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Risk Amplification of GMOs in Europe

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by

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Abstract

This project argues that the opponents of genetically modified organisms (GMOs) have amplified the socially derived feelings of risk that the public harbors towards GMOs in five European countries including, Switzerland, Germany, Spain, Italy and the UK. Through interviews with elite members of GMO opponent organizations and analysis of their publications, we have determined that GMO opponents are amplifying the factors of control and unknown risk. Recommendations were given to aid in the de-polarization of the GMO debate.

To Science!

By Edgar Allan Poe

Science! True daughter of Old Time thou art!
Who alterest all things with thy peering eyes.
Why preyest thou thus upon the poet's heart,
Vulture, whose wings are dull realities?
How should he love thee? or how deem thee wise,
Who wouldst not leave him in his wandering
To seek for treasure in the jewelled skies,
Albeit he soared with an undaunted wing?
Hast thou not dragged Diana from her car?
And driven the Hamadryad from the wood
To seek a shelter in some happier star?
Hast thou not torn the Naiad from her flood,
The Elfin from the green grass, and from me
The summer dream beneath the tamarind tree?

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Chapter 1 - Introduction

> I have been cursed for delving into the mysteries of Life – perhaps Death *is* sacred, and I have profaned it.
>
> - Dr. Henry Frankenstein, *The Bride of Frankenstein*

> ...[S]cience can no longer be content to present itself as an activity independent of the rest of society, governed by its own rules and directed by the inner dynamics of its own processes (Morison, 1969, p. 156).

We felt that in order to begin an intelligent discussion of this project, it was important to first understand the underlying scientific, ethical, and moral discussions that form the basis of it. A significant portion of this project was devoted to an understanding of the societal factors that have caused problems in the introduction of genetic technology. We understand that the introduction of any new technology encounters problems. The diffusion processes of technological breakthroughs have been widely studied. However, during the course of this project, we have attempted to understand why the diffusion of genetically modified (GM) crops and food has encountered societal opposition.

Not only have we attempted to delve into the public opinion data which has been made available to us, but we have also attempted to discover what comprises these underlying societal factors. Through our research it has become evident that one of these societal factors consists of feelings of risk associated with genetic modification. Our research into these underlying feelings of risk has involved concurrent studies of risk formation, public perception of risk and elite/public risk propagation.

Throughout the GM debate, the role of science as a "candle in the dark" (as astronomer and science popularizer Carl Sagan once described it) has been questioned

repeatedly. Much of society does not interpret science in this instance as acting in the role of a beacon of light and truth in a world filled with mythology, falsities and subjectivity. Rather, large proportions of the public (European in particular) interpret the science of genetic modification as a profession that is irresponsibly fooling with "random uncertainties, discontinuities, and relativism" (Lawler, 1988, p. 258).

Whether or not we accept this notion, we must concede that at times, science has been the harbinger of that which is uncomfortable and dangerous. In an age of nuclear and genetic technology, we have seen a continuous social questioning of the role that science should play in modern culture. However, this questioning is not a new phenomenon. Distrust of science as an altruistic entity has historic antecedents. Science, the vulture which Edgar Allan Poe speaks of, whose dull wings represent the dull realities which are often the conclusions of scientific inquiry, has often been seen as picking away at the mysteries of the universe which often form the basis of the ideas of nature, faith and God (Toumey, 1992). Distrust of science portrays the scientific method and the scientist as an axe, continually hacking away at the imaginative freedom that has allowed many people to perceive a higher level of control and order in their lives.

We have determined that the fundamental question underlying this project's goal of synthesizing societal and technological issues concerns the matters of how and why the public feels that genetically modified organisms (GMOs) pose high amounts of risk to both environmental and human health. In order to refine this question, we have utilized the simple assumption that *individuals have the capability of influencing other individuals*. In this way, it is possible to look at organizational structure and the process by which individuals are able to influence others, and determine that there exists a

distinct hierarchy in any organization; elite members of organizations, that is, individuals whose opinions are stable, manifest, and who use their opinions actively in a political arena, possess a distinct ability to influence the perceptions of others.

This phenomenon has not been isolated within countries. We have seen distinct resentful feelings in much of Europe towards GMOs as an American technology. Survey data shows that European public opinion is much more negative towards GMOs than public opinion in the US. This has been shown to be largely due to instances in which these elite members of trusted organizations that are opposed to the use of GMOs have used their abilities to amplify the feelings of risk of others.

Therefore, our question has been refined to look at this process, and can be restated as follows: How are the elite members of groups who are opposed to the use of genetic modification influencing the perception of risk that the European public harbors towards genetic modification of crops and food?

We start this discussion with an overview of the literature that has been published which relates to this issue. We began by looking at the scientific background behind the genetic modification of crops. Two ethically controversial topics that have arisen out of our research include terminator genes, a process by which seeds destroy themselves during their second generation, and Superweeds, genetically modified weeds created by the cross-pollination of naturally occurring weeds with GM crops.

From there, we looked at two of the trade associations that the biotechnology industry has created in an attempt to combat the strong influence that opponents of genetic modification had on the public. These associations include the Council for Biotechnology Information (CBI), the US based biotechnology trade association, along

with the European Association for Bioindustries, the European based biotechnology trade association. We have studied their effects on public opinion thus far, and have found that neither of these organizations has garnered an increase in public support through their public relations campaigns that have consisted of the dissemination of scientific information into the public arena in hopes of increasing awareness of genetic modification.

Following this, we looked at public opinion surveys in both the United States and in Europe towards genetically modified organisms. We have found that, according to the 1997 Eurobarometer survey, the amount of trust invested in governmental and industrial authorities has been eclipsed by the amount of trust invested in environmental and consumer organizations. This has led to the higher amount of influence which GMO opponents in environmental organizations have been able to wield in this debate.

After providing a background on the literature pertaining to the subject, we discuss the methods that we used to answer the aforementioned question. These methods included the implementation of a series of interviews in five countries with elite members of organizations opposed to GMOs in order to determine those individuals' feelings of risk. These countries include Switzerland, Germany, Italy, Spain, and the UK. We hypothesized that the risks of GMOs that are interpreted by elite opponents are then amplified to the public through material published by their organizations. This hypothesis was tested through the second method we implemented, *content analysis*.

The chapter following the discussion of our methodology looks at the analysis of the resulting data and the determination of which factors of risk the opponents of GMOs are amplifying in order to intensify public anxiety towards genetic modification. Our

interview analysis is broken into four sections, and looks at the factors of risk which are being amplified by the elite opponents. We also examine themes which we have found that exist between elite opponents in the same country, the same organization, and who have the same academic background.

Finally, our last chapter presents our conclusions that were based on our analysis of the data collected during our interviews and through our content analysis. Here, we also include our recommendations for lowering the polarization which exists in the GM debate today. These recommendations include the implementation of a different public relations strategy by biotech firms, the addition of social psychologists to public relations departments, and the implementation of more transparent research processes which allow a greater amount of public discussion before a product is brought to market.

Chapter 2 - Literature Review

2.1 GMO Scientific Background

Genetic modification involves "the insertion of genes from other organisms (within or between species) into host cells to select for desirable qualities" (Goodyear-Smith, 2001, p. 371). There are two common methods by which genes are inserted into new cells. The transfer may be made using a microorganism (virus or bacterium) or by shooting microscopic gold particles coated with genetic material into new host cells (Goodyear-Smith, 2001).

Though the science behind genetic engineering is relatively new, the knowledge base is already rapidly expanding. An increasing portion of the general public, farmers, and scientists are questioning the way research is being handled by large, profit-driven corporations. Not only are there scientific debates on the merits of genetically engineered foods, there are also equally important debates on the socioeconomic ramifications of the way such science is marketed and used (McHughen, 2000).

GMOs have sparked enormous debate in Europe over the safety and social acceptance of novel foods, which are foods resulting with some form of ingredient being subject to the application of recombinant DNA technology. Such examples of these are soya, maize, oilseed rape, and cotton plants that are made tolerant to herbicides or resistant to insect damage through the incorporation of bacterial genes.

Our research covered one main product being researched by Syngenta, Golden Rice. Golden Rice, one of the most recent genetically modified organisms to be engineered, has been under recent scrutiny by many scientists. Scientists Ingo Potrykus

of the Swiss Federal Institute of Technology and Peter Beyer of the University of Freiburg in Germany created Golden Rice by inserting a gene into the rice genome which codes for β-carotene, a precursor for the synthesis of vitamin A in the body (Schiermeier, 2001). Because vitamin A deficiencies can cause blindness and other illnesses, the creators believed that the rice grain enhanced with β-carotene would be an efficient way of distributing vitamin A. Unfortunately, research has shown that fats are needed to absorb vitamin A in the body because it is a lipid soluble vitamin. Therefore, a person whose diet lacks sufficient amounts of dietary fat would not retain the benefits of the genetically enhanced rice (Schnapp, 2001).

Syngenta holds the commercial rights to Golden Rice but has yet to begin field tests or experimentation on it. After the testing phase of Golden Rice is completed, Syngenta plans to market Golden Rice commercially to industrialized countries, while distributing it at no cost to farmers in developing countries (Syngenta AG, 2000). However, it has been argued that even though Golden Rice will be free to farmers in developing countries, the vitamin A fortification will be of little benefit to consumers who do not have a diet sufficient in lipids. World Health Organization (WHO) figures show that the fat consumption in many developing countries is not high enough to absorb the vitamin A from Golden Rice (Schnapp, 2001).

Although there are procedures that attempt to ensure that GMOs are safe before they are put on the market, many people still fear that these procedures are insufficient in detecting possible long-term effects. It is necessary for us to evaluate both negative and positive facts, feelings and concerns towards GMOs.

2.1.1 GMO Drawbacks

Let us look now at the negative attitudes towards GMOs. What causes these attitudes? What facts are known or unknown to the public in the GMO debate?

Through our research we have come across many criticisms of GMOs, including:

- Genetically engineered (GE) food is an expensive technology that the farmers of the developing nations would not be able to easily afford.
- Patenting laws allow biotech companies to benefit from patenting indigenous knowledge often without the consent of farmers who have utilized that knowledge for centuries.
- This science is new and untested, and may just not be the solution that researchers are looking for.
- Crop uniformity will reduce genetic diversity making crops more vulnerable to pests. This often results in the need for pesticides, which are produced by the same companies that create and promote GE crops.

In particular, many Europeans believe that the field of biotechnology is an American development and therefore they feel resentment towards the advancement of this technology. They see biotechnology as another Americanized entity being forced upon them (Moses, 1999).

Another possible way to explain the plethora of fears that have developed and been directed towards GMOs is illustrated by *pastoralism.* The concept of *pastoralism,* as stated by Leo Marx, is the idea that a social complexity or change will almost always result in a negative response. Essentially, an individual's view of his world, and the measure of control that he has over it is shaken, often resulting in discomfort and fear. In

other words, pastoralism is the idea that *people fear change*. In relation to our project, GMOs are acting as a new social complexity, the long-term effects of which are unknown. Pastoralism applies to our project because, in the case of GMOs, we have seen the spread of negative views towards the outcome of this new technology, even though little is known about the possible effects (Winner, 1986).

Martina McGloughlin, the director of the Biotechnology Program at the University of California at Davis and the University of California Systemwide Life Sciences Informatics Program, has published numerous papers, encyclopedia submissions, and two books on biotechnology. She states that biotech crops and foods have been carefully and extensively tested over the past 15 years both in the laboratory and in a controlled natural environment under the oversight of the National Institutes of Health (NIH), the Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), and the United States Department of Agriculture (USDA).

Statistics from the International Field Test Sources published in 2000 show that the USDA analyzed over 6,500 areas containing genetically modified crops in order to assess biotech crop performance and suitability for release in the environment. Additionally, some 25,000 field tests have been done on more than 60 crops in 45 countries, including most of the 15 countries of the European Union. There has not been a single report of any unexpected or unusual outcomes from these field tests, which leads some experts to believe that GE crops present no immediate danger to the environment (McGloughlin, 2001).

The field tests were then evaluated by the Union of Concerned Scientists (UCS), which found that the data collected by the USDA on small-scale tests had little value for

commercial risk assessment. Many reports fail to mention, much less measure, environmental risk. This shows that although risk assessments of GMOs are taking place, they fail to take into consideration the possible long-term effects (Mann, 1999).

One of the possible long-term effects that the public fears is the growth of Superweeds. Superweeds are the result of the cross-pollination between a genetically modified crop and its natural counterpart found in the environment. The resulting new strain of the crop can have unforeseen consequences. This idea of hybridization between species is analogous to the single Brazilian bee researcher who accidentally let aggressive African bees mate with gentle US domestic bees and created a continent wide nuisance in 1957. In 1996, the Scottish Crop Research Institute reported that pollen from transgenic oilseed rape can travel as far as two kilometers. At the same time, three Danish geneticists discovered that transgenic oilseed rape readily breeds with a similar plant species, *B. campestris*. The resulting plants are biologically similar to *B. campestris* but are resistant to the herbicides used on *B. campestris*. Many ecologists fear that the molecular biologists who modify DNA in the laboratory don't fundamentally understand how it behaves in the field (Mann, 1999).

Another ethically controversial topic in the GMO debate is terminator genes. In March 1998, Delta and Pine Land Company, in collaboration with the USDA, was awarded US Patent Number 5,723,765: *Control of Plant Gene Expression*. Although the patent covers many applications, one application is a method of engineering crops to destroy their own seeds during the second generation, essentially making it impossible for farmers to save and replant seeds (Crouch, 1998). This technology was later dubbed "terminator technology" by the Rural Advancement Foundation International (RAFI), a

group of researchers that has attempted to analyze some of the technology's social, economic, and environmental implications. Other opponent groups have dubbed terminator technology as Genetic Use Restriction Technology (GURT). Terminator technology remains, at this time, a laboratory technique. Due to the reluctance of biotechnology corporations to produce seeds with terminator genes, there still exists a lack of concrete evidence regarding the impact of this technology.

Originally terminator genes were introduced into seeds in order to control the effects of genetically modified crops. Since scientists were unsure as to the specific effects of genetically modified crops in the natural environment, they specifically engineered the GMOs to be viable for only one growing season (Crouch, 1998). They accomplished this by inserting three new genes into the genome of the plant organism.

Prior to distributing the seeds, the manufacturers introduced an inducer that activated the production of an enzyme that activated another gene, which produced toxin in the seed. The toxins produced inhibited the growth of new seed embryos and therefore made the individual seeds active for only the one growing season (Hagedorn, 1999).

Terminator genes are viewed as ethically and scientifically controversial for several reasons. Such scientific controversies include the issue of whether or not terminator genes can spread to other plants in the environment. Another serious question is whether or not seeds containing the toxin made by the terminator will be safe to eat. What ecological effects will come from toxin-laden seeds that are left in the field? How will seeds that come into contact with the soil affect the ecology of soil organisms? These questions have yet to be answered (Crouch, 1998).

Many ethical considerations continue to exist. The sterility of seeds that are derived under the terminator technology prevents farmers from reusing seeds from the past. This loss of "farmer's privilege" (the ability of farmers to choose whether or not they want to reuse seeds from previous years) mainly affects farmers in developing countries where the reuse of seeds is of great commercial significance. If farmers buy genetically modified seeds, they are also obliged to buy chemicals that accompany them from the same manufacturer. Here many people already see a trend towards monopolization and therefore a risk of abuse of the monopoly. This trend is further promoted as licenses issued for the technology increase the role of the technology as a product (SECNGT, 2000a). This is one of the many concerns of terminator technology that may threaten social rights.

2.1.2 GMO Benefits

There are many foods and food ingredients that have been developed by genetic modification. Preventing crop loss is a benefit of using genetically modified organisms. An example is the papaya industry in Hawaii, which was nearly destroyed by the papaya ring spot virus. Scientists found that a single gene from the virus acted like a vaccine to protect the plant. Due to the importance of the papaya in the Hawaiian region, this protection helped to restore the economy since agriculture is an important economic sector. Many things can be done through GMOs to combat both the biotic and abiotic stresses that can ultimately be responsible for the loss of entire crops in developing countries (McGloughlin, 2001).

Genetic modification can also reduce the dependence on chemicals and fertilizers and can increase pest resistance for crops. GMOs can achieve the same desired result

while not using these chemicals. The Economic Research Service of the USDA reported that adopters of the *Bacillus thuringensis* (Bt) technologies used 7.6 million fewer per acre treatments of pesticides than non-adopters in 1997 (Hyde, 2001). Also Bt protection dropped the Mycotoxin contamination by 92 percent. Mycotoxin is a deadly toxin produced by fungi, which has been found to cause brain tumors in horses and liver cancer in children. Over half of all the economic benefits generated by these technologies are not going to the biotechnology and seed companies but to the farmers themselves (Hyde, 2001). The results of this study clearly state that fewer potentially harmful pesticides will be dispersed into the environment if Bt technologies are utilized. In doing so, cost benefits are passed on from the farmer to the consumer.

In our research of GMOs and the dangers that may occur from their use, we feel that it is necessary to talk about the two errors that are possible in any type of scientific research. The first error in scientific research is known as a Type I error. A Type I error is the rejection of a hypothesis when in fact the hypothesis is true. This is analogous to the act of sending of an innocent person to the electric chair - rejecting the idea that the person is innocent (Radzicki, 1994). This type of error is the most significant fear in the GMO debate. This fear culminates in the idea that GMOs are extremely dangerous (the hypothesis), however, they are released into nature anyway.

The second type of error is known as Type II error. This occurs when a false hypothesis is accepted as true. This is analogous to setting a guilty person free – falsely concluding that the guilty person is innocent (Radzicki, 1994). Type II error is the fear of many GMO corporations and proponents. Here, the false hypothesis is that, "GMOs are dangerous." However, a Type II error in this case would occur if the scientific

community, and thereby the public, still considered GMOs to be dangerous, when in fact, they were not.

On April 5, 2000, the US National Academy of Sciences issued a report, which stated that there is no evidence that suggests that foods which are produced using biotechnology are any less safe than conventional crops. If GMOs are actually safe, than no scientific error exists in this statement. If GMOs are actually dangerous, the belief that they are safe is a Type I error – rejecting, falsely, the idea that GMOs are dangerous. If GMOs are safe and this statement is disregarded, and the world still believes that they are dangerous, this is a Type II error.

A study conducted in the UK funded by the Economic and Science Research Council showed that: 1) the general public is not ignorant about their approach to risks, but rather have a sophisticated grasp of the main ideas, 2) Science cannot provide definitive answers about the safety of new technologies, 3) A more independent and participatory style of decision-making is needed in circumstances where deep uncertainties about the effects of new technologies, such as genetic modification are the norm (ESRC, 1999).

2.2 Background on Organizations and Their Claims

The agricultural biotechnology industry is facing many opponents in its attempt to produce genetically modified products because consumers are still uncertain about the ethics and safety of GMOs. In an attempt to gain more support for genetically modified foods, many agribusinesses have joined forces in forming large biotechnology industry trade associations in both the United States and in Europe. Even though the trade

associations represent biotechnology businesses that specialize in a wide range of products, from pharmaceuticals to genetically modified crops and food, much attention has been focused on informing the public about GM foods. This focus is due to survey results which show that there is more support for pharmaceutical development and genetic diagnostics than there is for GM foods in both Europe and the U.S. (Gaskell et al, 1999).

2.2.1 Council for Biotechnology Information (CBI)

In the United States, several large biotechnology and agribusiness companies including Aventis CropScience, BASF, DOW Chemical, DuPont, Monsanto, Novartis, Syngenta and Zeneca Ag Products, as well as the Biotechnology Industry Organization (BIO), which represents over 900 smaller biotech companies, agencies and academic institutions, formed the Council for Biotechnology Information (CBI) in April 2000 (McCoy, 2000). Opinion polls conducted in the US showed that even though Americans were generally supportive of GM foods, the consumers desired more information about their safety and uses. The industry responded by creating a 3-year campaign targeting American and Canadian consumers to provide them with more information regarding agricultural biotechnology (Thayer, 2000).

The members of CBI have agreed to spend $50 million in advertising campaigns to spread scientific literacy of the safety and benefits of genetically modified crops in the US. The intensive campaign is targeting Americans to maintain their support of the technology and is selectively focusing on the potential that agricultural biotech has to improve health conditions around the world. The advertising campaign includes television and magazine advertisements, informational pamphlets and a website

(http://www.whybiotech.com) that contains information about genetically modified foods and links for further research (McCoy, 2000). Even though the CBI website serves to provide information to the public, statistics show that only a small percentage of consumers find Internet ads to be reliable whereas a larger percentage trust television ads. Televised ads are subject to certain restrictions while Internet information and claims are not necessarily monitored by any regulatory agencies (Diaz, 2000).

