 4 – 5 Discussing ethical legal and social issues
    e. 1 – 2 – 3 – 4 – 5 Interest as many as possible

33. What should be in your opinion the priority of the communication with **consumers and patients?** (in priority 1 (high) –5 (low), please circle your choice) ?
    a. 1 – 2 – 3 – 4 – 5 Explanation of science
    b. 1 – 2 – 3 – 4 – 5 Description of impact of technology to society
    c. 1 – 2 – 3 – 4 – 5 Building trust
    d. 1 – 2 – 3 – 4 – 5 Discussing ethical legal and social issues
    e. 1 – 2 – 3 – 4 – 5 Interest as many as possible

34. What should be in your opinion the priority of the communication with **NGOs**? (in priority 1 (high) –5 (low), please circle your choice) ?
    a. 1 – 2 – 3 – 4 – 5 Explanation of science
    b. 1 – 2 – 3 – 4 – 5 Description of impact of technology to society
    c. 1 – 2 – 3 – 4 – 5 Building trust
    d. 1 – 2 – 3 – 4 – 5 Discussing ethical legal and social issues
    e. 1 – 2 – 3 – 4 – 5 Interest as many as possible

Please feel free to provide any suggestions or comments:

Appendix 5

OVERVIEW COSTS	hours	costs hours	direct costs	total costs	direct reach	indirect reach	direct costs/ direct reach	total costs/ direct reach	total costs /indirect reach
Open day 2000			14835	45815	2000	132000	7,42	22,91	0,35
demonstration lab	64	1920	750	2670	1200	1200	0,63	2,23	2,23
information streets	136	4080	4575	8655	2000	2000	2,29	4,33	4,33
fun lab	152	4560	1550	6110	320	600	4,84	19,09	10,18
forum	64	1920	2700	4620	100	100	27,00	46,20	46,20
workshop	5	300		300	20	20	0,00	15,00	15,00
brochures	80	4800	1135	5935	1000	1000	1,14	5,94	5,94
lectures	14	1400		1400	560	560	0,00	2,50	2,50
press	40	2400		2400	5	132000	0,00	480,00	0,02
other costs, first aid etc	160	9600	4125	13725	2000	2000	2,06	6,86	6,86
Open day 2001			3850	14590	2000	30000	1,93	7,30	0,49
fun lab	120	3600	1250	4850	320	600	3,91	15,16	8,08
theatre			500	500	500	500	1,00	1,00	1,00
lecures	9	900		900	90	90	0,00	10,00	10,00
brochures	40	2400	1100	3500	1000	1000	1,10	3,50	3,50
other costs	40	2400	1000	3400	2000	2000	0,50	1,70	1,70
press	24	1440		1440	4	30000	0,00	360,00	0,05
Role play court case 2001	100	7000	15500	22500	80	41000	193,75	281,25	0,55
Open day 2004			1100	7100	2500	10000	0,44	2,84	0,71
fun lab	120	3600	1100	4700	320	600	3,44	14,69	7,83
other costs	40	2400		2400	2500	2500	0,00	0,96	0,96
Workshop Future issues 1999			25000	136200	26	10000	961,54	5238,46	13,62
event	832	83200	25000	108200	26	26	961,54	4161,54	4161,54
preparation/after care	400	28000		28000	26	26	0,00	1076,92	1076,92
Symposia sessions									
ESBES 1998	13	910		910	235	1000	0,00	3,87	0,91
ESBES 2000	20	1400		1400	334	1000	0,00	4,19	1,40
ESBES 2002	20	1400		1400	280	1000	0,00	5,00	1,40
ESBES 2002 newspaper	20	1400	500	1900	280	1000	1,79	6,79	1,90
Yeast conference			15000	27600	281	195000	53,38	98,22	0,14
media	40	2800	12000	14800	10	195000	1200,00	1480,00	0,08
panel	40	2800	1500	4300	281	281	5,34	15,30	15,30
tasting event	100	7000	1500	8500	281	281	5,34	30,25	30,25
Media presentation									
interview newpaper regional	4	400		400	1	10000	0,00	400,00	0,04
interview newspaper national	8	800		800	1	50000	0,00	800,00	0,02
interview newspaper national, science	8	800		800	1	15000	0,00	800,00	0,05
interview journal	8	800		800	1	1000	0,00	800,00	0,80
interview radio regional	4	400		400	1	10000	0,00	400,00	0,04
interview radio national	6	600		600	1	20000	0,00	600,00	0,03
interview tv regional	24	2400		2400	1	20000	0,00	2400,00	0,12
interview tv national	48	4800		4800	1	100000	0,00	4800,00	0,05
public lecture	14	1400		1400	100	100	0,00	14,00	14,00
brochure	32	2240		2240	1000	1000	0,00	2,24	2,24
stand/day	56	3360	750	4110	500	500	1,50	8,22	8,22
stunt	96	5760	500	6260	2500	2500	0,20	2,50	2,50
WWW survey/enquetes			9000	9000	500	500	18,00	18,00	18,00
survey/enquetes	40	2800	100	2900	500	500	0,20	5,80	5,80
imagine, round 1				150000	500	200000	0,00	300,00	0,75
course									
participation course	80	2400	2500	4900	1	1	2500,00	4900,00	4900,00
organisation course	80	5600	50000	55600	45	45	1111,11	1235,56	1235,56

