Globethics Repository



Implementing the Precautionary Principle through Stakeholder Engagement for Product and Service Development

This page was generated automatically upon download from the Globethics Repository. More information on Globethics see https://www.globethics.net. Data and content policy of Globethics Repository see https://repository.globethics.net/pages/policy.

Item Type	Article
Authors	Cucuzella, Carmen;Coninck, Pierre De
Publisher	Université de Montréal
Rights	With permission of the license/copyright holder
Download date	2026-11-11 03:02:22
Link to Item	http://hdl.handle.net/20.500.12424/172632

Article: 95➔107 Notes: 108 Bibliography: 109➔110
Tables: 111➔114

95

VOLUME 2 NUMÉRO 1
PRINTEMPS 2007
ARTICLES :

IMPLEMENTING THE PRECAUTIONARY PRINCIPLE THROUGH STAKEHOLDER ENGAGEMENT FOR PRODUCT AND SERVICE DEVELOPMENT

CARMELA CUCUZZELLA
CANDIDATE À LA MAÎTRISE EN AMÉNAGEMENT, OPTION «DESIGN ET COMPLEXITÉ»
AND PIERRE DE CONINCK
PROFESSEUR AGRÉGÉ, ÉCOLE DE DESIGN INDUSTRIEL, UNIVERSITÉ DE MONTRÉAL.

RÉSUMÉ

Le principe de précaution est un principe du développement durable et viable qui cherche à intégrer à l'éthique du processus décisionnel la notion d'incertitude. De fait, l'incertitude constitue un point d'achoppement lorsque vient le temps de passer à l'action. À partir du moment où l'on considère que les êtres humains doivent devenir responsables de leurs actions, et que l'éthique se fonde sur l'action, toute décision qui se fonde sur l'incertitude exige un nouveau cadre éthique. Au-delà de la simple observance d'une déontologie professionnelle, il devient nécessaire de considérer le processus de conception fondé sur une éthique qui intègre le futur et, conséquemment, un cadre éthique plus global et fondamental, qui permettra d'exposer les raisons des choix, de les soumettre aux débats avec les autres parties prenantes impliquées dans et par la situation, et donc d'opter pour une axiologie de la prise de décision en conception.

La responsabilité et l'approche participative pour une justice équitable pour tous les acteurs, sont à la base de cette nouvelle éthique. La compréhension du cadre éthique de ce principe et l'application de cette connaissance pour le design et l'innovation permettent son opérationnalisation. Cet article suggère que pour tendre vers un développement durable et viable, les parties prenantes doivent adopter un processus décisionnel intégrant entre autres, le principe de précaution. Un tel engagement vis-à-vis ce principe incite à développer une vision globale et favorise la recherche de nouvelles solutions et d'approches alternatives. De telles méthodes et approches à travers l'engagement des parties prenantes peuvent aider à provoquer ce changement vers la durabilité.

ABSTRACT

The precautionary principle is a sustainable development principle that attempts to articulate an ethic in decision making since it deals with the notion of uncertainty of harm. Uncertainty becomes a weakness when it has to serve as a predictor by which to take action. Since humans are responsible for their actions, and ethics is based in action, then decisions based in uncertainty require an ethical framework. Beyond the professional deontological responsibility, there is a need to consider the process of conception based on an ethic of the future and therefore to develop a new ethical framework which is more global and fundamental. This will expose the justifications for choices, present these in debates with other stakeholders, and ultimately adopt an axiology of decision making for conception.

Responsibility and participative discourse for an equal justice among actors are a basis of such an ethic. By understanding the ethical framework of this principle and applying this knowledge towards design or innovation, the precautionary principle becomes operational. This paper suggests that to move towards sustainability, stakeholders must adopt decision making processes that are precautionary. A commitment to precaution encourages a global perspective and the search for alternatives. Methods such as alternative assessment and precautionary deliberation through stakeholder engagement can assist in this shift towards sustainability.

INTRODUCTION

During the ‘60’s, if development was considered as an obvious strategy for growth, critiques of such an approach soon emerged, particularly those concerned with the situation of the environment. The 1972 conference in Stockholm (United Nations Conference on the Human Environment) was the first conference which dealt with issues relating to the preservation of the environment in order to provide a continued improvement in living conditions for all. This could not be achieved without international cooperation. The emphasis was on solving environmental problems, but without ignoring social, economic and developmental aspects. This conference led to the establishment of the United Nations Environmental Program (UNEP), based in Nairobi, Kenya. That same year, the Club of Rome published its report on ‘The Limits to Growth’ (Meadows, Meadows, & Randers et al., , 1972). The Club of Rome, (founded in 1968,) was vital for providing global awareness of the developmental crisis. Catastrophic scenarios were presented by Club of Romethis group. The key concept

resulting from this book was that if the current growth trends in world population, industrialization, pollution, food production, and resource depletion continued, the limits to growth on this planet would be reached within the next one hundred years, with the probable outcome of an unanticipated decline in population and industrial capacity.