The members of CBI feel that their campaign, which is designed to present information about the benefits and safety of GMOs, will serve only to increase public support in America rather than promote specific products (McCoy, 2000). However, the Council is focusing attention on Golden Rice because it is the newest product which has been developed for the benefit of the consumer to help combat vitamin A deficiencies (Thayer, 2000). Other GM crops do not offer the same consumer health benefits. An example of a crop that the Council is not attempting to endorse is the Monsanto GM soybean. These soybeans have been genetically modified so that they are resistant to Roundup, an herbicide manufactured by Monsanto that accounts for nearly 50 percent of Monsanto's profits. Herbicides are necessary to protect soybeans from destructive weeds. However, Roundup can only be used on Monsanto's genetically altered soybeans because it would ordinarily kill unmodified soybeans (Naude, 1998). Therefore, unlike the Monsanto soybeans, which have been genetically modified to ensure a strong market for Roundup, Golden Rice has been engineered to help combat a type of malnutrition (Scott, 1999). CBI is promoting Golden Rice in the hope to gain public favor by showing that the agricultural biotech industries are working directly for the health and well being of humanity (Thayer, 2000).

Also, CBI is directing its advertising campaign to the individual consumers of the genetically modified food, rather than the farmers and growers of the crops. Until recently, the industry focused on influencing the purchasers of GM seeds without much regard to the consumer. However, without people to buy the crops, farmers do not profit and consequently have no motive for purchasing the GM seeds. Therefore, the Council members are now trying to increase support at the consumer level by providing them with more information regarding GMOs so that farmers of GM crops have a greater consumer base. This, in turn, means increased crop sales and consequently greater demand from farmers for GM seeds (Thayer, 2000).

2.2.2 European Association for Bioindustries (EuropaBio)

In Europe, the public views GMOs drastically more unfavorably than in the United States (Gaskell et al, 1999). In response, the leading biotechnology industries joined forces to create the European Association for Bioindustries (EuropaBio) in 1997. EuropaBio has tried to respond to consumer fears about genetically modified foods by establishing a website and holding conferences in various European cities in which recent biotech issues are addressed. However, since EuropaBio's members include 47 large pharmaceutical, agricultural, and environmental companies, it is difficult for the association to concentrate strictly on agricultural biotechnology. There are not enough resources to allocate to only one of the many areas of biotechnology represented by EuropaBio and its member companies (Dorey, 1999).

EuropaBio represents companies in Norway, Switzerland and the 15 countries that are members of the European Union. With such a large number of different countries, it is difficult to concentrate on how to shape political and public opinions about

agricultural biotechnology, especially since many historical and political differences exist throughout Europe. For example, the European Commission can establish regulations for the mandatory labeling of GMOs within member countries. However, other European countries such as Switzerland and Norway, which are not members of the European Union (EU), are not required to conform to those rules and regulations and could establish entirely different regulations for GM food labeling thereby creating political diversity (Dorey, 1999).

There have also been different historical conditions that affect consumer opinions throughout Europe. Generally in the UK, consumers are more opposed to GM foods than people in other countries (Williams, 1998). This is due in part to the outbreak of mad cow disease and the resulting increase in the public's perception of risk in their food. In the UK, 180,041 head of cattle out of approximately 7.6 million (DEFRA, 1999) were infected with mad cow disease between 1987 and 2000. During that same time period, only 509 cattle out of approximately 750,000 (Heim, 1997) were infected with mad cow disease in Switzerland. The first reported case of BSE (Bovine Spongiform Encephalopathy) in Switzerland occurred in November 1990 and since then the Swiss government has enacted many regulations and precautionary procedures to control the spread of BSE (Underwood, 2001).

The increased incidence of food contamination has made the consumers in the UK more fearful and less trusting of government agencies than consumers in Switzerland. In fact, in a 1998 referendum in Switzerland 40 percent of the Swiss citizens voted two to one to reject a ban on genetic engineering of both transgenic animals and crops (Scott 1998). In conclusion, not only is EuropaBio hindered by the diversity in biotechnology

companies it represents and countries it is active in, but it is also not sure that an advertising campaign is the best way to gain public support in Europe (Dorey, 1999).

Because EuropaBio followed a non-aggressive PR campaign which had been unsuccessful in swaying public opinion, Monsanto launched their own advertising campaign in 1998 targeting consumers in the UK and France. Monsanto's advertising campaign caused the company to lose favor among the public (Scott, 1998). Their campaign included full-page print advertisements in major newspapers that listed the names and contact information for opponent groups of GMOs. Many British citizens viewed these advertisements as a tool of commercial manipulation of consumer opinion by the large agribusiness and came to mistrust Monsanto's motives (McHughen, 2000). It is important for other large agribusinesses to look at Monsanto's failed advertising campaign, analyze what aspects of the campaign led to a decrease of public trust in GM foods and agricultural biotechnology, and avoid launching a similar campaign.

In 1999, EuropaBio established a special Plant Biotechnology Unit (PBU) (Dorey, 1999). The PBU was created in response to consumer concern and media hype about genetically modified Pusztai potatoes which, when fed to rats, caused damage to their immune systems and organs (Scott, 1999). The special unit was created by 12 agribusinesses with the purpose of rapidly disseminating any available scientific evidence that might help to calm consumer concerns and fears (Dorey, 1999). The PBU's plan of quickly responding to consumer concerns with scientific knowledge is consistent with the belief that the more scientific information the public receives about a technological issue the less fearful and more supportive they will be toward it (Gaskell et al, 1999). In our next section, however, we will see that this is not always the case.

EuropaBio and CBI are currently the main trade associations for agribusinesses in Europe and the United States. Any collective campaigns aimed at gaining consumer support would be through these associations. Currently, EuropaBio and its Plant Biotechnology Unit have done little to advertise, except for establishing a website and holding conferences in European cities, while CBI has begun an aggressive campaign of television and print advertisements.

Unfortunately, their efforts don't seem to have increased public support for GM foods. A possible reason for this is that both associations have failed to account for other factors affecting public opinion including the consumer's perception of risk. It is more important to take into account the consumer's fears and perceived risks of the technology than simply disseminating scientific information to increase scientific literacy about agricultural biotechnology (Cantley, 1999). It is necessary to look at what EuropaBio and CBI have done thus far in response to European and American consumer opinion and how their strategies have affected current public opinion of GM foods.

2.3 Public Opinion

During the course of our research into the public opinion in both Europe and the United States, it became clear that Americans are generally more supportive of genetically modified foods than Europeans (Gaskell et al, 1999). European public opinion surveys concerning biotechnology were conducted in both the US and in Europe in 1996 and 1997. The surveys showed that, in regards to both GM crops and GM foods, Americans were generally supportive of the technology while Europeans were opposed to GM foods. Evidence that we have collected has shown that this difference in public

opinion is due to cultural differences between Europe and the US and differences in press coverage, public confidence in regulatory processes and institutional authorities, and scientific knowledge in the US and Europe. To elucidate our understanding of this topic, we have looked at some of the facts that have arisen from various surveys and qualitative background research.

Issues surrounding the current lack of diffusion of GMOs into Europe and elsewhere include:

> A mistrust of the science by some consumers; a concern about the choices available to consumers; the intellectual property rights of the public, private and nonprofit sector; and the appropriate rules, regulations, labeling, and testing that are needed to protect consumers and the environment from potential and unforeseen risks (Goldberg, 2000, p. S39).

All of these issues must be addressed in order to begin to understand the current European stance on GMOs. However, first we will look at how US public opinion has paralleled that of Europe.

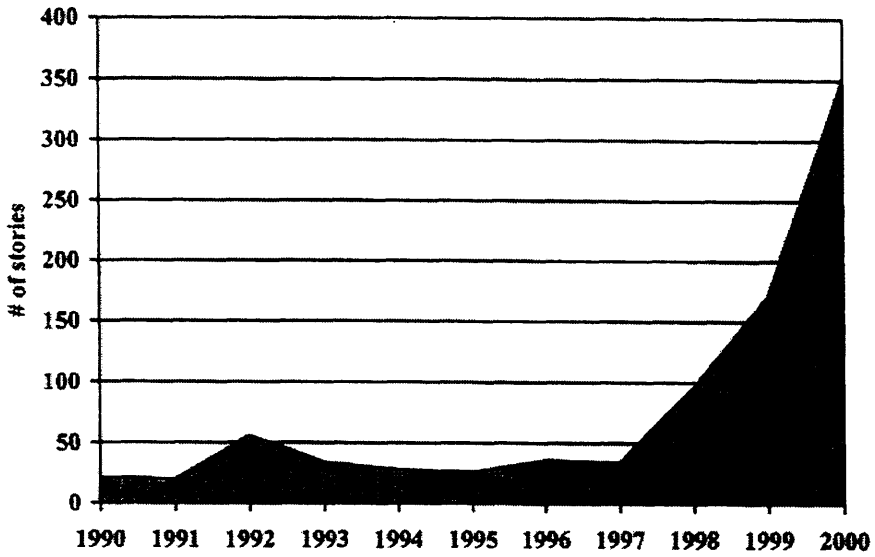
2.3.1 US Public Opinion

In the United States many applications of biotechnology have been widely accepted by the public. More than half the food items in supermarkets contain products derived from genetically modified crops. More than half of all cotton and soybeans and approximately a quarter of the maize grown in the US have been altered (Braun, 2001).

> Stories of genetic modifications in the dairy system (the Bovine Somatotrophin [BST] controversy) paved the way for the European experience to catalyze a wider journalistic and, possibly, public opinion reaction. ...Where once journalists had tended to pay attention mostly to the seemingly limitless benefits of genetic modification, by 1998 they were paying attention to the negative consequences (Shanahan, 2001, p. 268).

Over the last several years, the world has faced the prospect of making a decision about whether or not it wants fundamental genetic alterations to become an everyday aspect of its food. Negative European reactions to GMOs have led to an increase in US media coverage of the debate since 1998. It has been shown that US media coverage prior to 1997 was much more positive than it is today (Figure 1). It is difficult to say whether or not this coverage was a cause or simply a side effect of public concern toward the issue.

Figure 1: US Media Coverage of Agriculture Biotechnology 1990-2000.



Source: (Shanahan, 2001, p.268)

Although quite a bit of work has been done to increase the awareness of biotechnology and genetic engineering in the United States, surveys conducted between 1993 and 2000 reveal that "...more than half of the respondents in a variety of surveys have said they had read or heard 'not much' or 'nothing at all' about the issue" (Shanahan, 2001, p. 268).

The lack of knowledge about GMOs in the United States was exemplified in two Angus Reid studies that showed a 10 percent rise between 1998 and 2000 among people polled who stated that their understanding of GMOs was limited to the point that they had "heard the term [GMO]" but knew nothing about it. In a Harris Poll conducted in 2000, the majority of those polled reported that they had at least limited knowledge of GMOs (approx. 57%). However, these data sets create quite a bit of confusion on this issue, and do not give clear evidence toward trends in awareness. This confusion is due to the survey mechanisms that were used. In a series of Harris studies conducted in 1993 and 2000, the "mixed opinion" and "equal benefit and risk [that exists in GMOs]" response choices were not provided, which makes it impossible to infer a trend from the data obtained (Shanahan, 2001). The uncertainty in accuracy and consistency between the surveys leads us to conclude that *if* news coverage is affecting general awareness of biotechnology and GMOs, it has only been happening extremely recently (Shanahan, 2001).

Concerning the *attitude* of the public towards GMOs, the major issue that many of the studies have addressed is whether or not the perceived risks of GMOs outweigh their perceived benefits. Studies on some of the first GMOs showed that many people in the 1980s seemed unready to reasonably weigh the risks and benefits of new agricultural technology. In a 1985 Roper study, "...21 percent of respondents said they were 'not sure' or refused to answer the question. Furthermore, 29 percent said they had a 'mixed opinion'" (Shanahan, 2001, p.268). Of those who did give an opinion, a higher proportion believed that the risks outweighed the benefits (28% vs. 22%) in 1985, while

only two years later, more believed the benefits outweighed the risks (38% vs. 26%), with more than a quarter of those surveyed still stating that they did not have an opinion.

However, once again, problems due to the different wordings of the questions affect the ability to determine any sort of consensus from the data. According to National Science Foundation (NSF) data collected between 1985 and 1999, 46-50% of people believed GMOs provided greater benefits, where 33-39% believed they posed greater risk. However, the percentage of people who stated that they either didn't know or refused to answer increased from 10% in 1985 to 17% in 1997 (Shanahan, 2001). It is not clear whether or not this trend away from the extreme poles of public sentiment towards GMOs implies either an increasing confusion towards the topic or a hesitance of the public to accept or reject GMOs based on current information.

Between 1983 and 1993, the American public held an optimistic stance toward GMOs. However, as time passed, negative feelings towards GMOs began to mount. According to International Food and Information Council (IFIC) surveys, the proportion of people who disagreed with the positive vision of GMOs for the future rose from 14% to 24% between 1997 and 2000. (It should be noted that the IFIC is an organization created to support the diffusion of GMOs). However, two recent Gallop polls showed only slight increases in the perception of actual risk (Shanahan, 2001).

Referencing these recent Gallop polls, it could be contended that the very small changes in negative US opinion indicate that no significant effect has been derived from the increased news coverage of GMOs (Shanahan, 2001). After conducting our research on American public opinion, we can summarily say that the evidence points to a general malaise that has developed towards this issue. Although this issue is still widely debated,

the higher amount of trust vested in US food authorities combined with the lessening of polarized views on the subject (possibly due to the greater diffusion of genetically modified crops) have led to an overall more supportive public environment for GMOs. However, the reverse is true for the European public, which is our next topic of discussion.

2.3.2 European Public Opinion and the Swiss Genschutz Initiative

One unique Swiss event in the discourse on GMOs that occurred during the major Swiss initiative towards GMOs was the 1998 Swiss Biotechnology Referendum. This referendum, known more popularly as the Genschutz ('Gene Protection') Initiative (GPI), had as its goals, the prohibition of all transgenic animals, the banning of all field releases of transgenic crops and the prevention of patenting certain inventions of biotechnology. This referendum grew out of the Swiss national parliament's commitment to enact a strict regulatory regime, but refusal to ban many biotechnologies (EFB, 1998). The referendum was one of the most intense referendum campaigns that Switzerland had ever seen. Over the last several years a large amount of media coverage increased public understanding of GMOs in Switzerland. This media coverage eventually led to the initiative being defeated by a 2:1 majority. Although this can be attributed to many factors, such as lack of funds of the sponsors of the initiative, it may also be attributed to the unique Swiss referendum process, whereby the referendum itself led to public discussion and education (EFB, 1998).

Three events took place that affected the media coverage of this referendum. The first was a press conference of all Swiss Nobel Prize laureates who united and decried the loss of research potential and the lowering of standards at Swiss universities due to the

efflux of researchers to countries where they could continue biotechnology research. After the press conference came a televised interview of three of the seven federal councilors, explaining the government's unanimous opposition to the GPI. Two of these councilors, who are members of the Social Democratic Party which supported the GPI, went against their own constituents in voicing their opinions. The Swiss Ethics Committee on Non-human Gene Technology (ECNH), part of the Swiss Agency for the Environment, Forests, and Landscape (BUWAL), also published findings stating that:

> The ECNH is against a legal prohibition of the release of genetically modified organisms. However, a majority of the Committee is in favor of a moratorium on commercial releases and experiments that specifically serve the marketing of GMOs. In the case of releases for experimental field trials, we recommend a strict authorization procedure (SECNGT, 2000b, p. 1).

Finally, scientists organized demonstrations in Zurich and Geneva. It should be noted that in all three events, industry was not perceived to be in the foreground at all, even though it funded and organized these events.

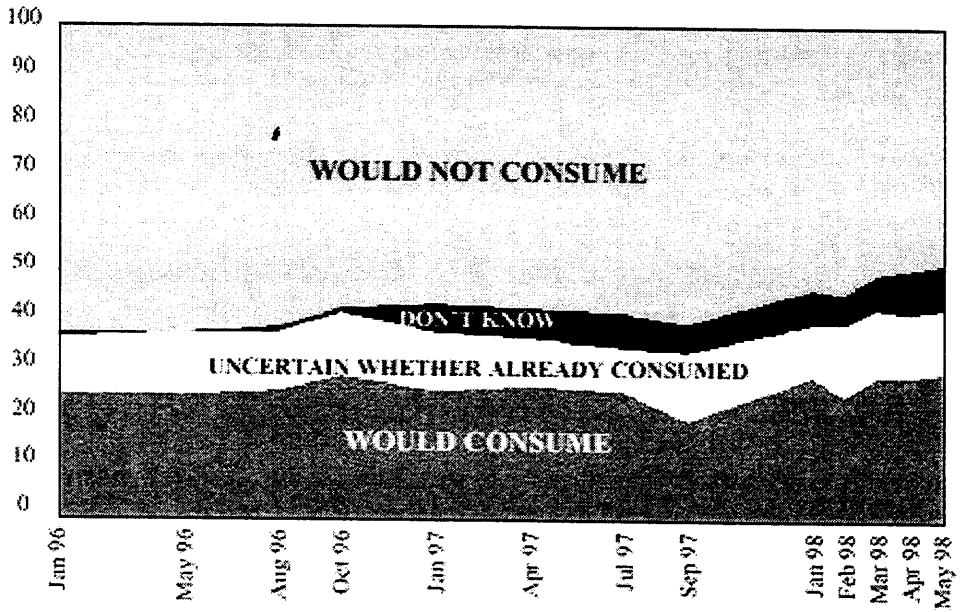
According to a GFS Research Institute survey taken after the referendum, general opposition to genetic engineering decreased from 62% to 33% and acceptance had increased from 25% to 39% (still leaving many people undecided) (EFB, 1998). However, the Swiss post-referendum acceptance of biotechnology was still heavily dependent on the application (Table 1). A 66% acceptance in favor of biotechnology in medical research was achieved, but an 82% opposition to increasing the productivity of farm animals with biotechnology remained.

Table 1: Percentage of Swiss in favor of using genetic engineering for specified purposes in animals and plants in May 1998.

Animals	
Increase knowledge in the medical field	66%
Test pharmaceuticals and vaccines	64%
Improve the health of animals	45%
Increase yields	11%
Plants	
Reduce world hunger	64%
Use less fertilizer	61%
Reduce post-harvest losses	47%
Improve quality	41%
Reduce prices	39%
Improve ability to store a food item	37%
Increase the choice of foods	25%

Source: (EFB, 1998, p. 3)

Figure 2: Percentage of Swiss answering the question: "If available, would you consume genetically modified food?"



Source: (EFB, 1998, p. 3)

Figure 2, constructed from data taken from the beginning to the end of the referendum initiative, illustrates the education that the Swiss Referendum provided to Swiss citizens. Although it is later demonstrated that an increase in understanding of biology and biotechnology does not necessarily mean an increase in support for GMOs, it

is evident that the role of distinguished experts (Nobel prize winners), public leaders, and thousands of scientists marching in the streets demonstrated to the public that several applications of biotechnology were useful and necessary.

Several of the strategies used by opponents to the GPI were successful. During the campaign, many claims of dangers were immediately followed up by refutations and strong counter-arguments from scientists and their published findings. The coalition that was formed to fight the GPI was essential for affecting political change. The coalition appeared to the public as a well-orchestrated, coherent group. They also realized that acceptance and understanding of GMOs and public familiarity with biotechnology products and services needed time to develop (EFB, 1998).

To gain an understanding of general European public opinion towards GMOs we have looked at historical issues surrounding GMOs, along with recent surveys and qualitative data that have been collected. This is also important when we look at our next topic, the public perception of risk.

Since World War II, technology has been increasingly threatening to many people in Europe. Both World Wars, fought predominately in Western Europe, ushered in many new forms of technology, many of them extremely threatening. The public witnessed ordinary bombs and missiles, which had already left them defenseless, evolve into nuclear technology, a far greater threat. Although the post-1945 period was relatively free from military conflict, threatening technologies continued to grow (Moses, 1999). Even removed from military activity, scientific and technological growth reached a pace that, in spite of better education, left the public feeling uneasy and unable to understand many new technologies. The more recent arrival of computers left many citizens

uncomfortable when it came to protecting personal privacy. Finally, biotechnology emerged and the public grew pessimistic fearing that biotechnology, like many things they had experienced during the 1940s, was a "threat to life itself and to the environment as they knew it" (Moses, 1999, p. 651). Due to many reasons, the American biotechnology revolution took place prior to Europe's own commercial development of biotechnology. This has left many Europeans with a measure of resentment.