* estimated reach for media presentation (NL):	
tv national	
tv regional	100000
radio national	20000
radio regional	20000
newspaper national general	10000
newspaper national science	50000
newspaper regional	15000
journal	10000
	1000

Appendix 6

Proposal for strategy for institutionalisation of science communication in a university setting, based on the Delft University of Technology.
(*Part of publication by P. Osseweijer and Tj. De Cock Buning in Proceedings of "Sharing Knowledge" Conference, Da Vinci Institute Amsterdam, November 2004)*

According to the typology of Mintzberg (1979), academia is composed of institutions with little formalised planning and control coupled with advanced professionalism. Coordination is carried out by standardising the input (selection of professionals) and facilitating the output. This implies that options for change have to be positioned within the existing management style focussed on selection of professionals and facilitation of output. *However,* Pascale and Waters (1981) and Peters and Waterman (1982) warned for the interdependency of components of the management structure of an organisation. Together they developed the "7-S" model, which was taken up as a basic tool by the global management consultancy McKinsey and can serve as a model to analyse existing situations and formulate the desired organisation. The model advises that structural implementation needs to be addressed at seven management aspects (Superordinate goals or Shared Values, Strategy, Skills, Staff, Style, Structure and Systems) with ample attention to the 'soft" S's: Skills, Staff, Style and Shared Values. The 7-S Model has since been recognised as a valuable tool to initiate change processes and to give them direction, also within university contexts. For the required changes towards science communication within the university the model suggests that science communication need to be included as a common value in *Superordinate goals*; *Strategy* needs to address the ways in which communication influences its long term goals; *Skills* will involve the need for training employees for the required communication skills. The university may also decide to change *Staff* in order to influence the recruitment criteria of new employees and *Style* to allow for more creativity in the interaction between public and scientists. The required adaptations within the management culture of the university therefore form a major change. In order to allow such a change to be effective, the challenges need to be analysed within the specific context of the university as defined by its more structural S's: *Structure*, *Systems* and *Strategy*.

To facilitate this process of change it is suggested to establish a Committee composed of a variety of university staff, experienced already with the required novel tasks. This group describes the required changes and processes of implementation, monitors the process, advises the meso- (faculty) and micro- (department) levels of the university and will report to the University Board. As in every transition process, it is important to define the means and ends clearly and transparently for all related parties, otherwise the process might slow down in vagueness. Again this group might also help in defining incentives and setting criteria for evaluation (Hanssen, 2003; Osseweijer 2004). Continuous feed-back will create an interactive learning process, which has shown successful results in similar introductions of new standards of performance. In the process ample attention should be given to the important differences of the deficit model and the dialogue model for communication. For the definition of goals and activities, lessons can be taken from industrial approaches for strategic corporate interaction, such as the ones suggested by Kennedy (2004), Mumpower (2001), van Ruler (2001, 2003) and Van Woerkom (2003).

Within the university there is great variation among scientists in both skills, experience and attitudes for public interaction. It is important to realise that the institutionalisation of public interaction in academia requires a change in attitude of at least a subset of the (sometimes autonomous) scientists. In order to accomplish this throughout the divisions of the university Brunet (1999) advises working with small, manageable groups. From a management perspective it has to be recognised that an enlightening role model is the best way to change attitudes. Small task groups (additional to the central Committee) could be formed by a number of scientists that are already active in various (inter)national activities to operate at the microlevel (defined subject field such as biotechnology or imaging science). This group could be highly instrumental as role models to enthuse colleagues and as a broader reference for the Committee.