In 1987, the World Commission on Environment and Development (WCED), which had been set up in 1983, published a report entitled 'Our Common Future'. This report[1] defined sustainable development as (WCED, 1987) :

> "Development which meets the needs of the present without compromising the ability of future generations to meet their own needs." (p. 43)

This report alerted the world to the urgency of making progress toward economic development that could be sustained without depleting natural resources or harming the environment. In 1989, the report was debated in the United Nations General Assembly, which decided to organize a United Nations Conference on Environment and Development. In June 1992, the United Nations Conference on Environment and Development held a conference in Rio de Janeiro, also known as the 1992 Rio Earth Summit. During this conference, three five agreements were signed by participating countries: Agenda 21, Rio Declaration on Environment and Development and, the Statement of Forest Principles, the United Nations Framework Convention on Climate Change, and the Convention on Biological Diversity. The Rio Declaration on Environment and Development (1992) identified 27 principles that defined the rights and obligations of nations. This declaration recognized the precautionary and polluter-pays principles as guiding principles. It described the struggle against poverty as a significant policy, and the reduction of unsustainable forms of consumption and production along with the general involvement of citizens in decision-making processes as pertinent to the pursuit of sustainable development.

More recently, the *Stern Review Report* (2007) has provided an economic and international perspective of the effects of climate change. According to Stern (2007) if no action is taken for dealing with the current global crisis, economic costs and risks will result. An estimated 5% of global Gross Domestic Product (GDP) will be lost on a continual basis; and when considering the broader impacts, this loss could rise to at least 20% of GDP. This indicates that current action is an imperative at an international level since the effects of climate change are global. The inequality of this crisis is that the poorest countries, those that have contributed the least will be affected first and worst than the more developed countries. Stern claims that the costs of inaction far exceed those of taking "*sustained long-term action*".

It is important to note that strategies and approaches for dealing with this crisis have progressed enormously over the past thirty to forty years. These strategies have evolved from short-term solutions, to medium and recently have begun to consider long-term, global solutions. Many analytical tools exist to deal with the eco-efficiency of products and service systems. These tools have been developed to enable designers and engineers to assess the life cycle of a product or service system from "cradle to grave" (Consoli *et al.*, 1993), and are often considered as tools that can help identify medium-term solutions. They have helped (and continue to help) in the design and production of eco-products as well as the construction of environmental policies. The assessments of negative impacts using such tools are done using objective, available data, with estimated margins of error; a deterministic or probabilistic approach. In fact, these earlier approaches are, on the most part, limited to environmental issues alone. And if they do consider social impacts, these are considered within a confined scale of vision; not on the most global scale. Therefore there is a need to consider alternate methods of decision making if society is to move towards sustainable development.

1. SUSTAINABLE DEVELOPMENT

Sustainable development does not only address notions of sustainable production and consumption, but also includes characteristics of the decision making process which constitute an important contribution for further research. Moving towards sustainable development requires a profound shift in the way stakeholders, such as, decision makers, designers, producers and consumers think about design, production and consumption; it not simply a measure added into traditional methods (Whiteley, 1995). This is because traditional modes of design, production and consumption do not address the issues of sustainable development; they are in fact, part of the progress paradigm[2]. In the progress paradigm the resources are perceived as unlimited, there is an exploitation of nature, and humans consider themselves as masters and owners of the universe. Some critical problems have emerged

as a consequence of the progress paradigm. The level of pollution in water, land and air is consistently on the rise; social responsibility is in demise, and the continual loss of natural resources at unprecedented rates are all outcomes of the progress paradigm. A major concern of consumption at very high levels is that the distribution of well-being does not occur equally within generations, let alone across generations.

Because of this reality, comparative ecological footprints[3] suggest that different responsibilities with respect to limiting or reducing material consumption would apply to different sections of the world population (Durning, 1992, from Schaefer & , Crane, 2005). Ecological footprints of countries like the U.K. or the U.S differ significantly to that of developing countries[4]. In fact, high consumption is often attributed to affluence. Typically a growth in economic development results in higher disposable income and therefore higher consumption (Schaefer &, Crane, 2005). This type of consumption is in high contrast to that of developing countries[5]. If the entire world population were to achieve the consumption levels of the average European citizen, we would need several planets of Earth to sustain them; it is worst when compared with a North American citizen. This is extremely critical if world populations follow the high fertility pattern proposed by the United Nation's (UN) report on "World Population in 2300" (UN, 2004, from Schaefer & , Crane, 2005). This has led to the belief that current consumption levels are approaching an unsustainable state (Schaefer & , Crane, 2005).

Yet, in current occidental societies, individuals are lead to believe that if they consume high levels of commodities they have a better sense of well-being than those that cannot or choose not to. This ideology is not meant to help improve the sense of well being among humans, but is necessary for a continued economic growth. Well being within a society is defined by the comparison to peers; therefore the choice of reducing consumption becomes a social choice on the individual, cultural, and societal level.