After the introduction of modern computers, the European public appeared relatively unconcerned about this new technology. The benefits were obvious and the ability of the technology to diffuse was mostly unhindered. Now, their familiarity has made them far less threatening. However, the same is not true with GMOs. During the introduction of GMOs, Europeans were often much more cautious than Americans had been. Concerns were raised about the consequences that the transgenic food would render on European lifestyles (Moses, 1999).

However, it should be noted that much of the concern for biotechnology in Europe has been focused on GMOs. This is due to the history behind the introduction of GMOs into Europe. Until the early 1990s, most biotechnology products and services were directed at highly specialized clients such as the medical profession, veterinary professionals, chemical, and mining and oil industries (Moses, 1999). It is possible that the European public views biotechnology in these professions as extremely beneficial to the consumer, while it views GMOs as mostly beneficial to manufacturers. It is also possible that the public views doctors and other professionals as more apt and capable than themselves to accurately judge the safety of GMOs.

Several Eurobarometer surveys have been conducted over the past several years. These surveys, conducted by the EU, were carried out in 15 countries. The last poll, conducted in 1999, surprisingly but clearly showed that several applications of biotechnology have achieved a large amount of diffusion and are now well accepted in Europe, although the factual knowledge about the underlying biology involved in many applications is extremely low[1] (Braun, 2001).

Biotechnology in basic research and in the medical field is well accepted. This acceptance holds for pharmaceuticals, diagnostics and vaccines – uses for which a personal benefit for one's health can be demonstrated. A large majority of Europeans stated that they do not want to eat food derived from GMOs, but at the same time they approve of agricultural biotechnology if it increases the sustainability of farming. The great majority of the participants also declared that they want to decide personally whether or not they will eat food derived from GMOs. Finally, the European public stated that they do not wish that genetically modified food be banned. The concerns surrounding the changes in food have led to an increase in the purchases of organic food products, and the move to institute mandatory labels for food treated with pesticides and hormones, and bio-engineered products. The findings from this survey form the basis for the EU's proposal for food labeling legislation (Braun, 2001).

Press coverage has been analyzed in both the US and Europe between 1984 and 1996. In these analyses researchers used *The Washington Post* as the representative American newspaper and, due to the diversity of Europe, national newspapers from 12 European countries were sampled. The comparison showed that between 1984 and 1991,

[1] American knowledge of basic biological functions is even lower. Several studies have shown that a significant proportion of the public believes that non-GM food does not contain genes (Shanahan, 2001).

the number of agricultural biotech articles and the topics they covered were just about equal for both the US and Europe. After 1991, however, the sampled European newspapers gave much more attention to GM foods with fewer articles on economic prospect and risk. The authors concluded that even though press coverage was more positive in Europe than the US, the negative view of GM foods in Europe by 1996 could simply be attributed to the greater quantity of media coverage (Gaskell et al, 1999).

Another possible reason for the difference in public opinion has to do with the scientific knowledge of the two populations. A test was administered to both Americans and Europeans that measured both basic biological textbook knowledge and perception of biotech foods. The results showed that the Europeans have a significantly greater biological textbook knowledge than Americans but view GM foods to be more threatening. The outbreak of BSE in Europe has been discussed as a possible reason for Europeans being more wary of the technology. Why are Europeans more suspicious of GMOs than Americans, even though they have a greater knowledge of biotechnology? Although we address this difference in perceived risk in the next section, we can begin to talk about it now (Gaskell et al, 1999).

A major factor influencing the discrepancy in public opinion was the difference in regulations of GM foods and the difference in the amount of trust vested in regulatory agencies. In the US, public opinion surveys showed that 84% of Americans trusted the FDA in their statements and policies towards GM foods. Europeans, however, did not show the same amount of trust in the food regulatory agencies. When Europeans were asked which sources they trusted to relay truthful information about GM foods, the

majority (23%) said environmental organizations, while only 4% of Europeans trusted their national public bodies (Gaskell et al, 1999).

What has caused this mistrust? The 1990s have made the European public extremely sensitive to alterations in their food. Europeans have felt misled by their governmental agencies, whose job it is to oversee food safety. Incidences that have led to increased negativity in the public's perception of the safety of their food include: benzene traces found in Perrier in 1990; the public assurance that BSE in the UK was not a problem in 1991 and later being told that ten individuals were infected with the nvCJD agent in 1996; dioxin being discovered in Belgian animal feed in 1999; and Coca-Cola being withdrawn in Belgium after consumer illness in 1999. The public perception of these incidences as negligence on the part of their governments has led 54% of Europeans to feel that the absence of pesticides is an indicator of food safety, and 86% to believe that crops produced with biotechnology should be labeled (Eurobarometer, 1999).

Here, we see a convergence of several different factors influencing public opinion. Firstly, scientific uncertainty still exists towards GMOs – groups such as the Union of Concerned Scientists in the United States still believe that GMOs represent a danger. Secondly, there exists the aforementioned accident history that is still being played out in the public's mind. Finally, this accident history contributes to the European public's vision of their food regulatory agencies not as regulators and adjudicators of what is safe and environmentally responsible, but rather as advocators of a new technology. All of these factors contribute to the public's perception of risk, which is our next topic of discussion.

2.4 GMOs and Risk

2.4.1 Expert Research vs. Public Perception

The feelings of risk emanating from the genetic modification debate are the underlying force driving negative public sentiment towards GMOs. It has become evident during the course of the GMO debate that there exists a substantial discrepancy between the risks the public and experts associate with GMOs. Not only are these risks viewed differently, but there has yet to be established an adequate definition of risk that is universally accepted. However, all risk concepts and definitions have one element in common; there is a distinction between reality and possibility (Renn, 1992). From a social science perspective, risk involves three elements: undesirable outcomes, possibility of occurrence, and state of reality (Renn, 1998). Kasperson and Stallen (1991) define risk as an objective threat of harm to people and identify it as a product of cultural and social experiences.

A major part of this project focused on the problem that arises when a large discrepancy exists between expert and public opinion. Table 2 comprises Covello's list of 19 factors that account for expert/lay conflicts of intuition (Kasperson and Stallen, 1991).

Currently, the view of many well-respected *world* scientific organizations is that genetically modified foods will both improve human and environmental health. However, worldwide public opinion does not share this view (Goldberg, 2000). In an attempt to explain this discrepancy, a widely used theory claims that ordinary citizens perceive things differently than experts. This difference in perception is due to the public's concern with additional dimensions of risk, such as the voluntariness of the risk

(whether or not they will be given the choice to consume GMOs), and trust in authorities responsible for managing the risk for themselves and for future generations. For example, trust in food regulatory agencies plummeted, as a result of the BSE outbreak. In spite of these events, it has been argued that the public's addition of extra dimensions to their view of risk is an *effect*, rather than a *cause* of the expert/public discrepancy (Margolis, 1996).

Table 2: Covello's list of the Factors that lead to Public Perception of Risk

Factor	Conditions associated with increased public concern	Conditions associated with decreased public concern
1. Catastrophic potential	Fatalities and injuries grouped in time and space	Fatalities scattered and random
2. Familiarity	Unfamiliar	Familiar
3. Understanding	Mechanisms or process not understood	Mechanisms or process understood
4. Uncertainty	Risks scientifically unknown or uncertain	Risks known to science
5. Controllability (personal)	Uncontrollable	Controllable
6. Voluntariness of exposure	Involuntary	Voluntary
7. Effects on children	Children specifically at risk	Children not specifically at risk
8. Effects manifestation	Delayed effects	Immediate effects
9. Effects on future generations	Risk to future generations	No risk to future generations
10. Victim identity	Identifiable victims	Statistical victims
11. Dread	Effects dreaded	Effects not dreaded
12. Trust in institutions	Lack of trust in responsible institutions	Trust in responsible institutions
13. Media attention	Much media attention	Little media attention
14. Accident history	Major and sometimes minor accidents	No major or minor accidents
15. Equity	Inequitable distribution of risk and benefits	Equitable distribution of risks and benefits
16. Benefits	Unclear benefits	Clear benefits
17. Reversibility	Effects irreversible	Effects reversible
18. Personal stake	Individual personally at risk	Individual not personally at risk
19. Origin	Caused by human actions or failures	Caused by acts of nature or God

Source: (Margolis, 1996, p. 29)

Margolis (1996) puts forward three theories that he believes explain these "expert/lay" conflicts. Theory one states different ideas exist between experts and the public regarding "power and responsibility, about human obligations to other humans and to nature, and hence about what ends public policy is going to serve" (Margolis, 1996, p. 21). For these reasons, the conflicts arise from differences in ideology between experts and the public rather than differences in the perception of risk. Theory two suggests that the public simply does not trust institutions that regulate risk. Finally, theory three puts forth the idea that experts and the public simply differ in what they see to be a risk. That is, the experts and the public have *rivaling rationalities* (Margolis, 1996). Rivaling rationalities implies that even though views are different, they are not different in a way that necessarily makes one wrong whenever the other is right. This concept is similar to theory one, but is stating the problem from a different perspective; the underlying concept being that different motivations and experiences shape each and every individual's own view of the world, and the risks which exist in it.

An important step in understanding the perception of risk is to understand some of the even more specific aspects behind risk itself. A discussion of various risk theories will provide a better understanding of the risks associated with GMOs, the conflict between public and expert views, and the various ways in which risk can be interpreted.

2.4.2 Probabilistic risk assessment (PRA)

A probabilistic approach to risk assessment attempts to predict the potential safety failures of complex technological systems in the absence of sufficient data for the system as a whole (Renn, 1992). In this case, the risk is based on the probability of events whose

occurrence can lead to undesired consequences. Many who use PRA commonly calculate risk by the following equation:

Risk (consequence/unit time) = Frequency (event/unit time) X Magnitude (consequence/event)

When using the probabilistic approach in large accidents of low probability, one must employ a subjective approach since rarely will enough data exist to use the *frequentist* approach. *Frequentists* are individuals who accept that a certain probability has a precise value and that information needed to make estimates of it can only come from observation of the process, where subjectivists believe that a certain probability has a value at any time that represents the total available knowledge about the process at that particular time (Rasmussen, 1981).

It should be noted that the PRA method recognizes the knowledge of both the probability of possible accidents and the magnitude of the consequences that may result. PRA is primarily used to provide a measure of the risk so that it can be regulated. The outcome of PRA is a quantitative measure of the risk of a given activity which can be utilized in making comparisons between possible choices.

Many scholars believe that the problems with this method of analysis lie in the interpretation of the results. Techniques for comparing risks of different types need to be more fully developed if widely accepted ways of handling this difficult problem are to be achieved. This problem is further complicated if the results are used incorrectly or in misleading ways. The ultimate goal of PRA is to provide a measure of risk of an activity that can be used in the regulatory process to provide assurance that an activity is acceptably safe. This is a helpful approach, if used correctly, to help make estimates of the risks associated with low probability, high consequence events. However, decision makers must also develop an understanding of the public's attitude towards the risks of a

subject in order to be responsive to public preferences. Clearly the information calculated by the PRA method falls short of providing this (Rasmussen, 1981).

Currently, the biotechnology industry uses two methods for assessing the risk which GMOs may pose. The first assessment approach is probabilistic. Here, the PRA approach's attempts to predict the possibility of safety failures of complex technological systems relate to the possible effects of GMOs on the environment and on human health. This technique has been employed because it is useful even in the absence of sufficient data for the system as a whole.

2.4.3 Economic Risk Analysis

Economic risk analysis involves a systematic thought process about the consequences that arise from different courses of action. This analysis is designed to aid in the decision making process by weighing the costs and the benefits of a risk (Kelman, 1981). The economic concept of risk is based on probabilities, a social definition of undesirable effects based on individual utilities, and the treatment of these effects as real gains or losses to individuals or society. The economic analysis of risk has contributed to our understanding of risk and the improvement of risk policies in that:

1. The treatment of risk in economics has sharpened our ability to conceptualize risk as a cost factor that can be exchanged, treated, or mitigated just like any other cost factor. The economic methods currently employed by the GM industry involve treating or lessening risk by increasing the investment in research and development;
2. The mental processing of uncertainty is part of an individual's cost/benefit analysis in which risk avoidance as well as risk proneness

may be a prudent response when selecting the best option from a variety of possibilities;

3. Economic studies of risk have demonstrated the opportunities and limits of exchanging different types of costs and offering compensation (Renn, 1998). This is important because it can help provide information that will help enable decision makers to make more informed choices.

One application of an economic approach to risk is *cost/benefit analysis.* Cost/benefit analysis involves a process where by an individual compares specific costs of a risk to its benefits. Decisions on socially acceptable risks, which imply the calculation of costs/benefits, should not necessarily be confined to an elite group, but established through a consensus of society as a whole and/or its representatives assisted by experts (Crouch, 1982).

An individual's perception of risk is summarized in the Margolis Risk Matrix (Table 3) (Margolis, 1996). This matrix looks at the four possibilities people feel as they weigh the benefits and costs associated with any action. The first possibility is that a person sees a benefit *and* a danger in an action. This leads to *fungibility*, the process of weighing advantages and disadvantages of the action. The second possibility is that a person views an action as dangerous, with no benefit (Cell two). Therefore, the person does nothing, and takes on the attitude of "better safe than sorry." Hence, the action is perceived as a great risk. This is often experienced when a person who is uninformed about GMOs or distrustful of those who made them, yet concerned with their food, is given the choice of buying a GM food and a non-GM food. No benefit is perceived (no health benefits, environmental benefits, etc.) and the choice is made.

Cell three represents a situation where an individual perceives a benefit to an action, with no accompanying cost. This perceived lack of risk leads to action. This is currently the view towards non-GM food in Western Europe. No danger is seen in unadulterated food, and any health benefits associated with that food still exist. Finally, Cell four illustrates the situation where both benefits and costs are non-existent. It could be argued that this is the current view towards GM foods in the US. Here, we see indifference towards the choice between non-GM food, and GM food. The US public perceives both the risks and benefits of GM food as very low.

Table 3: The Margolis Risk Matrix

		Benefits	
		YES	NO
Costs	YES	1 - "Fungibility" – consider advantages to caution vs. advantages to boldness	2 - "Better safe than sorry" – perceived risk leads to no action
	NO	3 - "Waste not, want not" – perceived lack of risk leads to action	4 - Indifference

Source: (Margolis, 1996, p. 76)

If there exists a situation where a perceived risk is contested (Cell one), we can expect that both sides of the argument will seek expert advice and eventually arrive at a consensus. If the public reaches a balance where nothing is gained by shifting opinion to a bolder approach, or a more cautious approach, the public will sink into an indifferent position (Cell four).

A common case exists when individuals are drawn to a danger and are placed in Cell two. However, soon after, they begin to see that reducing the risk also has costs

thereby moving them into Cell one in the Risk Matrix. For example, a large portion of the public does not currently see any consumer benefit to GMOs. Therefore, they are effectively blind to the *costs* of reducing the risks that they associate with GMOs (Margolis, 1996).

An example of this occurred when, in the UK, two major supermarket chains marketed genetically modified tomato puree. Informative leaflets were made available to consumers (Moses, 1999). The cans, clearly labeled "made with genetically modified tomatoes," were placed next to cans of puree made from non-GM tomatoes. The two cans were *identical in price*, however, the GM tomato puree can weighed 170 grams, larger than the non-GM can which weighed 140 grams. Consumers could clearly see the price advantage in the can of GM tomato puree, however, sales were approximately equal for the cans throughout the 150 stores that were offering both products (Moses, 1999). Here, we can see the Margolis Risk Matrix come into play. The perceived risks of GMOs that existed in the UK were weighed against the price benefits of the larger can of GM tomato puree. It is evident that during this process consumers weighed the consequences of the two cans (Cell 1), due to the existence of risks and benefits. Approximately half of the public who performed the cost/benefit analysis found, from fungibility, that the risks slightly outweighed the benefits. The other half found the contrary to be true.

The economic approach provides techniques and instruments to measure and compare utility loses or gains from different decision options, thus enabling decision makers to make more informed choices. The technique enhances technical risk analysis by providing a broader definition of undesirable events which include nonphysical aspects of risk. The approach also provides techniques to measure distinctively different

types of benefits and risks with the same unit. Finally, the method includes a model for rational decision-making provided that the decision makers can reach agreement about the utilities associated with each option (Renn, 1998).

2.4.4 Psychological Risk Analyses

Psychological risk assessment focuses on personal preferences for probabilities and attempts to explain why individuals do not base their risk judgments on expected values. It expands the realm of subjective judgment about the nature and magnitude of risks. Paul Slovic (1992) writes:

> [R]isk is inherently subjective; risk does not exist out there, independent of our minds and cultures, waiting to be measures, instead human beings have invented the concept of risk to help them understand and cope with the dangers and uncertainties of life (Slovic, 1992, p. 119).

Through numerous investigations it has been shown that many people balance their risk-taking behavior by pursuing an optimal risk strategy which does not maximize their benefits but assures both a satisfactory payoff and the avoidance of major disasters (Kahneman & Tversky, 1979; Simon, 1976; Luce & Weber, 1986).

An example of this kind of strategy is "portfolio theory". This theory tells investors to select a portfolio of stocks in which the risk of losing money on one share is balanced by the probability of gaining money on another share. Here, in order to minimize losses, an individual does not "put all of their eggs in one basket," so to speak. This example and many others show that deviations from the rule of maximizing one's utility are less a product of ignorance or irrationality than an indication of one or several intervening contextual variables, which often make perfect sense when seen in the light of the particular context and the individual decision maker's values (Lee, 1981; Brehmer, 1987).

Also, more specific studies on the perception of probabilities in decision-making identified several biases in people's ability to draw inferences from probabilistic information. These biases are:

1. *Availability* - Events that come to people's mind immediately are rated as more probable than events that are less mentally available. We see this dynamic in the GM debate when genetically modified food is referred to as "Frankenfood," after Frankenstein, a widely known character which represents the negative effects which can arise from mankind's interference with nature.
2. *Anchoring effect* – Probabilities are adjusted to the information available or the perceived significance of the information.
3. *Representativeness* – Singular events experienced in person or associated with properties of an event are regarded as more typical than information based on frequencies. We see this idea express itself when GM opponents discuss "well known" accidents such as the StarLink Corn case (discussed in section 2.4.9).
4. *Avoidances of cognitive dissonance* - Information that challenges perceived probabilities that are already part of a belief system will either be ignored or downplayed (Renn, 1998).

Renn (1998) discusses the images of risk in public perception with respect to technological risk, breaking it into four semantic images, *risk as a pending danger*, *slow killers*, *cost-benefit ratio*, and *avocational thrill.*

The first semantic category of risk is known as a pending danger. Here, risk is seen as a random threat that can trigger a disaster without prior notice and without sufficient time to cope with the hazard involved. The magnitude of the probability is not considered, but rather it is the randomness itself that evokes fear and avoidance responses. In contrast, natural disasters are perceived as regularly occurring and thus predictable or related to a special pattern of occurrence. The image of pending danger is therefore particularly prevalent in the perception of large-scale technologies. Nuclear power plants are a prime example of this semantic category (Renn, 1998). This category applies to transgenics in the same way it applies to nuclear technology, which is often seen as an analogous technological revolution. In this instance, random occurrences of gene transfer and ecosystem impacts have alarmed the public in much the same way that nuclear accidents have in the past.

The second semantic category is known as a slow killer. Here, risk is seen as an invisible threat to one's health or well-being. Knowledge about these risks is based on information from others, rather than on personal experience. These types of risks impose a major demand for trustworthiness in those institutions that provide information and manage the hazard. If trust is lost, the public demands immediate action and assigns blame to these institutions even if risks are relatively small. Typical examples of this risk class are food additives, pesticides, and radioactive substances. Due to the importance of trust in monitoring and managing slow killers, risk managers should place a major effort to improve their trustworthiness and credibility in the community (Renn, 1998). Along with the pending danger category, this category can be used to describe risks posed by genetic modification. Currently, as we discussed in the public opinion section of this

chapter, the trust in institutions that provide information on genetic modification is at a very low level. This lack of trust contributes massively to the high sense of risk felt in many European countries.

The next semantic category is referred to as the cost/benefit ratio. In this case, risks are perceived as a balance of gains and losses. This concept of risk comes closest to the technical understanding of risk, that is, the PRA method of risk assessment. However, this image is only used in the public's perceptions of monetary gains and losses. Typical examples are betting and gambling, both of which require sophisticated probabilistic reasoning. People are normally able to perform such probabilistic reasoning but only in the context of gambling, lotteries, financial investment, and insurance. Laboratory experiments show that people orient their judgment about lotteries more towards the variance of losses and gains than towards the expected value (Renn, 1998).