Based on the analysis above, an approach is suggested for the university management system of the Delft University of Technology. This management procedure operates with a “bottom up” provision of annual SMART[65] goals by individual research teams. The Dean of the Faculty defines the major goals with his team and annually agrees the realisation ambitions with the Board of the University. Simultaneously, the Board decides on major aims in achievement, which it discusses with the collected assembly of Deans who have to implement the agreed procedures and business objectives. The university is largely decentralised, although the financial allocation model provides a major drive in setting the rules for dividing the main government income. In this system the commitment for implementation can be raised from either “bottom up” or through “top down” incentives. As we have seen in the results of the Welcome/Mori study and the surveys described in Chapter eight, motivation is a lesser problem than incentives. The Netherlands Minister has given clear indications that she expects universities to take up the task of public communication. That is why it is suggested to use a more “top down” oriented approach coupled with a tailor made awareness programme to enthuse the staff as is described in the following paragraphs.

The top-down implementation procedure can be divided into five phases:

Phase 1 (important actors: University Board):
The new task needs to be incorporated in the management model of the university and relate to the strategic plan and mission of the university. This is the prime task of the university Board. The more specific the plan specifies its goals, the easier it will be for university staff to adhere to it. As the university needs to define the output, it therefore needs to set criteria and procedures for measuring the ‘output’ of public interaction. With well defined goals in combination with the advantage of the flat and hierarchical culture of the university as a whole, a trajectory can be planned for implementation. This phase needs the input of the experiential knowledge of scientists from different research groups already experienced in society interactions. A committee at the corporate level needs to be established to guarantee the structural character of its recommendations. The Committee will have the task to advise the Board on the required criteria and procedures, the approximate content of the strategic plan and its introduction within the diversified units within the university. They will provide the interaction with the diversified units and help the participants in each phase of the institutionalisation process.

Phase 2 (important actors: University Board and Deans of Faculties and Committee):
As responsibility and authority are diversified in a university context it is important that the leaders (professors) and their staff recognise the need for change and adopt responsibility for the implementation of the new tasks. This requires a programme to build awareness and commitment at all

[65] SMART: Specific, Measurable, Attainable, Result-focused, Time-Oriented

levels of the university. Important factors in this process are to what extent the university will take financial responsibility to allocate budget to stimulate the new tasks, accept new performance criteria and which policy priority is given to its implementation by the Board. The Deans can suggest to include in the programme the establishment of small task forces with innovative, enthusiastic staff members to help extending the commitment on the floor. The Committee will play a crucial role in interacting with these groups and/or motivating the staff in the research groups.

Phase 3 (important actors: Deans and Heads of Department):
Each diversified unit (Faculty or Department) needs to specify the implementation plan of the new task and specify the overall goals for the specific field of expertise. The following questions need to be answered: to what extent is public interaction included in departmental plans (this necessitates a communication plan related to the specific research activities and (inter-national) projects and the general mission of the department); how does the department decide on the individual involvement of staff members; how will the new tasks be included in the job specifications of these staff members; how is new staff selected for this; and how are individual staff members evaluated on their qualitative and quantitative performance in this new task? Dependent on the organisational culture (the 'environment'), each domain can specify a tailor made strategy for implementation. The small task groups can play a coordinating role in answering these questions and developing a tailor made strategy.

Phase 4 (important actors: Heads of Departments, trainers, staff):
It is crucial that the goals at this micro level are further specified in close collaboration with the staff. Training programmes for the essential competences need to be developed for the scientific staff to increase knowledge, skills and attitudes in public interactions. The decisions need then be translated in the Department's SMART goals to find their way back into the university Board agenda. The small task groups can form the link with the Committee that will provide advice and maintains the link with the university Board for adjusting the university objectives and incentives.

Phase 5 (important actors: all involved)
Design and carrying out of a continuous evaluation procedure, to allow flexibility and learning within the organisation. This requires specification of measurable goals and expected results. The Committee has an important role in the design of the specification and expectation, while the small task groups are central in providing the required information in the feed-back loops.

Each phase needs to have several iterations of re-valuation, problem recognition and solving, creating an interactive institutionalisation process, using the model of the Action Research Spiral described in various case studies for institutionalisation processes (Zweekhorst, 2004).

Conclusions
It is shown from several surveys that scientists themselves feel restricted in their wish to increase their level of interaction with society. This indicates that the universities should facilitate the need for more interaction with society from a corporate level. Most universities do not have a strategy for (disciplinary) public communication in place and it is proposed to institutionalise this novel responsibility by an interactive (learning) process. However, several crucial issues have to be defined such as the model and content of corporate responsibility and governance (including financial allocations), the assessment criteria for evaluation and the process to internalise the required

competences among the scientific staff (such as selection criteria for staff and stimulation of competence building). The skills for interactive communication also include the ability to reflect, which links it to the efforts to institutionalise a general code of ethics. Here the available knowledge on this topic developed by the social sciences and philosophy of science will provide some answers. In addition, studies into new arrangements for public involvement in the decision making processes, interactive communication methods, risk communication studies and technology assessment methods will provide other elements of the new tasks for the university.