The final semantical category is known as avocational thrill. In this instance, risks are often actively explored and even desired (Renn, 1998). These risks include all leisure activities for which personal skills are necessary to master the dangerous situation. The thrill is derived from the enjoyment of having control over one's environment or oneself. Such risks are always voluntary and allow personal control over the degree of riskiness (Renn, 1998).

The major weakness of psychological risk assessment is that it focuses on the individual and, thus relies on subjective estimates. According to Renn (1998), the breadth of the dimensions that people utilize in making judgments, as well as the reliance on intuitive heuristics and anecdotal knowledge, make it difficult to aggregate individual

risk preferences and find a common denominator for comparing individual risk perceptions.

2.4.5 Social Theories of Risk Analyses

This perspective follows the notion that all humans do not perceive the world through their own eyes, but rather sees the world filtered by social and cultural meanings transmitted via primary influences such as family, friends, and fellow workers (Renn, 1992). Knowledge of physical consequences, the handling of risk information by individuals and social groups, the social and cultural meanings of the causes and effects of risk, as well as structural and organizational factors, shape the social experience of risk (Renn, 1992).

2.4.6 Psychometric paradigm

The psychometric theory of risk, sometimes referred to as the cognitive theory, involves two principal tributaries:

1. Studies of public response to natural hazards such as floods, hurricanes, and earthquakes, and
2. The study of how people reason under conditions of uncertain knowledge (Krimsky, 1992).

Experiments show that when people were asked to compare the frequency of certain events, they judged an event more likely to occur if it was easier for them to imagine or recall for reasons including the event's intensity, its reinforced by the media, or simply due of their familiarity with it (Krimsky, 1992).

2.4.7 Social constructionist risk assessment

Social constructivists treat risks as social constructs that are determined by structural forces in society. Issues such as health threats, inequities, fairness, control, and others cannot be determined by objective scientific analysis, but rather by the reconstruction of the beliefs and rationalities of the various actors in society (Johnson & Covello, 1987; Bradbury, 1989; Gamson & Modigliani, 1989). The fabric and texture of these constructions reflect both the interests and values of each group or institution in various risk arenas, the shared meaning of terms, cultural artifacts, and natural phenomena among groups (Wynne, 1983). Risk policies result from a constant struggle of all participating actors to place their meaning of risk on the public agenda and impose it on others. This assessment of risk is based on group conventions, specific interests of elites, and implicit value judgments (Appelbaum, 1977; Dietz, Stern & Rycroft, 1989).

For most constructivists they do not separate reality from their perception of reality; the negotiated knowledge of the world is the functional equivalent of the world itself; the world is only understandable and has meaning to the extent that we grant those qualities. Definitions of risk, knowledge, and responses to information and uncertainty are based ultimately on the attempted maintenance of familiar social identities. Physical risks thus have to be recognized as something which is embedded within and shaped by social relations and the continual negotiation of our social identities (Wynne, 1983).

2.4.8 Social amplification of risk

The concept of social amplification of risk is based on the concept that events pertaining to hazards interact with psychological, social, institutional, and cultural processes in ways that can heighten or attenuate perceptions of risk and shape risk

behavior, which in turn generate secondary social or economic consequences (Kasperson, 1992). These secondary effects often generate demands for additional institutional responses and protective actions, or in terms of attenuation, place impediments in the path of needed protective actions. Risk is both an experience of physical harm and the result of cultural and social processes by which individuals or groups acquire or create interpretations of hazards. With these interpretations, the individual who communicates knowledge to the general public has the ability to amplify the risk. During this IQP, we identified elite GMO opponents as individuals who possessed the ability to amplify risk to the general public.

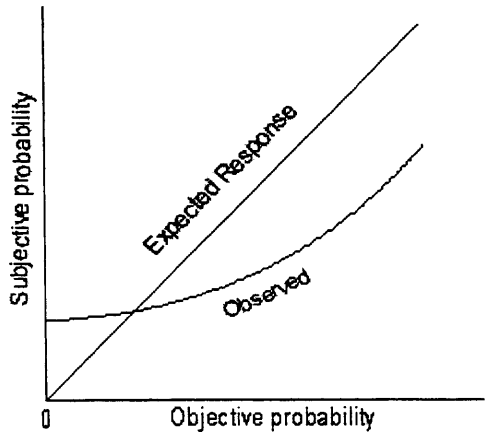
Kasperson (1992) discusses that the amplification process starts with either a physical event or a report on environmental or technological events, releases, exposures, or consequences. Groups and individuals monitor the experimental world, searching for hazardous events related to their agenda of concern. Individuals or groups select specific characteristics of these events or aspects of the associated depictions and interpret them according to their perceptions and mental schemes. These individuals or groups that collect information about risks communicate with others and through behavioral responses act as *amplification stations.* They take the information they have found and distribute it to others with their interpretations, and amplify the consequences of the risk (Kasperson, 1992).

2.4.9 Exposure vs. Harm

In many instances, the media forecasts risks associated with a situation to be much more significant than they really are. Predicting the results or consequences of risks is extremely difficult. Referencing past psychological studies, Margolis (1996)

looks at the relationship of objective (what is actually probable) and subjective (what is perceived as probable) probability of a risk. The following graph illustrates the relationship between the expected response to a given risk and the observed response.

Figure 3: Expected Risk Response vs. Observed Risk Response



Source: (Margolis, 1996, p. 81)

The *expected response line* illustrates the common and naïve idea that people see risk as it really exists. That is, when a risk is small, the public sees it as small, and when a risk is highly probable and large, the public's perception changes accordingly. This concept is illustrated by using a linear, positive relationship between the subjective and objective probability associated with a risk (Figure 3). Here, the *perceived* danger of a risk is measured by the *subjective probability*, and the *actual* danger of a risk is illustrated by the *objective probability.* The problem with the expected response line is that it is a poor model for human response to risks. Rarely are individuals able to see all aspects of a risk. Therefore, the *observed line* illustrates a better model of the human perception of risk. This model, derived from the results of many empirical experiments and studies,

indicates that when a dangerous risk exists, it is often perceived as less dangerous than it really is, and when a risk is not actually dangerous, it is still perceived as though it was (Margolis, 1996). Essentially, when little probability of risk exists, the perceived risk is already relatively high.

However, as objective probability increases the perceived probability remains almost static for quite some time. This was evident in the Y2K computer scare in the late 1990s when professionals, warning of possible worldwide financial and governmental collapse if many computer systems were not fixed, were unable to generate authentic public concern for the problem. Fortunately, the systems were fixed, and a worldwide crash was avoided. However, this only helped to reinforce the public's perception that the problem was only a scare generated by the media and was due to the over-cautiousness of many professionals.

The reaction to GM corn in Taco Bell brand taco shells in September 2000 was an example of the initial perception of risk being overtly high. Created by the StarLink Corporation, the corn used in the taco shells had not been tested or approved for human consumption by the US government. In response Kraft, the manufacturer of the taco shells, recalled the product because it contained a potential human allergen that may not have been able to be broken down by digestive processes. The perceived risk of consuming the shells containing the genetically modified corn was great even though the actual risk unknown and may have even been relatively low (Rosset, 2001).

This discrepancy in expected response and observed risk perception is imperative in explaining the lack of acceptance of GMOs because the publics in Switzerland and the rest of Europe see GMOs as a significant risk, even when, according to significant

scientific data, the objective probability of danger is unknown, or may even be low. Contributions to this increased perception of risk may be heavily dependent on the accident history that is all too well known by the European public. It is possible that news of these accidents contributed significantly to the public's perception of GMOs as high-risk products. Public skepticism of GMOs existed prior to many of the food incidences in Western Europe and the risks posed by many accidents became magnified in the public eye, leading to future accidents being magnified even more.[2]

2.4.10 Allocation of Benefits and Costs

The fifth and final cause of differences in perceived risk is the allocation of benefits and costs. An example of this is a situation where a group of people, such as consumers of GM foods, will be directly subject to the potential dangers associated with the risk. It is the consumer of the GM food that will suffer the costs if the GMO is harmful to one's health while the manufacturer of the GM seeds will reap the monetary benefits. On the other hand, a risk will be perceived as less dangerous if the potential benefits and costs are distributed more evenly among all groups involved. Reform proposals that attempt to help people reach fungibility (that is, to see both the costs and benefits of a risk issue) must encourage fungibility without "provoking a moral response that makes talk of efficiency seem irrelevant or perverse" (Margolis, 1996, p. 167). That is, reform efforts must show the public that they may benefit from taking the risk, not just rationalize a plan that will allow victims to suffer while allowing non-victims to benefit.

[2] Sterman (2000) discusses this same dynamic during the cocaine epidemic in the United States during the 1980s.

2.5 Strategies for Public Relations

There exist four kinds of public relation strategies. Deciding on the proper method depends on the desired effect of the campaign and the intended audience.

The first strategy is known as, *press agentry*. This is the most basic and cost efficient PR strategy. Its main objective is accruing positive publicity for a cause or organization through mass media. This is a very aggressive and one-sided method of public relations because it does not take into consideration the type of public for which it is intended.

The second strategy also functions as a one-sided method of PR. This strategy is referred to as, *public information*. Its objective is the same as *press agentry*, however, it goes about reaching its goal in a different manner. This method looks to accrue positive publicity through mass media by using the release of selective information about the issue or organization. It is important to note that these first two methods do not change the organization; rather they attempt to make it look better in the eyes of the public (Grunig, 1994).

The third PR strategy is called, *two-way asymmetric*. In this method, the company markets their ideas to a specific demographic. That is, they research their audience in order to get the best results.

The fourth and final method of public relations is known as, *two-way symmetric*. This method is used when a conflict has arisen, and calls for negotiations and compromise between the organization and its opposition. This strategy forces the organization to not only research the public, but also to communicate with it. For example, this can be accomplished by using forums consisting of stakeholders pertinent

to the issue. It is important to note that the two latter methods are the exact opposite of the first two in that the two latter strategies change the organization in an attempt to gain public support (Grunig, 1994).

EuropaBio and CBI are two examples of the *public information* and *two-way asymmetric* methods. CBI has chosen to follow the second method of PR, *public information.* Thus far, CBI has used mass media to present itself to the public. They have presented information not only about themselves, but also about the benefits of GMOs in the hope of gaining US public favor for genetically modified foods. CBI's mass media presentations have come in several different forms. They have used websites (in particular www.whybiotech.com), which include articles and links with information about the benefits of GMOs. CBI has also used TV and print advertisements. These advertisements mostly focus on the latest genetically modified crop, Golden Rice. This particular crop has been put into prime focus because it shows the possibility of humanitarian relief that GMOs can provide. It is clear that CBI has exercised public information because their efforts, thus far, have done nothing to change their organization. Rather their PR campaign is focused on making GMOs appear healthier, more environmentally responsible, and ethically acceptable in the public light.

On the other hand, EuropaBio has implemented the third method of public relations into their PR campaign, *two-way asymmetric.* Due to the European dislike of GMOs, EuropaBio has gone farther into the public relations matrix. They too have established a website, however they have implemented several changes in their organization which places them into the *two-way asymmetric* category. EuropaBio has created a subgroup within itself, the Plant Biotechnology Unit, which responds to

concerns regarding GMOs quickly. The organization also holds conferences within Europe to address public concerns and discuss the current benefits of GM foods. This direct interaction with the public is another reason why EuropaBio's campaign resides in the *two-way asymmetric* realm of public relations.

2.5.1 The Mutual Gains Approach

In 1996, Lawrence Susskind and Patrick Field published a book, Dealing With an Angry Public: The Mutual Gains Approach, which presents a radically different viewpoint on strategies for public relations. The authors look at the flaws with current public relation techniques. First, they argue that companies do not follow the previously stated methods of PR work, but rather, they put into practice six distinct PR actions. They call these actions, *stonewalling*, *whitewashing*, *smoke screening*, *presenting a false front*, *blocking and blaming*, and *slash and burn*. All of these ideas relate to the corporation not taking responsibility for its previous actions. That is, the corporation attempts to deflect blame, or lessen the effects of something that they may have done wrong, or may have been perceived of as doing wrong.

Susskind and Field (1996) present a plan for improving public relations campaigns, which is known as the *mutual gains approach*. The approach is broken down into six principles:

- Acknowledge the concerns of the other side.
- Encourage joint fact-finding.
- Offer contingent commitments to minimize impacts if they do occur, and promise to compensate knowable but unintended impacts.
- Accept responsibility, admit mistakes, and share power.

- Act in a trustworthy fashion at all times.
- Focus on building long-term relationships. (Susskind & Field, 1996).

Certain situations call for an adjustment of the mutual gains approach. For example, if there is an element of risk that is perceived in a particular situation, such as the risk surrounding GMOs in Switzerland, then supplemental steps must be taken to gain the public's trust. The public relations campaign must acknowledge the concerns of the public, promise to release all information in the company's possession, offer to jointly develop plans for addressing problems, offer a short term plan to minimize risk, and work in conjunction with the press (Susskind & Field, 1996).

In order to use the mutual gains method to work with GMO opponents, Susskind and Field (1996) suggest searching for shared principles in order to build common ground, and thus, a dialogue with GMO opponents. By avoiding stonewalling and belittling, a positive PR campaign will create a closer and more productive work relationship with the opposition. By researching opponents' arguments and beliefs, critics will observe that a PR campaign is taking their arguments seriously. The acknowledgement of an opponent's emotions are important, but discussions must consist of reasoned arguments, otherwise, both sides will waste time and will fail to form a consensus. Furthermore, Susskind and Field (1996) illustrate that it is imperative to seek all views of a problem, and to avoid what he calls, "right talk." For example a statement such as, "It is our right to support or disapprove of GMOs," will lead to stubbornness and will create a division between the efforts of those coming together. Finally, discussions must avoid adversarial debates and the airing of differences (Susskind & Field, 1996).

Rather, discussions must focus on objectives and compromises in order to attain mutual goals.

2.5.2 Lerbinger's Role of the General Public

The mutual gains approach is a trust building, all-inclusive method of public relations, which takes into direct account the general public. That is, the mutual gains approach is a *two-way symmetric* method of public relations. There exist two major questions pertaining to this radical idea for a research and development firm producing GMOs. First, how will the firm be able to inform the public about GMOs when there exists no definitive, undisputed evidence supporting or denouncing the use of GMOs? Second, can the firm, include public and non-expert input regarding scientific development, in this case GMOs? Dr. Otto Lerbinger of Boston University provides the answers to these two questions involving the public for not just scientific enterprises, but any major corporation that must deal with swaying public opinion and gaining its trust. Lerbinger's method of informing the general public differs drastically from that of the mutual gains approach in that it follows the *two-way asymmetric* method of public relations.

Lerbinger (2001) posits that public relations are an entity within the larger concept of public affairs, the goal of which is, "to achieve enough power over others in society to enable an organization to forge and maintain a favorable socio-political environment" (Lerbinger, 2001, p. 3). It is essential that in order for a corporation to sway public opinion, they must first convince those that influence it. The foundation for public opinion consists of three major groups: interest groups, news media, and government. Participation with these groups is vital to enabling the corporation to

function at an optimal level. If the corporation can convince these three cells of public opinion, they can in turn convince the general public. The relationship with these groups must be long term and publicly known in order to reach the general public effectively through the foundations of public opinion (Lerbinger, 2001).

Research is still a major asset to the effectiveness of this strategy, however the center of the research differs drastically from that of the mutual gains approach. The mutual gains approach's research answers the question: "Who is the public?" However, Lerbinger (2001) suggests asking the question: "Who should know what, and when should they know it?" For example, according to the mutual gains approach, when researching for their public relations campaign, an agribusiness firm should be gathering information on the general public to which it wants to market. The Lerbinger theory, however, would suggest that research consist of only two groups: their opposition and stakeholders involved in GMOs. Stakeholders are defined as those individuals who can either help or hurt a corporation. It is easy to see that this strategy significantly downsizes the importance of a corporation directly addressing the general public. It is also suggested that addressing the general public is the responsibility of interest groups, the media, and the government - not the corporation (Lerbinger, 2001). When researching stakeholders it is important to review each one individually based on the following criteria.

1. Basis of relationship: Who are they and how are they involved in the issue?
2. Attitude towards the company: Regardless of the stand on the issue, do they respect the company?
3. Important issues of stakeholders: What other issues do they bring to the debate?

4. Stand on the issue: Will they prove to be an ally or an opponent?

5. Amount of power: How well and to what extent will each stakeholder affect public opinion (Lerbinger, 2001)?

The stakeholder must be handled with delicate care. This strategy does not totally dismiss the actions that the mutual gains approach calls for, but rather, it suggests that a company use those actions on the stakeholders and leave the responsibility of the general public to the three foundations of public opinion. So how does a company, convince these three foundations (media, interest groups and the government) to support their ideas? One effective method is to exceed previous government standards.

The Trojan Nuclear Plant of Portland General Electric and The Chemical Manufacturers Association are two examples of corporations that exceeded governmental requirements to gain the public's favor. By exceeding previous regulations the corporation is seen as caring, responsible, and hardworking by, "going the extra mile." This image is then transmitted through the media to the general public and an effective bond of trust is created without direct communication between the corporation and the general public. Another method used quite frequently in corporate operations is the conversion of economic resources into political power. For example, using economic power to buy advocacy ads, or well-connected and expert lobbyists (Lerbinger, 2001).

Lerbinger's theory stresses the importance of using the government, media, and interest groups, but it certainly does not *completely* dismiss the need of a corporation to directly interact with the general public. This conclusion is based on a 1999-2000 survey of 1087 companies by the Foundation for Public Affairs. This survey gives the percentage of the companies that focuses on one of the following functions within their public affairs operations. For example, the first function on the survey reads "Federal

government relations (87%)". This means that 87% of the 1087 public affairs companies that were surveyed have a department within their organization that specifically deals with the federal government.

Table 4: Departments within Public Affairs Corporations and Their Prevalence

Departments	*% of PA Corporations in which they exist*
Federal government relations	(87%)
Business/trade assn membership	(84%)
Issues management	(83%)
State government relations	(79%)
Grassroots/grasstops lobbying	(81%)
Local government relations	(79%)
Political action committee	(75%)
Direct corporate contributions	(73%)
Public policy group relations	(70%)
Community relations	(61%)
Public interest group relations	(58%)
Regulatory affairs	(55%)
Public relations	(54%)
Media relations	(54%)
Employee communications	(49%)
International public affairs	(43%)
Employee volunteer programs	(40%)
Internet	(38%)
Corporate foundation	(35%)
Educational relations	(35%)
Advertising	(28%)
Environment affairs	(22%)
Stockholder relations	(18%)
Institutional investor relations	(13%)
Consumer affairs	(13%)

Source: (Lerbinger, 2001, p.7)

The results show that Lerbinger's theory is valid. The list of functions can be reduced to four major departments: government relations, media relations, interest group relations and lastly public relations. The eight most common departments coincide with government, media, and interest group relations - not general public relations (Lerbinger, 2001).

In conclusion, public relations activities are obviously an integral part of public affairs, but not nearly as important, especially for the functions pertaining to a research

and development corporation. According to this theory, the general public should be shown the results of work done by a research and development corporation, however, there is no reason to concern the general public with statistics and results that they cannot understand and may cause them to jump to conclusions that may or may not be true before the research is completed (Lerbinger, 2001).

Kathleen O'Neil presents an interesting, yet unethical, idea of how a corporation can gain the trust of the public during the research and development process without waiting until the end of the corporation's work. She suggests using a survey in a rather unorthodox way to gain the trust of the people. Most corporations will release a survey to the public to better understand the public's opinion about a product or change in policy after the work has transpired. O'Neil suggests using the survey as an initial step in the public relations process. She begins by fully explaining the profound effect that a publicly released study (PRS) can have on the general public, as well as governmental leaders, the media, and public interest groups (The three entities that make up the foundation of public opinion according to Lerbinger.) (O'Neil, 1995).

> Because survey research provides information that is both new and newsworthy, it can attract the attention of journalists, policy makers, and other key opinion leaders. Such studies can also be very helpful in attaining specific marketing objectives, such as introducing new products or repositioning products and services. Properly done, a publicly released study (PRS) can be a powerful addition to the repertoire of the public affairs and public relations professional (O'Neil, 1995, p.63).

The PRS is sometimes "the star of the show," the centerpiece of a news conference or media event. However O'Neil suggests gaining public consensus using the survey at the beginning of a corporation's research. This way the corporation will be able to find out exactly what the consumer, or potential consumer, wants most from the

product and then shape that product around the public's desired results. Too often, large corporations produce or manipulate their product and then concern themselves with fitting it to the public. This method clearly is not the most effective way to satisfy the public's desires or to gain public support. By using the PRS at the beginning of their project a corporation will be sending a very specific message to the public. It will position itself as a caring and responsive organization and will convey an impression of being an industry leader. Using the PRS will also save a corporation, an enormous amount of time, effort, and most important, money. Public relations experts will know how the people want to have the results presented. Also, they will not have to worry about conveying the wrong message to the public. They will have already known exactly what the general public was looking for initially (O'Neil, 1995).

2.5.3 Effective Ways to Research an Intended Audience

After choosing the appropriate public relations method an organization must then answer five key questions pertaining to the chosen demographic. Who is the intended audience? What are their views of the subject? When and where were these opinions formed? Lastly, why does the intended audience feel as they do? Only after researching these questions extensively can a public relations campaign begin to take form and become effective.

Advertising is not necessarily a part of public relations work. Advertising is a possible tool that could be used in a public relations campaign depending on the audience that one is trying to reach, but does not need to be used in a successful public relations campaign. The methods, however, for researching an audience for a PR and an advertising campaign are quite similar.

There are five major checkpoints to follow and keep in mind while researching the targeted audience. The data collected must be clear, objective, complete and cumulative, and lastly, the researcher must be open minded as well as skeptical (Haskins, 1993).

Ten specific guidelines to plan and execute a PR campaign must also be followed in order to obtain a productive result. First, the campaign team must be aware of the problem. They must then define and clarify the problem. Existing knowledge on the topic is to be researched and reviewed. The team must then define and analyze one specific problem in order to solve it. It is better to start small and work all angles of the task at hand into the solution as the team progresses. The team must then develop a research plan, implement it, and gather the appropriate data. The data has to then be processed and interpreted. The team must come together and communicate their results in order to apply them and solve the problem.

2.5.4 Common Mistakes in Public Relations

It is important to not only educate ourselves on effective public relations strategies, but also on methods in public relations that have proven ineffective. There are three methods that are often used which contain costly flaws. The first deals with gaining more technical evidence about an issue. Campaigners will feel that not enough information is known, so they increase their knowledge base by funding more research. Unfortunately research is unable to keep up with the changing public opinion and no ground is made in attempting to convince the public that the technology is safe and beneficial (Jamison, 2001b).

The second strategy that often proves to be ineffective is diminishing public alienation to the issues through "transparent" processes such as focus groups and public hearings. These have a tendency to fail because these "transparent" processes are often taken over by interest groups that use manipulation in order to receive a particular outcome. Instead of becoming closer and more informed on the issue the public has now gone in the opposite direction. For example, surveys conducted by Dr. Thomas Hoban, a public relations/biotechnology specialist, are believed by opposing groups to be inaccurate due to the way he manipulates the wordings of his survey questions in order to reach his desired result. Focus groups, often thought to be a legitimate research method are often tampered with by individuals or groups with an agenda, thus resulting in an incorrect analysis of the resulting data, which does not get to the heart of the problem but rather leads to lack of trust on the part of the public (Jamison, 2001b).

The last strategy is a campaign's attempt to educate the public and close the gap between fact and perception on the issues through an abundance of information. This method does not gain public support because the information is often biased or believed to be biased. There is not enough trust in the proclaimed "experts" that the company or organization hires for the public to believe their finding, regardless of how true it could be (Jamison, 2001b).

Chapter 3 – Methodology

We determined that the underlying structure of this IQP was centered on risk. Our goal was to establish which factors of socially constructed risk have been amplified by the opponents of GMOs in five European countries: Switzerland, Germany, Italy, Spain and the UK. This chapter outlines and explains the methods that we used to determine which of the 19 factors of risk, defined by Vincent Covello and published by Kasperson and Stallen (1991), have been amplified by GMO opponent groups in these countries.

In order to determine how the opponent groups are amplifying risk, we needed to determine their feelings and opinions towards the risks that GMOs pose. Hence, we concluded that qualitative, rather than quantitative, research was necessary. Qualitative research "...refers to the meanings, concepts, definitions, characteristics, metaphors, symbols and definitions of things," (Berg, 2001, p. 3) while quantitative research refers to mathematical counts and measures.

Various methods of qualitative research include interviewing, focus groups, ethnography, content analysis, and case studies. All of these methods implicitly contain a certain degree of error. To offset this error, we incorporated a methodology based around the concept of triangulation. Triangulation is the use of multiple data gathering techniques in order to eliminate the amount of error in qualitative social science research (Berg, 2001). This IQP was triangulated using method triangulation. In method triangulation,

> Researchers can minimize the degree of specificity of certain methods to particular bodies of knowledge using two or more methods of data collection to test hypotheses and measure variables; this is the essence of triangulation" (Berg, 2001, p. 5).

> Here, each method that is used reveals different aspects of empirical reality, hence, multiple methods of observation must be employed; this is termed triangulation (Berg, 2001, p. 6).

We incorporated method triangulation by performing interviews with the elite members of opponent groups within the five specified European countries and also by performing a content analysis of the printed campaigns and websites of these opponent groups. Essentially, the content analysis gave us information as to which factors of risk are being amplified in the opponent groups' printed campaigns and verified the responses by the elites in the interviews. If the content analysis and interview responses from the opponent organizations showed similar results in that they are amplifying the same factors of risk, we could infer that the information was accurate.

3.1 Interviews

The first research method that we incorporated during the course of this IQP was interviewing, which, is defined as a conversation with a purpose (Berg, 2001). Our purpose in this project was to determine which factors of risk were being amplified by GMO opponents. To realize our goal, we performed a series of interviews with the elite leaders of GMO opponent groups in the five aforementioned European countries, between which exists a large variation in public support for GMOs. We defined the elite leaders of GMO opponents as individuals whose opinions are *stable* over time, *manifest* in that they know what they think and are *politically active*. Therefore, it was the opinions of these elites that influenced and were reflected in the campaigns, advertisements and messages of their respective opponent organization. By interviewing the elites, we determined which of the 19 factors of risk they perceived GMOs presented and which they then communicated to the public through their campaigns.

An organization is composed of people who can be ordered according to their involvement in that organization. Within many organizations this involvement can vary greatly, from those who rarely attend organization functions, to those who devote large amounts of time and money to the organization (de Grazia, 2000).

> An internal measure is the extent of one's spiritual and mental life that is bound up in a role; an external measure, more useful in studying elites, is the extent of his behavior or action-output that is oriented towards or done in the context of a role (de Grazia, 2000).

Here, we look at external measures that measure how involved an individual is in an organization. The following graph (Figure 4) demonstrates the distribution of scores that were gathered in a study of the political activity of the American population in 1950. The study asked a representative sample of the population a series of questions about their articipation in politics, an accurate model of participation in organizations (Woodward & Roper, 1950).

The greatest possible score (12) represents the highest level of involvement in an organization. Individuals with this approximate level of involvement (top 1%), are classified as elites in their organization. Individuals with the next highest level of involvement (top 4-5%) are classified as active members in their organization. Those with the top 10% of involvement are classified as attentive members, and finally, those in the bottom 85% are classified as general members of the organization (de Grazia, 2000). Under this distribution, as the level of involvement decreases, the opinions of the members become increasingly passive, latent and unstable. Here, the level of political involvement, defined as the amount of time and money devoted to the organization, decrease as well

Figure 4: Distribution of Political Activity in an Organization

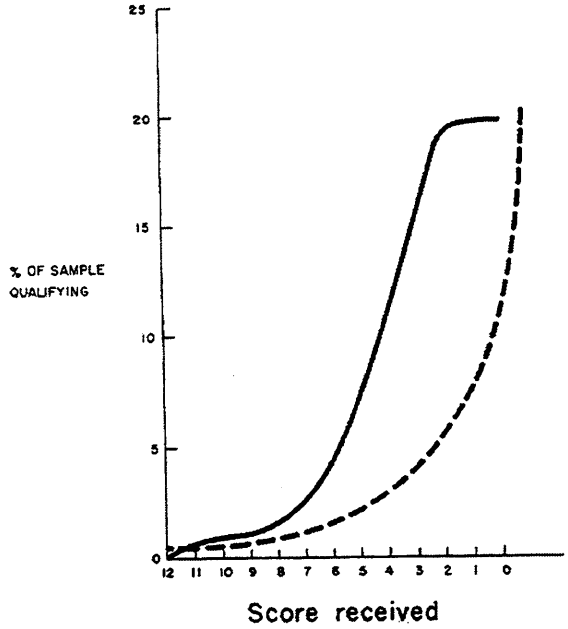


Figure I — The curve of the distribution of political activity, after Woodward — Roper

Distribution found in the Woodward-Roper study ——————
Model of a J—curve distribution - - - -

Source: (de Grazia, 2000)

In order to determine which elite opposition opinion leaders were to be interviewed, we employed a non-probabilistic sampling method known as reference sampling. Here, sampling is defined as the process of determining whom to interview to obtain desired information by removing selection and other biases (Jamison, 2001c). Nonprobability sampling is the most common form of sampling in qualitative research and has several advantages over probability sampling. Even though nonprobability sampling does not offer the advantage of representing a large, general population, it does "offer the benefits of not requiring a list of all possible elements in a full population, and the ability to access otherwise highly sensitive or difficult to research study populations"

(Berg, 2001, p. 32). When specific information for a qualitative research project is desired, a nonprobability sampling technique may be the most efficient way of collecting the data.

Reference sampling, the type of nonprobability sampling method utilized in this IQP, involves a snowballing effect in attaining interviewees. The basic strategy in reference sampling "...involves first identifying several people with relevant characteristics and interviewing them...these subjects are then asked for the names of other people who possess the same attributes as they do" (Berg, 2001, p. 33). This process continues until the interviewer begins to be referred to the same individual several times or the interviewer has conducted enough interviews that they believe that the field has been saturated, that is, interview questions with different individuals yield the same answers.

To begin this process, we obtained the names and contact information for Syngenta affiliates in each of the five specified European countries. Since we were unsure as to which groups and organizations were the most influential in the anti-GMO campaigns in these five countries, we asked the affiliates for contact information for the most influential GMO opponent groups in their respective countries. We then contacted each of these opponents for interviews. In some cases, we were referred to other individuals if the person declined to be interviewed, or thought that another individual had more pertinent information to our project.

The most essential underlying theme of social science research is the Social Exchange Theory. This theory is particularly important in the construction of useful interviews. It was the implementation of this theory, both in the initial contact with elite

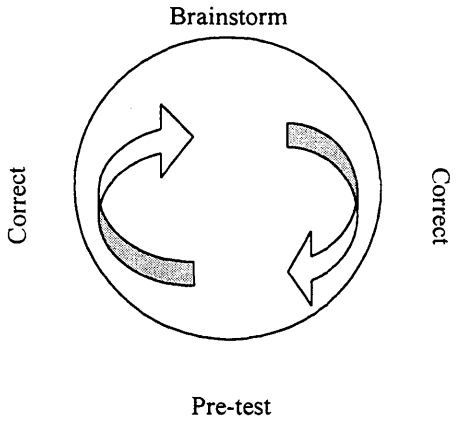
opponents to schedule interviews and in actually eliciting truthful responses during the interview, which aided in the completion of this IQP. This theory's major component is the analysis of costs and benefits. During the course of an interview, if the costs of answering a question or giving the interview outweigh benefits, the interviewee will be hesitant to talk, and may even be untruthful. If the benefits outweigh the costs, the interviewee will feel comfortable talking, and will be honest (Jamison, 2001d).

To accomplish the social exchange, it is imperative to develop a rapport with the respondent, by using the Total Design Method (TDM) of social science research. The TDM is a method by which an interviewer can pre-test his interview questions so that the interviewee will perceive that the benefits involved in the interview will outweigh the costs. According to Don Dillman, the Total Design Method is:

> Nothing more than the identification of every aspect of the survey process (even the minute ones) that may effect the response quantity and quality and shaping them in a way that will encourage good response (Jamison, 2001d, p. 2).

In the Total Design Method, an analysis procedure was engineered where every aspect is tested for weaknesses. This process consisted of six major checkpoints: writing the instrument, brainstorming all its potential weaknesses, correcting them, pre-testing the instrument, correcting any weaknesses that emerged from the pre-test, then administering the instrument. These six checkpoints could be narrowed down into four with the use of the TDM quality circle.

Figure 5: TDM Quality Circle



Source: (Jamison, 2001d, p. 2)

There are four types of questions used in interviews: essential, extra, probing, and throw away questions. Essential questions exclusively concern the central focus of our research. Extra questions are essentially the same as certain essential questions, but are worded differently in order to overcome response bias. Throw away questions help develop rapport with the interviewee. Finally, probing questions help to draw out more details and stories from the respondent. In order to acquire information while interviewing, it was necessary to word questions so that they would elicit the necessary data. It was imperative that all interview questions accurately conveyed meaning to the respondent. They aimed to motivate the interviewee to become involved and to communicate clearly his or her attitude and opinions (Berg, 2001). Consistent with the requirements of the TDM, our interview protocol was pre-tested with our sponsors to make sure that the questions we devised would ultimately elicit the responses we hoped for, and were not poorly worded or offensive.

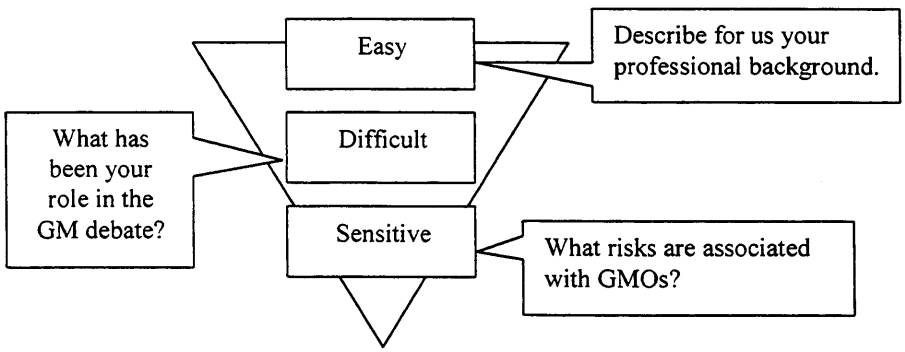
The type of interview implemented in this IQP was the semi-standardized interview.

> This type of interview involves the implementation of a number of predetermined questions. These questions are typically asked of each interviewee in a systematic and consistent order, but the interviewers are allowed freedom to digress; that is, the interviewers are permitted (in fact expected) to probe far beyond the answers to their prepared and standardized questions (Berg, 2001, p. 79).

In semi-standardized interviews, if an interesting or pertinent topic arises during the course of the interview, the interviewer has the freedom to pursue that topic and briefly depart from the question outline.

The one-on-one atmosphere that the interview created gave us the opportunity to probe the interviewee and allowed us to use *funneling* interview techniques so that we may obtain the truth to our questions. *Funneling* (Figure 6) is the process of gradually asking questions that gradually increase in their level of difficulty and sensitivity. This acts to develop a rapport with the interviewee and gain as much information as possible.

Figure 6: Funnel Interview Design



We began the interview by first asking general questions to allow the interviewer to feel comfortable and begin talking with us. Then, in a conversational manner, we

moved onto asking more difficult questions and finally, at the end of the funnel, we asked the most sensitive questions that embodied the focus of our study.[3]

Another issue associated with interviewing is that of confidentiality.

> Confidentiality can be defined as an explicit or implied guarantee by a researcher to a respondent in social science research whereby the respondent is confident that any information provided to the researcher cannot be attributed back to that respondent (Jamison, 2001a, p. 1).

There are two distinct types of confidentiality that are practiced. The first being explicit. This method involves verbal or written specifications of what actions will be implemented in terms of confidentiality. Explicit confidentiality was the method used during the course of this IQP – confidentiality was outright guaranteed to the interviewee both during the scheduling, and at the beginning of the interview. The second type is known as implied confidentiality. The steps taken in this case are not formally written, but rather, there exists an implied agreement between interviewer and interviewee stating that the responses to the questions will be held in confidence. An example of this is seen when journalists use the phrase "off-the record."

Several issues are involved with confidentiality, the first being the ethical responsibility of the researcher towards the sources of the information being gathered. Harsh consequences could ensue if the information is not handled and released to the public properly. These consequences could affect the source of the information and the researcher, and include social sanctions, termination of employment, the loss of competitive business advantages, the loss of vital trade secrets, embarrassment, and legal penalties. The second issue involves the ethical responsibility by the researcher to the social science practice. Confidentiality methods and ethics exist and have been defined

[3] Please refer to Appendix D for interview protocols used throughout our IQP.

throughout the past two centuries. These definitions have formed a code that must be upheld and continue in order for social science research to be perpetuated. The third and final issue is the legal liabilities that come with confidentiality in social science research. By not protecting confidentiality, many legal problems may arise (Jamison, 2001a).

Because of time constraints and our geographic distance from other countries, we performed telephone interviews in all of the countries encompassed in our project, except for Switzerland. In Switzerland, all of our interviews were in person due to the convenience of proximity. In the other five European countries, we conducted telephone interviews. For all the interviews, we first telephoned the individuals to see if they would be willing to schedule an interview with us. We guaranteed them confidentiality and attempted to demonstrate the importance of our research in the hopes that their perceived benefits would outweigh the costs of speaking with us about the GMO issue, which is often perceived as very sensitive due to the many moral and ethical concerns surrounding it. One way of doing this was to offer the individual a copy of our findings and results at the end of the process. Once the interviewee felt comfortable, we were then able to schedule a telephone interview for a later date.

Telephone interviews are fundamentally different than face-to-face interviews. Telephone interviews did not offer us the opportunity to observe and record the interviewee's physical actions and gestures. We could not observe facial expressions that are often a good indicator of whether or not the interviewee is confused or upset about a particular question. Also, as the interviewer, we did not have the opportunity to use hand gestures and movements to perhaps explain or clarify our questions. Therefore, during

our telephone interviews, we had to rely solely on the verbal cues given by the interviewee (Dillman, 1978).

Every data-gathering technique has potential for error and other disadvantages. Interviews are no different in that regard. During the course of our interviews, there existed the possibility of misinterpreting the information given to us by the interviewee. Interviews were difficult because it was time consuming to establish a rapport with the interviewee so that their true views could be uncovered. It was imperative as an interviewer to establish trust with the interviewee and prove to him that the benefits of speaking truthfully and openly outweighed the cost. During an interview, an interviewee may have also got into the habit of answering questions monosyllabically. Funneling questions were put into effect in order to avoid these responses. These processes are time consuming, difficult, and take a large amount of patience (Jamison, 2001d).

The final topic that we need to address with regards to interviews is the topic of transcription – the verbatim recording technique that we applied to all of our interviews (Rogers & Kalmanovitch, 2001). All of our interviewers were transcribed with a relatively high level of detail that included the recording of pauses and laughter. However, we did not record dialect, colloquial speech ("goin'" rather than "going"), or false starts (many of which were due to interviewees attempting to translate their thoughts into English). This level of detailed transcription allowed us to analyze the thought process that the interviewee went through in order to answer our questions. The transcriptions were then sent back to the interviewee for verification of accuracy.

3.2 Content Analysis

The next method, which we used for triangulation of our data, involved the content analysis of a set of materials which were collected from GMO opponents. Content analysis is a set of methods used by social scientists for analyzing the content of any communication. The total content of a communication is reduced to a set of categories that represent certain characteristics of the research topic from which inferences can then be made.

Both the Swiss and US team used content analysis as an analytical tool to examine the symbolic content contained in multiple forms of communications regarding GMOs. The Swiss team used content analysis to analyze the interviews they conducted with the elite leaders of groups opposed to GMOs. Also, during these interviews, the team asked for any documents in the form of brochures, pamphlets, press releases, and also web pages in which they could pass on to the US team for a formal content analysis.

The US team examined various forms of media including web pages, brochures, press releases, and public statements, as well as other pertinent documentation that was made available to the public. The goal for both teams was to determine how GMO opponents are amplifying the feelings of risk that have increased public anxiety in the GMO debate. The US team looked through opponent publications to determine how certain words or images related back to these factors.

The US team analyzed the documents obtained by the Swiss team for symbolic content. The process of content analysis began with question formulation. The US team identified its question as: "How do opponent groups use publications and the media to aid in altering the public's perception of risk regarding GMOs?" Next, the US team defined

the units of analysis, which were words, images, ideas, and overall tone of the communication.

The next step, *sampling*, involved employing all knowledge of the project to distinguish between relevant and irrelevant material obtained by the Swiss team. Sampling was an important step because it allowed for the reduction of a large volume of potential data down to a manageable size and also allowed for a sample size in which generalizations about the topic could be made safely. In content analysis sampling from one population so that they can make generalizations about another population.

Once a good sample of the material was obtained, the next step involved the *construction of coding categories*. The most effective way to begin this step was to take an inductive approach. By inductively reviewing the material, we immersed ourselves into the documents and attempted to identify the dimensions and themes that seemed to be meaningful and pertinent to the procedures of each message.

3.2.1 Content Analysis Procedure

Two processes interact through content analysis:

1. The specification of the characteristics of the context a researcher is to measure;
2. The application of the rules that the researcher uses to identify and record characteristics which appear in the material being analyzed (Krippendorff, 1980; Nachmias 1996; Stone 1966).

During content analysis, a researcher might analyze material to:

1. Test a hypothesis about the characteristics of text or images used,
2. Find out what inspired the material to be produced,

3. Determine the effects of the communication. Most frequently the application of content analysis is used to describe a message's attributes. It is also useful for making inferences about the sender of the message and inferring elements of culture, cultural change and the message's effects on its recipients (Nachmias, 1996).

Independent of the form of content analysis that is used, a researcher will follow five steps:

1. *Question formulation*- define and identify the hypothesis being tested and the question which they wish to answer.
2. *Define the units of analysis* - define the units of material to be analyzed including words, phrases, pictures, paragraphs or ideas.
3. *Sampling* - obtain samples of units that collectively represent the topic of interest.
4. *Definition of variables and construction of coding categories* – develop a set of instructions or rules on how to systematically observe and record content from the material under analysis.
5. *Making inferences from the data* – reveal aspects of the material under analysis that might be difficult to see at first glance and is the first step where the researcher has concrete data to support the hypothesis being tested (Neuman, 2000).

With this five step process, the procedure of content analysis is an effective method for making informed inferences regarding the effects of messages in a given set of material.

3.2.2 Inductive analysis

When a person argues inductively, the individual claims that the conclusion is probably true but not necessarily true if all the premises are true. Berg (2001) indicates that an inductive approach begins with the researchers "immersing" themselves in the documents in order to identify the dimensions or themes that seem to be meaningful to the procedures of each message (Berg, 2001, p. 286). In contrast, in a *deductive* approach, researchers must use some categorical scheme suggested by a *theoretical* perspective, and the documents provide a means for assessing the hypothesis (Berg 2001).

The process of analytic induction differs in that researcher collects data and attempts to create a *grounded theory*. Strauss and Corbin's (1990) define grounded theory as:

> [A theory which is] inductively derived from the study of the phenomenon it represents. It is discovered, developed, and provisionally verified through systematic data collection and analysis of data pertaining to that phenomenon, therefore, data collection. Analysis, and theory stand in reciprocal relationship with each other. One does not begin with a theory, then prove it, rather, one begins with an area of study and what is relevant to that area is allowed to emerge (Strauss & Corbin, 1990, p. 23).

Grounded theories arise out of and are directly relevant to the particular setting which is being studied. For example while in the field, the researcher continually asks questions as to the fit, relevance, and workability of the emerging categories and relationships between them. By raising questions at this point, the researcher checks those issues while he still has access to the data. As a result, the researcher continually fits his analysis to the data by checking as he proceeds. Researchers must approach the

field with an open mind to ensure that their ultimate theory is grounded in empirical evidence (Nachmias, 1996).

The Swiss team conducted interviews with elite members of the opponent groups of GMOs. Once an interview was complete they transcribed the recorded interview and inductively analyzed the content for themes related to the list of factors that influence risk from Kasperson and Stallen (1991). Also, during these interviews, the team asked for any documents in the form of brochures, pamphlets, press releases, and also web pages in which they could pass on to the US team for a formal content analysis.

3.2.3 Categories, coding, and inferences

Coding and categorizing data are the most important aspects of content analysis. The categories of coded content vary with the nature of the data and the purpose of the research. Before categorizing methods are explained, the use of recording units and context units should be addressed.

A recording unit is the smallest body of content in which the appearance of a reference is noted. There are five major recording units in content analysis: terms, themes, characters, paragraphs, and items. These recording units are eventually classified and coded into categories. A context unit is the largest body of content that may be examined when characterizing a recording unit.

Data is coded and put into categories. After reviewing the material to be analyzed and noticing common themes of uncertainty, risk, public opinion debate, and questions surrounding the safety of GMOs, a series of categories were found to be pertinent to the analysis. Table 5 lists the most common categories used in content analysis, along with several which we determined were very important for our analysis (Nachmias, 1996).

Table 5: Categories Used in Content Analysis

Categories of content

Subject Matter	What is the communication about?
Direction	How is the subject matter treated (favorably or unfavorably)? (In what way does the opponent group treat GMOs?)
Standard	What is the basis on which the classification is made?
Values	What values, goals, or desires concerning GMOs do the opponent groups reveal?
Methods	What methods are used to achieve goals?
Traits	What are the characteristics used in describing people?
Actors	Who is presented as undertaking certain acts?
Authority	In whose name are statements (concerning GMOs) made?
Origin	Where does the communication originate?
Location	Where does the action take place?
Conflict	What are the sources and levels of conflict (regarding GMOs)?
Frequency	Are certain words or ideas pertaining to GMOs and the amplification of the uncertainty behind it present and, if so, how often are they repeated?
Intensity	How strong is the overall message from the specific opponent group?
Space	How much is information is available for the general public?

Categories of methods that were used in communication

Form or Type of Communication	What is the medium of communication (radio, newspaper, speech, television, etc.)?
Form of Statement	What is the grammatical or syntactical form of the communication?
Device	What is the rhetorical or propagandistic method used?

Source: (Nachmias, 1996, p. 328)

The categories chosen by the researcher must be exhaustive in order to ensure that every recording unit relevant to the study is classified. The categories must also be mutually exclusive so that no recording unit can be included in more than one given category within the system.

Inferences are made from the data collected by processing the data and inferring as to whether or not that data indicates a certain variable (Stone, 1966). Stone (1966) writes about a researcher's perspective when performing analysis:

> When analyzing material, the words of the speaker not only reflect "the signification of what we imagine their nature" but "have a signification also of the nature, disposition, and interests of the speaker." The "disposition and interest" of the speaker partly reflects the pressures of the current social situation, which may determine the topic being discussed and engender a need to make a particular effect on others. The "nature of the speaker" includes personality characteristics and styles of expression, derived in part from the individual's past experience in family, neighborhood, school, and work situations (Stone, 1966, p. 5).

During our interviews, confidentiality was guaranteed to all individuals. However, a content analysis of the international organizations of which our interviewees were members does not fall into this realm of this confidentiality, as our study has strictly looked at materials which were placed into the public arena prior to our interviews. During the course of our analysis, international groups and their subsidiary national groups were studied. The websites of several organizations for which we could not obtain hard copy materials were analyzed. Also, brochures, pamphlets, and other publications from were gathered from the following organizations:

The following is a breakdown of the opponent groups and the materials that were analyzed:

(1) **Opposing Group**: Greenpeace, Intl.
What they are: An organization developed to promote and inspire interest in urgent global environmental issues.
Materials under analysis: Their website at http://www.greenpeace.org and various pamphlets obtained by both teams.

(2) **Opposing Group:** World Wildlife Federation, Intl. (WWF)
What they are: WWF's mission is to conserve nature and ecological processes, and to address this in a way which benefits human needs and livelihoods.

Materials under analysis: Their website at http://www.panda.org and various pamphlets obtained by both teams.

(3) **Opposing Group:** GeneWatch UK
What they are: GeneWatch, UK is an independent, voluntary, non-profit organization formed in January 1998 that works to promote environmental, ethical, social, human health and animal welfare considerations in decision-making about genetic engineering and other genetic technologies.
Materials under analysis: Their website at http://www.genewatch.org and various pamphlets obtained by the US team.

(4) **Opposing Group:** UK Soil Association
What they are: The Soil Association was founded by a group of farmers, scientists and nutritionists who were concerned about the way our food was produced. Their core concern is to maintain a fundamental link between healthy soil, healthy food, and healthy people.
Materials under analysis: Their official response to the risks of GMOs obtained by the Swiss team.

(5) **Opposing Group:** Friends of the Earth, Intl. (FOE)
What they are: Friends of the Earth is an organization that works to form solutions to environmental problems in order to improve the quality of life for people. It has concluded that the safety assessment process in use for assessing the impacts of GM food and crops on human and animal health have not been adequate.
Materials under analysis: "The Great Food Gamble: An Assessment of Genetically Modified Food Safety." This material was obtained by the Swiss team.

A content analysis of the published materials and websites of these organizations, coupled with an analysis of interviews that were completed with organization members, comprises the data collection that was completed during this project. A thorough analysis of this data was completed and is the topic of discussion in our next chapter.

Chapter 4 – Analysis

This chapter describes the analysis of data collected from the methods outlined in the previous chapter. First, an analysis of the interviews which were conducted with elite opponent leaders is presented. This analysis is broken into four sections. The first looks at the opinions which were expressed based on the different factors of risk that were being emphasized. Next, we observe the common themes that were expressed in Switzerland, Germany, Italy, Spain, and the UK. Following this, we provide an analysis based on common themes that have surfaced among different national branches of international organizations. Finally, we look at the feelings of risk that have been expressed by elites with similar academic and technical backgrounds.

Following the analysis of the interviews, the results of the content analysis performed on the published materials and websites of these organizations is presented. Finally, we relate the results of the interviews to the results of the content analysis.

4.1 Interviews

4.1.1 Analysis Based on Factors of Risk

Upon completing a series of eleven interviews with elite members of opponent groups in the countries of Switzerland, Spain, Italy, Germany and the UK, we observed that several factors of risk were repeatedly emphasized. By analyzing the verbatim transcripts of these interviews, we observed that these elite opponents were addressing 13 of the 19 factors of risk outlined by Vincent Covello's list published in Kasperson and Stallen (1991). These risk factors propagated by the elites are listed in the following table.

Table 6: Factors of Risk Expressed in Interviews with Elite Opponents

Risk Factor	Opinions Expressed by Elite Respondents
Control	Monopolization of seeds and food products by a small number of multinational corporations through patents on plants and genes, etc.
Unknown risks	Fear of unknown effects on the environment and human health both now and in the future.
Origin	Ethical reservations about human interference in the genetic composition of "natural" living organisms.
Voluntariness	Lack of proper labeling which does not give the consumer a choice as to whether or not he will consume genetically modified food.
Irreversibility	Once released into the environment, unforeseen plant breeding and crossing could have irreversible environmental consequences.
Understanding	There is a lack of understanding of the scientific mechanisms of GMOs by both the scientific community and the average public.
Catastrophic potential	Genetic engineering of seeds and food is still a relatively new technology and the potential for catastrophe as an environmental threat or human allergen has yet to be assessed.
Equity	There are many concerns regarding liability and who is ultimately responsible in the event that GMOs pose a real environmental or health risk. The benefits appear to be allocated solely to the large multinational companies and industrial farmers producing the genetically modified seeds and crops in terms of monetary profit while the consumer will absorb any dangers associated with potential health risks.
Benefits	Related to equity, many consumers do not clearly see benefits in GMOs for themselves. They perceive the benefits of GMOs as being directed towards farmers and biotech corporations.
Trust	Related to accident history in that consumers' trust in governmental and food regulatory agencies have been fractured by past occurrences.
Accident history	Due to prior food scares, such as the outbreak of BSE, many consumers have become wary of food safety and scrutinize institutions which try to alter their food.
Familiarity	GM technology is relatively new and in the minds of the public it contrasts sharply with the traditional approach to food and farming.
Dread	The consumer has reservations about a future with GMOs.

In all of the interviews, the factors of *control, unknown risks* and *origin* were identified as the major risks associated with GMOs. The other factors listed in the table above are arranged in decreasing order of importance and emphasis. These subsequent

factors of risk were addressed in at least several of the interviews; however, they were not emphasized as greatly as the factors of control, the unknown and origin.

We begin analyzing these three important factors by first looking at the most influential factor in this case, *control.* Many respondents put forth feelings that biotech corporations were gaining too much control in a variety of areas. The first area that was feared was characterized as the monopolization of the global seed supply.

> So, now you have more than 50% of all the seeds in the world are in the hands of 5 companies, so it's such an incredible power...food is so important for anybody and if it's controlled by so few hands, they have such a power...they control too much.

Here, respondents see a correlation between the ownership of seeds and the ownership of the global food supply, thus eliminating food security and putting large amounts of both economic and social power in the hands of several large corporations.

One way of taking control and monopolizing the market has to do with the "patenting of life." Here, many respondents gave their views on the patents that are being given to corporations for naturally occurring plants, GMOs, and gene sequences.

> When you introduce the concept of patenting of life, and the patenting of genetic resources, you can impede local communities to have access to that...basically, countries and industries are able to *impose* the genetic paradigm.

Finally, respondents voiced their fears over the control which industrial farmers and multinationals will have over small-scale farming. Statements such as, "...farmers around the world are just losing little by little their own power of decision," were common.

The next factor of risk that frequently came out of our discussions with interviewees was the unknown characteristics of GMOs, that is, the unknown effects that they may have on both human and environmental well-being.

> [I]t's irresponsible to go into the environment with this genetically modified organism because the impacts on the environment, on animal health, and on human health are really unknown.

Here, the respondents discussed their views on the perceived lack of knowledge about the effects of GM technology. Many respondents stressed that they believed that more scientific research was necessary in order to assess the actual risks that GMOs pose. However, when asked if they would accept a GMO with a proven safety record, they replied that they might, but did not see this kind of technology on the horizon.

> We really don't know much about the safety of genetic engineered organisms, and we have to do that before we go in the big scale in the environment.

Many respondents expressed their belief that the effects of GMOs on human health were largely unknown. These include possible allergic reactions to GM food. They often cited the StarLink corn case that was described in section 2.4.9. Other examples that were offered include the claim that Monsanto's Bt potatoes unexpectedly killed monarch butterflies that fed on the potatoes in fields.

> [Y]ou don't know which other animals are affected by the Bt. You don't know....I don't think everything will be harmful but I think the problems will be identifying it, which ones will go wrong.

The second area of unknowns that was discussed involved the unknown interactions of GMOs with the environment. Several respondents addressed the cross-pollination of GM and non-GM crops. The most common example of this was the case of Mexican maize being altered unintentionally through cross-pollination with GM maize

that was planted some distance away. This case was particularly troubling for many individuals due to the role of Mexican maize as the "genetic stock from which all maize crops on Earth are derived," as one respondent described it.

The final major risk factor that dominated our discussions was the topic of *origin.* This topic elicited a short discussion with many interviewees that involved the determination of their ethical views and definitions of 'natural' and 'artificial.'

When asked to define *natural,* one respondent answered:

> [N]atural is using the resources that you have at your disposal...so that you're not introducing artificial chemicals or artificial organisms into that system.

Then, when asked to define *artificial*, the same interviewee responded that artificial was that which was "produced by human interference."

The concerns surrounding this factor of risk were expressed through ethical arguments that questioned the role of humans in interfering with natural evolutionary processes. Several of the respondents conceded that evolution and genetic engineering are similar in that they both result in an organism with an altered genome. However, the time span that is inherent in evolution allows for the integration of new genetic material and new species into the global ecosystem, while genetic engineering does not.

> [T]he barrier even in nature has that kind of transfer between very different organism but this was an evolution on a million years and we are doing it in only 2 or 3 years.

This issue was then reinforced through respondents' ideas that natural evolution differs from genetic engineering in that evolution supports the survival of the fittest, allowing for the integration of only the organisms that are compatible with those that previously existed in the environment.

Several GMO opponents also stated their concerns towards scientists "playing God" through their role in creating GMOs.

> [U]nder the present system, you can take any genes from any organisms on the planet and put into any organism if you chose....[T]hat seems to be for many people's moral perspective to be one barrier too far to cross really, in terms of interfering with natural systems.

Many interviewees had ethical reservations about tampering with the genome of living organisms, and therefore altering the genetic basis of the organism.

4.1.2 Analysis Based on Themes in Countries

During our interviews we noticed several themes in the responses from different interviewees in the same country. The first theme emerged in Switzerland where all of our interviewees addressed the need for a 10-year moratorium on GMO field releases, which is currently being debated in the Swiss national legislature. One respondent stated the following:

> You know a little bit but you don't know anything about GMOs. And, so, maybe in 10 years or 20 years you'll know a lot more and then you can say that the environment risks are so small that you can risk it, risk the release of this plant into the environment.

All of the respondents felt there was a need for a moratorium due to our current inability to assess the ecological and health risks associated with GMOs. However, they believed that within 10 years scientists and researchers would be better able to assess the risks and determine whether or not this is a safe technology.

The next theme that emerged during the course of our interviews occurred in Spain. Here, all of the respondents revealed that their campaigns had begun only recently, with most campaigns beginning in 1999. In contrast, many of the other countries in which we had interviews had GMO opposition campaigns running in 1996.

The second theme that emerged from our interviews in Spain had to do with the *precautionary principle*. The precautionary principle is a commonly used policy that states that if the effects of an action are unknown, then the action should be prohibited until more knowledge is gained.

> ...[I]f we don't know we should adopt the precautionary principle.
>
> So, let us begin to apply the precautionary principle and let's not use the dangerous things when there are demonstrated sustainable ways of producing food.

The respondents in Spain advocated the application of the precautionary principle because they believed that the current risks of GMOs are unknown and the future risks have yet to be properly assessed. They believed that the application of the precautionary principle would protect them against that which is unknown and that which they cannot control, two factors of risk stressed in all interviews in Spain.

The final theme that was observed relating to geography was seen in the UK. We determined that *involuntariness* and *control* were the dominating factors in all of our interviews in the UK. This included the opinions expressed during our attendance of a debate in London sponsored by the UK Grocer Magazine which took place between Hugh Grant, executive vice president of Monsanto, and Patrick Holden, the director of the UK Soil Association.

Our respondents discussed in depth their concerns over the "illusion of being able to choose between GM and non-GM food." At several different instances the respondents discussed the corporations that they believe might one day control the world's seed supply.

> [W]e're seeing the monopolization of agricultural seed by the same group of companies over time.

During these discussions, the idea of "corporate environmental vandalism," also surfaced. Here, one respondent said that the biotech corporations were, "rolling out technology," and that, "[this idea] scares me."

The second theme that emerged in the UK was a lack of trust towards both the government and the biotechnology industry. The BSE outbreak that shook the public's trust in the UK food regulatory agencies and scientific institutions also emerged during our discussions.

> I personally never had any trust in the government to be honest. But I think [the BSE scare] had a dramatic effect in the public's trust, in both the government, in science as a whole.

It was evident in our interviews that this accident history has contributed to the distrust of other entities that attempt to modify food.

> [I]t will take a long time to repair the damage they've done in terms of their public perception and the faith that the public would have in them.

4.1.3 Analysis Based on Organization

There are two international organizations in which we have conducted several interviews with different national branches: Greenpeace, Intl. and Friends of the Earth, Intl. Interviews with elite members of Greenpeace branches are linked in that all of the respondents discussed *control* as being one of the major risks that they associated with GMOs. Here, the feeling of being controlled was based on the fear of allowing multinational corporations to control the world seed supply.

Interviewees from the national branches of Friends of the Earth stressed the *irreversibility* of the release of genetically modified plants into the ecosystem as one of

the top risks associated with GMOs. The other heavily correlated risk factor took form in feelings of concern towards the *origin* of GMOs. In many instances this included ethical discussions as to what right humans have in interfering with otherwise natural evolutionary processes.

4.1.4 Analysis Based on Academic Background of the Respondent

The respondents were categorized by their scientific academic backgrounds. We considered someone to be of an advanced biological background if they possessed an advanced degree in medicine, veterinary science or biology. We considered the respondent to be of moderate academic background if they possessed an undergraduate degree in a scientifically related field. Finally, the third category consisted of those individuals that did not possess any academically supported scientific background. Using these categories, we determined that three of the respondents came from an advanced biological background, five from a moderate scientific background and three from an unscientific background.

We found that respondents from different scientific backgrounds held different views towards origin. Those with an advanced biological background did not view origin as an ethical risk. Rather, they viewed origin in terms of scientific and ecological impacts. Origin was addressed in terms of the potential effects of introducing a non-native species into the environment. On the other hand, the respondents who did not possess a strong biological knowledge viewed origin in terms of "playing God." They perceived genetic modification of plants as ethically and morally wrong and genetic engineering as a technology which has crossed the line between what humans *can* do and what humans *should* do.

4.2 Content Analysis of Publications from GMO Opponent Groups

Our second method, used to triangulate the data which was collected through our interviews, involved the content analysis of material collected from GMO opponents. The content analysis was conducted as described in the previous chapter with the purpose of identifying which factors of risk were being amplified in publications from five widely recognized GMO opponent groups: Greenpeace, Intl., World Wildlife Federation, Intl. (WWF), the UK Soil Association, GeneWatch UK, and Friends of the Earth, Intl. (FOE). The data presented in this section provides a qualitative account of the ideas and concepts used by opponent groups in their publications and on their websites to amplify the public's perception of risk regarding GMOs. It is important to note there was clearly a significant element of subjective judgment involved in the analysis, nonetheless, this analysis provides some degree of objective basis for assessing the way opponent groups portray GMOs.

4.2.1 Analysis Based on Factors of Risk

Upon completion of the content analysis, we observed that all of the 19 risk factors were addressed between the 5 organizations. The results of the collective analysis of all the GMO opponent group material presented in the table below shows that all the factors of risk were addressed by the opponent groups.

Table 7: Factors of Risk Expressed in Opponent Group Publications

Risk Factor	Opinions Expressed in GMO Opponent Group Publications
Control	There is no control over the use of GMOs. Possible outcomes from the use of GMOs are uncertain and may be uncontrollable by scientists.
Unknown risks	Scientific unknowns and risks have yet to be determined.
Voluntariness	Relates to the lack of control; many GMOs have been released without public knowledge and are, in turn, being forced upon the consumer market.
Irreversibility	GMOs may have irreversible effects on the environment.
Understanding	The opponent groups try to make the public feel as though they do not understand the scientific processes behind genetic engineering. Consequently, the level of public concern increases.
Catastrophic potential	Due to a lack of knowledge and unknown risks, there is the potential for a catastrophe once GMOs are released into the environment and food supply.
Equity	Not enough benefits exist to counter the numerous risks of developing GMOs.
Benefits	The benefits of GMOs are unclear from the consumer perspective.
Trust	Opponent groups have pointed out different incidents as examples of why the public should not trust the governmental and scientific community on issues related to GMOs.
Accident history	Past GMO accidents were repeatedly cited so as to heighten the risk and concern for their use.
Familiarity	The public is not familiar with the technology used to create GMOs.
Dread	The effects of GMOs could be so horrible that the public will regret their decision to accept them.
Origin	GMOs are an invention of human beings, not nature itself, thus raising many ethical issues.
Effects manifestation	There are possible delayed effects from the use of GMOs.
Effects on future generations	There is possible risk to future generations.
Victim identity	The victims of the adverse effects of GMOs are identifiable.
Media attention	Opponent groups use various forms of media and have multiple documents and ads available for the public that portray GMOs in a negative light.
Personal stake	Each individual is at risk.
Effects on Children	Children are at risk. By mentioning children, opponent groups immediately create concern for their well- being.

The factors observed in the GMO opponent group publications are listed in the table above in order of decreasing emphasis. Overall, the two factors of risk that were most strongly amplified were *lack of control* and *unknown effects*. Most of the remaining

17 factors of risk were used to support and propagate these two major factors. Through the content analysis it became evident that the opponent groups portrayed the *lack of control* in several ways:

1. The public does not have control over the use and the release of GMOs into the public venue.
2. The public could be consuming food containing GMOs without knowing it.
3. Scientists do not have control and will possibly not have control over the effects of GMOs in the future both in terms of industrial monopolization and inability to remedy unexpected consequences.

The lack of control was first encountered before even reading any text; images alone allowed the viewer to get a sense of the lack of control associated with using GMOs. For example, an image found on the Greenpeace, Intl. website showed an individual standing beside an ear of corn which was four times his size. The exaggerated size of the corn in relation to the human alludes to the fact that GMOs (Bt corn, in this case) will be the dominant products on the market, which consumers will be forced to buy due to the monopolization of the consumer market by large industrial biotech companies. Another Greenpeace image that amplifies a lack of control is a spoof on the cereal, Frosted Flakes. On the cereal box, Tony the Tiger is likened to Frankenstein and is holding a beaker filled with GM corn. This image causes the viewer believe that GM corn was used to make their cereal and they really have no choice but to eat it. (See Appendix B for opponent group images upon which the content analysis was performed).

Upon reading through the documents, it was clear that the documents contained images and text that would make one feel as though they had a lack of control over the release of GMOs into the public venue and had no choice but to consume GMOs. The following are excerpts from the literature published by the opponent groups which exemplify the public's *lack of control* over their use of GMOs.

> As long as consumers and farmers are denied the right to know which products contain GMOs...multinational traders...can still force feed Europeans with GMO contained soya beans and maize.
>
> Deliberate releases of genetically engineered organisms are increasing rapidly and may multiply very quickly in number and scale.
>
> It is almost impossible to keep GMOs out of the food chain once they are grown commercially...
>
> Chances are you have already eaten GMOs...

In addition to portraying a lack of control on the part of the consumer, some of the opponent groups portrayed scientists as not having control over the release of GMOs. Scientists and researchers were portrayed as puppets of the biotech industry that could be swayed to develop GMOs through promises of funding and monetary rewards. In that context, scientists were being controlled by the interests of large multinational corporations. "This scientific research is no more than a charade that barely conceals the underlying aim of commercialization of GM crops as fast as possible."

Opponent groups cited examples of prior scientific experimental accidents to show that scientists cannot control the outcomes of GMOs once they are created. So, the *accident history* of GMOs and the field of biotechnology itself has been a very effective way for opponent groups to show how past GMO trials have resulted in unexpected, and

undesirable effects because scientists *lacked control* over the release of GMOs and the effects GMOs had.

> The recent scandal around genetically engineered "StarLink" maize, which is suspected to have an allergenic potential and hence is not allowed for human consumption world-wide, shows that it is almost impossible to keep GMOs out of the food chain once they are grown commercially. "StarLink" maize, which was supposed to be used only in animal feed, was found in tortilla chips and other maize products.
>
> [With regards to] GM potatoes, experiments by Dr. Arpad Pusztai at the Rowett Institute, found that gut lesions developed in rats, which suggests that there is damage to the gut immune system in humans.

In all of the publications, we observed that many of the other risk factors outlined by Covello supported the public's perception of a lack of control. We found that the 19 factors are not mutually exclusive in their ability to amplify risk and often times are used to support each other. This idea is seen in the excerpts above which allude to *accident history* and scientists' inability to control the results of GMOs. The other factors of risk that were used to amplify this lack of control included: *voluntariness*, *irreversibility, effects manifestation,* and *effect on future generations*.

The factor of *unknown effects* was the second most prominent factor that appeared in the literature published by the opponent groups. According to this literature, opponent groups believe that there is still not enough scientific evidence to show that GMOs are free from unwanted effects. They repeatedly stated that there exists little credible scientific evidence to support the use of GMOs and stressed that genetic modification could unexpectedly change the way in which things behave. The publications often referred to experimental results as having wider effects than those desired by scientists.

Opponent groups, through their publications, propagated the idea of public unknown. The opponent groups literature stated that the general public does not have

access to all the research that has been privately funded because biotech companies refused to make the results of their GMO studies public. By propagating the fear of unknown in this respect, the opponent groups are effectively fracturing any *trust*, another factor defined by Covello, the public has in the industry. Other factors of risk which were used to amplify the fear of unknown included: *understanding*, *catastrophic potential, equity, benefits, origin, familiarity,* and *dread.*

The remaining factors that do not fall under either of the two main categories of control and unknown include: *victim identity, media attention, personal stake,* and *effects on children*, and were used throughout the literature as well. Most of the opponent groups pointed out that the readers of the document could themselves be victims of adverse effects from consuming GMOs. As for media attention, each opponent group has a webpage, has published multiple documents available to the public, and Greenpeace and WWF both have TV commercials airing. The opponent groups were also able to point out that there was a personal stake for everyone involved and some groups used the images of children to show that the use of GMOs could indeed affect children.

4.2.3 Analysis Based on Organization

We examined the themes that emerged within each of the five organizations and determined exactly which factors of risk they were amplifying.

Greenpeace is an organization developed to promote and inspire interest in urgent global environmental issues. Greenpeace opposes the release of GMOs into the environment because they carry unnecessary risks and bring unforeseeable damage to the environment, human health, and sustainable agriculture. Out of the 19 factors that are on

Covello's list, Greenpeace hits and stresses all. Some of the headlines of Greenpeace publications included:

"Genetically Engineered Bacteria: US Lets Bad Gene Out of the Bottle"

"GE Animal Feed is Sneaking into the Food Chain"

"Centres of Diversity: Global Heritage of Crop Varieties Threatened by Genetic Pollution"

"Genetic Engineering Produces Risks, Not Solutions"

In addition to these headlines, which alluded to the factors of control, voluntariness and catastrophic potential, Greenpeace utilized many images to amplify the public's perception of risk towards GMOs. As shown in Appendix B, there is a picture of a box of "Frosted Fakes" cereal. In this image, the factor of control is amplified in the message which says, "Untested! Unlabeled!"

The World Wildlife Federation's (WWF) mission is to conserve natural and ecological processes, and to address this in a way that benefits human needs and livelihoods. Their stance on GMOs is that they recognize the potential value to society arising from the new opportunities provided by the developing science of GMOs, especially for medical application. However, they are concerned about the potential dangers involved in releasing GMOs into the general environment through use in agriculture. Out of the 19 factors that are on Covello's list, WWF stresses 13 including *unknown, catastrophic potential, familiarity, effects manifestation, victim identity, dread, trust in institutions, media attention, accident history, benefits, irreversibility, personal stake* and *origin.*

There were four documents that were obtained from WWF that underwent content analysis. The first was the WWF Policy Statement on Genetically Modified Organisms.

Generated in Zurich, Switzerland, this document was the group's formal stance regarding GMOs. The main concepts and risks that were driven across to the reader were those of uncertainty, negative impacts on both the environment and human health, and GMO release into the environment and food supply without the public's knowledge. Below is a table of keywords contained within this 2-page document which shows that WWF is emphasizing the factors of control, unknown, catastrophic potential, irreversibility and origin.

Table 8: Frequency of Keywords Found in WWF Policy Statement on GMOs

Keywords in the Document	Frequency
Natural	6
Biodiversity	5
Escape of	3
Threat	2
Risk	2
Alien	1
No control	1
Danger	1

The second document analyzed from WWF was a press release entitled, "Genetic Engineering Does Not Yield Pesticide Reduction." While not many words with a specific negative connotation were used in this document, the main idea was that GE crops require an increased use of pesticides, which is linked to risk factors such as *control* by biotech firms in making farmers dependent on the use of their pesticides once they have purchased the seeds for the GMO.

The third document was entitled "Background Paper on the Need for a Biosafety Protocol as Part of the Convention on Biological Diversity." This document emphasized

reasons for developing a framework to assess risks associated with GMOs. Background information was given on the history of GMOs and results of field tests were described as well. The table below contains a list of keywords and the frequency with which they were found in the document. These keywords help to amplify the risks of unknown, control, irreversibility and catastrophic potential.

Table 9: Frequency of Keywords Found in WWF Document on Biosafety Protocol

Keywords in the Document	Frequency
Risk	107
Release of GMOs	36
Environment	34
Uncertain	7
Unpredictable	7
Precautionary	7
Health	5
Escape	5
Adverse	3
Alien	2
Natural	2

The final document that was analyzed was an article that appeared on the WWF Intl. website from the Director General entitled, "Food and the Frankenstein Factor." In this article the Director addresses fears that are arising about how GM food and GM technology has failed in the past. It discusses the demands that WWF is calling for as an organization. Again, we identified certain keywords and counted the number of times they were repeated throughout the article. In this case, however, the title of the article itself blatantly conveys the uncertainty and catastrophic potential of GMOs by making the allusion to Frankenstein, a character from a novel by Mary Shelley that created a monster. After performing the content analysis of this document, we counted that the

phrase "Frankenstein food" was used three times and words such as "health" and "environment" were often followed by the word "threatened."

The next organization on which content analysis was performed was the UK Soil Association. Their stance on GMOs is that genetically modified foods should be prohibited from all food production. The Soil Association is an organic farming association that was founded by a group of farmers, scientists and nutritionists who were concerned about the way food is produced. Their core concern is to maintain a fundamental link between healthy soil, healthy food, and healthy people. Out of the 19 factors that are on Covello's list, the Soil Association stressed 13 risk factors including: *unknown*, *control*, *voluntariness to exposure*, *familiarity*, *effects manifestation*, *victim identity*, *dread*, *trust in institutions*, *accident history*, *equity*, *benefits*, *irreversibility*, and *personal stake.* In the document entitled, "GMOs in Food Production: Scientific Evidence of the Risks," the major themes that emerged were that "GM crops will lead to unpredictable and possibly very serious impacts on health and the environment" (UKSA, 2001, p. 4) The idea that "scientists question the whole technology themselves" (UKSA, 2001, P. 4) is also emphasized as a factor of the unknowns associated with GMOs.

The second British GMO opponent organization that was analyzed was GeneWatch UK. GeneWatch UK is an independent, voluntary, non-profit organization that works to promote environmental, ethical, social, human health, and animal welfare considerations in decision-making about genetic engineering and other genetic technologies. GeneWatch is not opposed to genetic technologies in principle but believes that public participation is crucial for robust and effective decision-making and that this

can only take place in the context of openness, where debate is well informed and proper weight is attached to public concerns and aspirations for the future.

Understanding their mission statement allows one to realize it is not that the organization is opposed to GMOs but rather feel that the way in which decisions regarding them do not incorporate the general public. GeneWatch feels that more effective decision-making could be made if there was a higher level of participation from the public.

At the GeneWatch website (http://www.genewatch.org) we found numerous briefings on GMOs and information for farmers regarding use of GE technology. Upon analysis of headlines and text on the website, we discovered that GeneWatch only stressed 9 of the 19 factors of risk. These factors included: *control, voluntariness, accident history, victim identity, dread, trust in institutions, media attention, personal stake* and *origin.* Although they amplify certain factors of risk, GeneWatch is not demanding the prohibition of GMOs, only a moratorium which would allow more research to be conducted and more comprehensive risk assessment procedures to be instituted.

The final organization that we looked at was Friends of the Earth, Intl. (FOE). FOE is an influential national environmental organization that has concluded that the safety assessments used to determine if GM crops are harmful to human or animal health are not adequate. A content analysis of their website shows that they addressed 14 of the risk factors including: *catastrophic potential, familiarity, unknown, control, voluntariness to exposure, effects manifestation, effects on future generations, victim identity, dread,*

trust in institutions, *accident history*, *equity*, *benefits*, and *personal stake*. A keyword count of text from their international webpage produced the following results.

Table 10: Frequency of Keywords Found on FOE, Intl. Webpage

Keywords in the Document	Frequency
Novel	74
Allergy	52
Health effects	26
Unexpected	17
Uncertainty	7
Problems	6
Random	5
Haphazard	3

The frequency with which these keywords are found on the website shows that irreversibility, unknown and catastrophic potential were the major factors emphasized by the organization.

The following is a table which shows exactly which of the 19 factors of risk are being amplified by each of the five organizations considered for this content analysis.

Table 11: Opponents of GMOs and the Factors of Risk that they Amplify

Factor	WWF	Greenpeace	GeneWatch	SA	FOE
1.Catastrophic potential	X	X			X
2. Familiarity	X	X		X	X
3. Understanding		X			
4. Unknown risks	X	X		X	X
5. Control		X	X	X	X
6. Voluntariness of exposure		X	X	X	X
7. Effects on children		X			
8. Effect of manifestation	X	X		X	X
9. Effects on future generations		X			X
10. Victim identity	X	X	X	X	X
11. Dread	X	X	X	X	X
12. Trust in institutions	X	X	X	X	X
13. Media attention	X	X	X		
14. Accident history	X	X	X	X	X
15. Equity		X		X	X
16. Benefits	X	X		X	X
17. Irreversibility	X	X		X	
18. Personal stake	X	X	X	X	X
19. Origin	X	X	X		

4.3 Comparison of the Analyses

After completing the analysis of our interviews with elite opponents and a content analysis on publications from major opponent groups within the five European countries previously specified, we found that the two factors of risk that were emphasized in both

analyses were control and unknown. Overwhelmingly, these two factors were repeated as the most dangerous aspects related to GMOs. Even though there were slight variations to the opinions expressed in regards to each of the 19 factors between the two forms of analysis, the basic principles were the same. The table below lists all the 19 factors and the interpretations of these factors through interviews and content analysis.

Table 12: Comparison of the Analyses of the Factors of Risk Emphasized in the Interviews and Content Analysis

Risk Factor	Opinions Expressed by Elite Respondents in Interviews	Opinions Expressed in Content Analysis
Control	Monopolization of seeds and food products by a small number of multinational corporations through patents on plants and genes, etc.	There is no control over the use of GMOs. Possible outcomes from the use of GMOs are uncertain and may be uncontrollable by scientists.
Unknown risks	Fear of unknown effects on the environment and human health both now and in the future.	Scientific unknowns and risks have yet to be determined.
Origin	Ethical reservations about human interference in the genetic composition of "natural" living organisms.	GMOs are an invention of human beings, not nature itself, thus raising many ethical issues.
Voluntariness	Lack of proper labeling which does not give the consumer a choice as to whether or not he will consume genetically modified food.	Relates to the lack of control; many GMOs have been released without public knowledge and are, in turn, being forced upon the consumer market.
Irreversibility	Once released into the environment, unforeseen plant breeding and crossing could have irreversible environmental consequences.	GMOs may have irreversible effects on the environment.
Understanding	There is a lack of understanding of the scientific mechanisms of GMOs by both the scientific community and the average public.	The opponent groups try to make the public feel as though they do not understand the scientific processes behind genetic engineering. Consequently, the level of public concern increases.
Catastrophic potential	Genetic engineering of seeds and food is still a relatively new technology and the potential for catastrophe as an environmental threat or human allergen has yet to be assessed.	Due to a lack of knowledge and unknown risks, there is the potential for a catastrophe once GMOs are released into the environment and food supply.

Equity	There are many concerns regarding liability and who is ultimately responsible in the event that GMOs pose a real environmental or health risk. The benefits appear to be allocated solely to the large multinational companies and industrial farmers producing the genetically modified seeds and crops in terms of monetary profit while the consumer will absorb any dangers associated with potential health risks.	Not enough benefits exist to counter the numerous risks of developing GMOs.
Benefits	Related to equity, many consumers do not clearly see benefits in GMOs for themselves. They perceive the benefits of GMOs as being directed towards farmers and biotech corporations.	The benefits of GMOs are unclear from the consumer perspective.
Trust	Related to accident history in that consumers' trust in governmental and food regulatory agencies have been fractured by past occurrences.	Opponent groups have pointed out different incidents as examples of why the public should not trust the governmental and scientific community on issues related to GMOs.
Accident history	Due to prior food scares, such as the outbreak of BSE, many consumers have become wary of food safety and scrutinize institutions which try to alter their food.	Past GMO accidents were repeatedly cited so as to heighten the risk and concern for their use.
Familiarity	GM technology is relatively new and in the minds of the public it contrasts sharply with the traditional approach to food and farming.	The public is not familiar with the technology used to create GMOs.
Dread	The consumer has reservations about a future with GMOs.	The effects of GMOs could be so horrible that the public will regret their decision to accept them.
Effects manifestation	N/A	There are possible delayed effects from the use of GMOs.
Effects on future generations	N/A	There is possible risk to future generations.
Victim identity	N/A	The victims of the adverse effects of GMOs are identifiable.
Media attention	N/A	Opponent groups use various forms of media and have multiple documents and ads available for the public that portray GMOs in a negative light.
Personal stake	N/A	Each individual is at risk.
Effects on Children	N/A	Children are at risk. By mentioning children, opponent groups immediately create concern for their well- being.

Although only 13 of the 19 factors were addressed in the interviews, the 6 that were not addressed were not emphasized as greatly in the publications of opponent groups.

One interesting difference we observed in the results of the interviews and content analysis dealt with the factor of *origin.* Origin was a major theme in most of the interviews conducted, however, this was not the case with the published documents, as we saw that origin was not a factor that came out during the content analysis. One explanation for this difference is that the factor of origin and the ethical issues surrounding GMOs and genetic engineering is a more personal issue, which differs according to a person's moral and religious beliefs. Perhaps many of the elites personally had ethical reservations about the alteration of a living organism's genome, but that idea was something based on their own morals, which is not easily communicated to the public through printed documents.

Another theme we noticed was among organizations. We interviewed elites within several national branches of both Greenpeace and Friends of the Earth. The major factor of risk that was observed in the interviews with Greenpeace was *control.* The content analysis of Greenpeace publications and website verified this observation. *Control* and *voluntariness* were repeatedly found in all the Greenpeace material that was analyzed.

The major factors of risk that was found in the interviews with elites from FOE were *irreversibility* and *origin.* The respondents from this organization repeatedly spoke of the irreversible effects both on the environment and human health. The content analysis of the FOE, Intl. website stressed the potential of human allergens within GMOs.

This relates to the factor of irreversibility in that there could be irreversible effects to human health as a result of consuming a product with GMOs. Also, another major theme of the content analysis of FOE, Intl. was *unknown*. Scientific unknown and the fact that scientists do not have all the answers and information about a technology which they created is a common theme. This was an important factor emphasized in the interviews however not as prominent as found in the content analysis.

Chapter 5 - Conclusions and Recommendations

The final chapter of this report consists of the conclusions and recommendations that we have drawn upon the completion of this project. First, we present our conclusions that are based on the analyses presented in the previous chapter. We also demonstrate how our analyses of both our interviews and the published opponent material we have collected relate to the literature that has attempted to explain the underpinnings of the GM debate. This chapter's second section, our recommendations, is based on our experiences with, knowledge of, and feelings toward GMOs and Syngenta's role in the GM debate.

5.1 Conclusions

After analyzing the data that we have collected during the course of this project, we have formed several conclusions with regards to the way in which GMO opponents are amplifying the factors of risk that have contributed to the public's feelings of anxiety towards GMOs in Europe.

Our first conclusion directly supports our problem statement: the opponents of GMOs are amplifying the factors of socially constructed risk. The basis for our project stems from the results of the 1997 Eurobarometer survey in which citizens from 15 European countries were polled and asked to identify the organizations that they trusted to present factual information about GMOs. Overwhelmingly, the survey showed that the European public trusted environmental and consumer groups which were strongly opposed to GM crops to provide them with information on GMOs (see section 2.3.2). In the analysis of our interviews, we noticed that all the opponent groups' campaigns against GMOs began around 1996, except for the campaigns in Spain which started very

recently. This is significant because of the 5 European countries we studied in this project, Spain is the only country currently growing GM crops on a commercial scale. From this, we can conclude that the lengthy absence of GMO opponent groups from the debate in Spain helps to explain the more supportive attitude of the Spanish towards GMOs.

Our second conclusion relates to the idea that scientific concerns are not the underlying forces driving negative elite sentiment towards GMOs. It has become quite evident through our interviews that the negative sentiment towards GMOs does not pertain to the *science* behind genetic modification. In section 2.3.2 of our literature review, we present data which supports the idea that the process of increasing scientific knowledge and then disseminating that knowledge into the public arena is not an effective method for gaining public support. Simple scientific evidence alone will not garner public support for a new technology. Research shows that gaining more technical evidence about an issue is an ineffective method for conducting a PR campaign (see section 2.5.4). Many studies have been conducted which show that the European public has a greater scientific and biological knowledge than Americans. However, Europeans are much more critical and unsupportive of GMOs than Americans.

The statement that no amount of scientific research will solve the problem of public anxiety towards GMOs was put forth by several influential interviewees and leads us to conclude that these opponents are concerned more about the attitudes and level of control of the institutions creating and regulating GMOs than the science behind the genetic modification.

> I don't think more scientific research is going to be the panacea for sorting out this problem...people don't trust some of the companies to reveal the

> data, to have conducted all the experiments thoroughly and I think there could be room for improvement....

The idea that science is not the reason for the lack of support for GMOs in Europe is evident when looking at the academic background of the respondents. Even though many of the respondents held an undergraduate degree in some type of biological science, several did not. Some held degrees in law and sociology and stated in their interviews that the public doesn't care about *how* GMOs are being created, but rather, what the potential consequences of the technology may be.

The public is concerned with the *identities* and *roles* of those who perform the modification. This is one consequence of past accidents such as the BSE outbreak and other food accidents mentioned in section 2.3.2. As stated in section 2.4.1 of the literature review, the public's trust in government, food regulatory agencies, and the scientific community was fractured due to the way in which regulations were mandated and research was conducted in response to BSE. The public's distrust of these organizations and their distrust for profit-driven industry propagates their concern about the control which a few large corporations could wield over the world's food supply. In our interviews we have observed passionate feelings directed towards large corporations who would wish to control the world's seed supply.

Research conducted by entities that are viewed as biased or untrustworthy does not constitute an efficient way to alleviate public discord. This was demonstrated in section 2.5.4, when it was seen that attempts by distrusted institutions to educate the public and provide objective research are merely seen as biased and are rejected, thereby rendering the educational material and research unusable.

Rather than strong *scientific* concerns towards GMOs, we observed strong *ethical* concerns towards those who wish to alter the genetic makeup of life. As Patrick Holden, the director of the UK Soil Association, said, "..they think they've 'cracked' life." These concerns all point towards Margolis's first theory (section 2.4.1) which states that there exist different ideas between GMO opponents and proponents about "power and responsibility, about human obligations to other humans and to nature, and hence about what ends public policy is going to serve" (Margolis, 1996, p. 21). At this stage, it is valid to ask whether GMO opponents are basing their underlying opinions on GMOs themselves, or on the institutions producing them, and the technological and ethical principles by which they are created.

Our third conclusion is that biotech firms are currently failing to use *social* risk assessment in the GMO production process. Rather, these firms are employing scientific assessments and assurances of the safety of GMOs that are based on probabilistic (mainly toxicological/epidemiological approaches – see Appendix C) and economic risk assessment methods.

However, these are not the forms of risk assessment being used by the public. Rather, members of the public are using their own inherent psychological risk assessment capabilities and are not drawing the same conclusions as these other approaches do. An example of an aspect of risk assessment that is not addressed with probabilistic or economic risk assessment methods has to do with how individuals magnify their reactions to particular occurrences. While offering examples of GMO accidents and problems, elites used the same examples repeatedly, thus implying a decision making bias based on *representativeness*, the act of seeing singular events that were either

experienced or were very familiar as more typical than events which were based on frequency (see section 2.4.4). For example, elites offered the case in which a *single* monarch butterfly died for unknown reasons after eating Bt potatoes as a reason for fearing the unknown effects of GMOs. This instance is taken as the norm instead of as a coincidence, even if evidence shows the latter to be the case. This is an example of a reaction to GMOs that is seen in the psychological, social, and cultural theory approaches to risk assessment, but is overlooked when using probabilistic and economic risk assessment methods.

Our fourth and final conclusion is that many players in the GM debate reject any idea that causes them *cognitive dissonance*. As explained in section 2.4.4, cognitive dissonance is the act of ignoring information which challenges one's beliefs. That is, there is a rejection on both the part of elites, and on the part of biotech firms, of information that does not support their previously held stances. For example, when asked if they would accept a GMO if it was proven to be safe, many respondents stated that they *might*, but dismissed the idea as a pipe dream which would never be realized. We believe that this behavior has been one of the significant causes of the polarization that exists in the GM debate.

5.2 Recommendations

Our first recommendation relates to our first conclusion: greater support for GMOs in Spain is the result of the absence of an early strong anti-GMO campaign. We recommend that Syngenta attempt to build the public's trust in Spain so as to gain support for GMOs before opponent groups have the opportunity to sway public opinion.

This same dynamic took place in the United States with the creation of CBI. Even though there was a relatively high level of support for GMOs in the US, the industry still formed a trade association to maintain this support. We recommend the that this same action occur in Spain. Since GM crops are already being grown commercially, we feel that the industry has an opportunity to present themselves as an ethical company with the intent to improve agriculture and the well-being of the public.

Our second recommendation is that Syngenta not base public arguments on the scientific merits of GMOs. As stated in the literature review (section 2.3.2), there exists no correlation in this instance between greater scientific knowledge and greater acceptance of this technology. Rather, Syngenta needs to base arguments on the psychological principles put forth in our literature review which state that the way in which the public interprets the risk associated with a technology is socially constructed, and hence, very subjective.

In order to assist Syngenta in accomplishing this, we recommend the addition of psychological and risk perception experts to the Syngenta public relations team. This addition would increase the likelihood that Syngenta could predict the effects of its products on the public psyche and the social tensions that might result. Full-time individuals who are experts in these fields would go far in educating Syngenta employees as to the public's perception of the risks that lie behind their products, as well as informing members of the public as to Syngenta's intentions and role in the future of agriculture.

Third and finally, we recommend that Syngenta utilize a different public relations method. Currently, most of the public relations mechanisms that are being utilized by

Syngenta reside in industry associations and the funding of further research to enhance the dissemination of knowledge of GM technology. However, as stated in section 2.5.4, this has been shown to be an ineffective public relations technique due to the inevitable lag time that exists between the publication of research and the formation of public opinion. Here, when research *is* revealed, it is seen as biased and motivated by profit. This is also true for public education campaigns performed by corporations. Rather, Syngenta should take on a role utilizing the mutual gains approach described in section 2.5.1. This gives the impression that their research and activities are more 'transparent,' in that Syngenta's research and motivations are not hidden from public view, only to be demonized by GMO opponents.

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Appendix A - Glossary of Terms

***Bacillus thuringensis* (Bt):** Naturally occurring bacterial disease in insects that has been inserted into the genomes of various crops for use as an insecticide.

Bovine Spongiform Encephalopathy (BSE): More commonly referred to as mad cow disease, BSE is a prion disease that affects cattle.

Council for Biotechnology Information (CBI): Industry association based in the US which represents almost all major biotech corporations and supplements their US public relations campaigns. Founded in 2000.

Eurobarometer: Public opinion surveys conducted to gauge public sentiment in Western European countries towards technology and society.

European Association for Bioindustries (EuropaBio): Industry association based in Belgium which represents almost all major biotech corporations and supplements their European public relations campaigns. Founded in 1997.

European Union (EU): A union of 15 Western European countries which acts to coordinate member governments in trade, economic, and other types of policy.

Frankenfood: Derogatory nickname for genetically modified foods.

Fungibility: The process of weighing advantages and disadvantages of the action.

Genetic engineering (GE): The application of engineering processes and ideas to biological mechanisms and subjects.

Genetic modification (GM): The insertion of genes from other organisms (within or between species) into host cells to select for desirable qualities.

Genetically modified organism (GMO): An organism to which genetic modification has been applied.

Genschutz initiative (GPI): 1998 Swiss Referendum campaign whose goals were the prohibition of all transgenic animals, the banning of all field releases of transgenic crops and the prevention of patenting certain inventions of biotechnology. This referendum was voted down by a 2-1 margin.

Golden Rice: A genetically modified organism that contains a gene that codes for β-carotene, a precursor for the synthesis of vitamin A in the body. This is also known as "Vitamin A rice."

Mutual gains approach: Method of public relations that emphasizes the acknowledgement of the concerns of the other side, and actions that are based on trust and the wish to establish long term relationships.

New Variant Creutzfeldt-Jakob's Disease (nvCJD): The prion disease that affects humans and results from the consumption of food contaminated with BSE.

Novel foods: Food products derived from genetically modified organisms.

Pastoralism: The theory states that a social complexity or change will almost always result in a negative response.

Press agentry: A method of public relations whose main objective is accruing positive publicity for a cause or organization through mass media

Public information: A public relations method that looks to accrue positive publicity through mass media by using the release of selective information about the issue or organization

Rivaling rationalities: The instance in which there are different viewpoints on an issue, but even though the viewpoints are different, they are not different in a way that necessarily makes one wrong whenever the other is right

Superweeds: The possible result of the cross-pollination between a genetically modified crop and its natural counterpart found in the environment. It is theorized that this cross-pollination may create weeds that are herbicide and insecticide resistant.

Terminator genes: A method of genetically engineering crops to destroy their own seeds during the second generation.

Two-way asymmetric: A public relations method in which a company markets their ideas to a specific demographic.

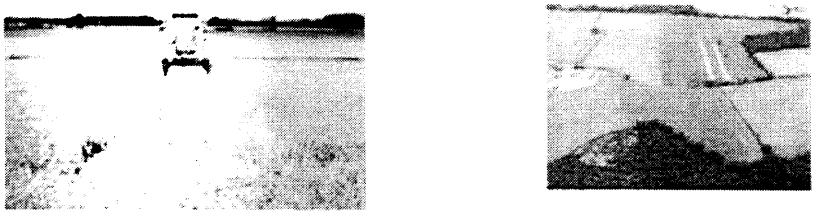
Two-way symmetric: A public relations strategy that is used when conflict has arisen, and calls for negotiations and compromise between the organization and its opposition. This strategy forces the organization to not only research the public, but also to communicate with it.

Appendix B – Images Used in Content Analysis

Farm Animals are fed with GM animal feed

Pictures taken at various demonstrations held by opponents of GMOs

Ad campaigns run by opponent groups



GM crops still need to be sprayed with pesticides

Appendix C – Risk Matrices

Approaches to the Concept of Risk

Type	Concept
Actuarial Approach	Attempts to predict the likelihood of a risk being dangerous based on available data pertaining to the risk. This perspective relies on two conditions. (1) Enough statistical data must be available to make meaningful predictions. (2) The causal agents that are responsible for negative effects must remain stable over the predicted time period.
Toxicology /Epidemiology Approach	Assesses health and environmental risks. It is similar to the actuarial approach but differs in the method of calculating the possibility of undesirable effects. Researchers attempt to identify and quantify the relationship between a potential risk agent and a physical harm observed in humans or other living organisms.
Probabilistic Approach	Attempts to predict the possibility of safety failures of complex technological systems even in the absence of sufficient data for the system as a whole.
Economic Approach	Constitutes a coherent logical framework for situations in which decisions are being made by individuals. It is based on probabilities, a social definition of undesirable effects and the treatment of these effects as real gains or losses. This approach: (1) Provides techniques and instruments to measure and compare utility losses or gains from different decision options, thus enabling decision makers to make more informed choices. (2) Enhances technical risk analysis by providing a broader definition of undesirable events which include nonphysical aspects of risk. (3) Under the assumption that market prices represent social utilities, it provides techniques to measure distinctively different types of benefits and risks with the same unit. (4) It includes a model for rational decision making provided that the decision makers can reach agreement about the utilities associated with each option.

Psychological Approach	Expands the realm of subjective judgment surrounding the nature and magnitude of risk in three ways: (1) It focuses on personal preferences as probabilities and attempts to explain why individuals do not base their risk judgments on expected values. (2) More specific studies on the perception of probabilities in decision-making identified several biases in people's ability to draw inferences from probabilistic information. (3) The importance of contextual variables for shaping individual risk estimations and evaluations has been documented in many studies on risk perception.
Social Theories Approach	Keeps in mind the notion that all humans do not perceive the world through their own eyes, but rather see the world filtered by social and cultural meanings transmitted via primary influences such as family, friends, and fellow workers.
Cultural Theory Approach	Assumes that cultural patterns structure the mind-set of individuals and social organizations to adopt certain values and reject others; these selected values determine the perception of risks and benefits. There are different types of individuals: (1) Atomized Individuals – risks are out of their control and safety is a matter of luck. (2) The Hermit – risks are acceptable as long as they do not involve the coercion of others. (3) Bureaucrats – risks are acceptable as long as institutions have the routines to control them. (4) Entrepreneurs – risks offer opportunities and should be accepted in exchange for benefits. (5) Egalitarians – risks should be avoided unless they are inevitable to protect the public good.

Sociological Perspectives on Risk

Type	Concept
Objective concept	Implies that risks and their manifestations are real, observable events.
Rational actor concept	Claims that risks and their manifestations are social artifacts fabricated by social groups or institutions.
Social mobilization theory	Focuses on two questions: (1) Under what circumstances are individuals motivated to take actions? (2) What are the structural conditions necessary for social groups to succeed (accomplish their goals)? The first question refers to the elements of social experience of risk that trigger actions by individuals and the second to the results of social processing of risk among different social actors.
Organizational theory	Emphasizes two structural aspects of institutions: the action of making tasks routine and the diffusion of responsibility.
Systems theory	Regards risks as an element of a larger social institutional unit, and focuses on structural factors and spans real and constructed realities.
Critical theory	Contains the objective component of the rational actor approach but relies on structural analysis for determining institutional interests and social group behavior. Here, the focus is on the normative aspect of emancipation (involves the empowerment groups and communities to enable them to determine their own acceptable risk level) rather than explanation of risk experience or policies for risk reduction.
Social constructivist theory	These concepts treat risks as social constructs that are determined by structural forces in society. Risk policies result from the constant struggle of all participating actors to place their meaning of risk on the public agenda and impose it on others.

Appendix D – Interview Protocols

GMO Group Interview Protocol #1

Interviewee: _____

Date: _____

Interviewee Institution: _____

Hello, my name is Adrianne Kolpak/Todd BenDor. We understand that your time is valuable and would like to thank you again for speaking with us. We ensure you that the information gathered in this conversation will be strictly confidential – you will be sent a copy of the transcript to verify its accuracy. The transcript will be destroyed after our analysis is completed as this interview is to going to be used only for data collection purposes. If it is alright with you, we will be tape recording this interview so that we can accurately document your responses and will be sending you a transcript of this interview so you can verify that the information accurately reflects your opinions. We will ask you 10 questions because we seek your expert opinion on the risks and benefits of genetically modified foods.

1. Please describe for us how you came to work for this organization
2. How long has your organization been active (campaigning/attempting to affect how the public feels towards GMOs) in the GMO debate?
3. What has it done regarding GMOs during this time?
4. Describe for me your role in the GMO debate during this time.
5. How do you feel about GMOs?
6. What are some of the dangers that are associated with genetically modified food?
7. Describe for me your opinions on the EU labeling requirements. (1% GM rule)
8. Describe for me any benefits you see in GMOs.
9. If yes, to who receives these benefits?
10. What about GMOs do you believe is risky?

GMO Group Interview Protocol #2

Interviewee: _____

Date: _____

Interviewee Institution: _____

Hello, my name is Adrianne Kolpak/Todd BenDor. We understand that your time is valuable and would like to thank you again for speaking with us. We ensure you that the information gathered in this conversation will be strictly confidential – you will be sent a copy of the transcript to verify its accuracy. The transcript will be destroyed after our analysis is completed as this interview is to going to be used only for data collection purposes. If it is alright with you, we will be tape recording this interview so that we can accurately document your responses. We will ask you 12 questions because we seek your expert opinion on the risks and benefits of genetically modified foods. To ensure our studies remain consistent we can't clarify any of the questions until the end of the interview.

1. Please describe for us how you came to work for this organization. What is your academic/professional background?

2. How long has your organization been active (campaigning/attempting to affect how the public feels towards GMOs) in the GMO debate?

3. What has your organization and yourself in particular done regarding GMOs during this time?

4. Describe for us your role in the GMO debate at this time.

5. How do you feel about GMOs?

6. What are some of the dangers that are associated with genetically modified food or crops?

7. Could you please share with us what you think of the EU labeling requirements? (1% GM rule)

8. Describe for us any benefits you see in GMOs.

9. If yes, who receives these benefits?

10. What about GMOs do you believe is risky?

11. What are the best alternatives that you see to the use of GMOs?

12. Why are they the best alternatives?

GMO Group Interview Protocol #3

Interviewee: _____

Date: _____

Interviewee Institution: _____

Hello, my name is Adrianne Kolpak/Todd BenDor. We are students at the Worcester Polytechnic Institute in Worcester, MA, and are in an exchange program with the ETH in Zürich, Switzerland. We're working on a school thesis that is done in a field that we wouldn't ordinarily work in. The thesis is a study of how opponents to GMOs view risk in different countries. We understand that your time is valuable and would like to thank you again for speaking with us. We ensure you that the information gathered in this conversation will be strictly confidential – you will be sent a copy of the transcript to verify its accuracy. The transcript will be destroyed after our analysis is completed as this interview is to going to be used only for data collection purposes. If it is all right with you, we would like to tape record this interview so that we can accurately document your responses. We will ask you several questions because we seek your expert opinion on the risks and benefits of genetically modified foods.

1. Please describe for us how you came to work for this organization. What is your academic/professional background?

2. How long has your organization been active (campaigning/attempting to affect how the public feels towards GMOs) in the GMO debate?

3. What has your organization and yourself in particular done regarding GMOs during this time?

4. Describe for us your role in the GMO debate at this time.

5. How do you feel about GMOs?

6. Could you please share with us what you think of the EU labeling requirements? (1% GM rule)

7. Describe for us any benefits you see in GMOs.

8. If yes, who receives these benefits?

9. What are the risks that are associated with genetically modified food or crops?