In the context of sustainable development, it is not only the growth in the economic sector that is essential; social and environmental growth is equally fundamental. In a market driven economy, monetary growth is a major measure of success; the progress paradigm. However, trying to achieve sustainability within a market-driven economy is not trivial. In a market economy, the main responsibility for the environmental deterioration stems from the consumer, because consumption is the reason why anything gets produced (Heiskanen &, Pantzar, 1997). In a sustainable paradigm, the rules of success will change. Success will now refer to growth in the several paradigmatic spheres (economic, social, and environmental), and not only the success of the economic sphere. Responsible consumers, will base their consumption choices not only on economic criteria, but also on social and environmental criteria. Therefore the idea of success extends to the health of society and the renewal of primary resources, as well as the growth of the economy. In the sustainable paradigm, resources are to be preserved or renewed. Responsible consumers become a significant part of this sustainable paradigm. With the three spheres sharing prominence, sustainable development can be obtained. Table 1 proposes a summary of the characteristics of each of the paradigms. (SEE TABLE 1, p.111)

When seeking to comprehend the various elements that define a developmental paradigm, it is important to point out that each of the elements are closely interrelated. For example, when considering the technology component, in the progress paradigm, according to Table 1, the idea of efficiency, is fundamental. This implies that when developing new technologies, the idea of rendering the product or service system eco-efficient is a major concern. Yet this is not enough in a sustainable context. To move towards sustainability, over and above the efficiency of technologies, the idea of sufficiency (Princen, 2005) is essential. Sufficiency questions the need for the existence of the product or service system and in fact, seeks to consider the development of solutions based on fundamental human needs. Therefore the reflection that is needed when considering impacts occurs very early during the conceptualization of a product or service system. This reflection is done through an understanding of the way in which humans conduct their lives on a daily basis, therefore understanding consumption habits and fundamental human needs. From this comprehension, new lifestyles can be conceptualized rather than new products or service systems.

So by simply shifting from an efficient mode of *technological* development within a progress paradigm to a sufficient mode of consumption on a *cultural* basis within a sustainable development paradigm, the effects will ripple across several other developmental components. By adhering to the idea of sufficiency based on a new cultural perspective, the way in which technologies are developed within a sustainable development context will also change; innovation will

be based on an ethic of responsibility. In addition, new methods of satisfying human *needs* will result; if possible, without the use of primary resources. This reflection will require the involvement of the community; therefore there is a need for the *individual* to shift from an individualistic mindset to a responsible citizen that can contribute to social change; therefore resulting in a societal shift as well. *Social* issues will no longer be based solely on economic considerations, but will be considered as equal to economic issues.

Therefore even if the progress paradigm has improved the quality of life of many individuals and their communities, it has also led to a plethora of environmental and social issues. Approaches to such issues have evolved tremendously over the past thirty years. During the '60's, environmental strategies for reducing pollution to help clean up the planet and strategies for the end-of-life of products to help increase the longevity of products were introduced. During the '70's, multi-criteria and hierarchical modes of decision making were established. These were methods to facilitate decision making so as to minimize the negative environmental impacts of projects before they were manifested. Life Cycle Assessment (LCA) is an example of such methods. These tools helped to assess the life cycle of products from resource extraction to manufacturing and have contributed in the design and production of eco-products as well as the construction of environmental policies.

Such approaches, although very useful in assessing environmental impacts for a product, are no longer sufficient because they limit the point of view of the problem to the product in question and therefore evade the more global perspective; selecting between long and short term solutions; finding the balance among conflicting objectives such as conservation, development, equity and peace. Also, most LCA tools assess a product system's impact using a cause-effect approach and it is unclear how decisions or assessments are made in conditions of uncertainty. These tools are more reactive than proactive; in other words more preventive than precautionary. Technocratic methods are often advantageous in economic analysis and provide indicators for final decisions. However, this is where an understanding geared towards the benefit of the common good is not considered (Droz & & Lavigne, 2006).

2. PRECAUTIONARY PRINCIPLE

The Rio Declaration on Environment and Development (UNCED, 1992) identified 27 principles of sustainable development, one of which was the precautionary principle[6]. Out of these 27 principles, Vigneron, Patingre and Schiesseret al. (2003), has identified four principles specifically for design: responsibility, solidarity, precaution, and participation. These four interrelated principles are fundamental to the implementation of sustainable development. According to Vigneron, Patingre and Schiesseret al. (2003), the precautionary principle for design is defined as (loosely translated by the authors) as:

"This principle was first introduced in Germany, and can be used in parallel to several other eco-conception tools that employ a preventative approach. This mode of action goes beyond a life cycle analysis thinking; an approach that evaluates the environmental impacts of the inputs and outputs of a product system during the course of its life cycle. A precautionary approach requires an approach that is reflective, exploratory, and prudent. The identification of a real or potential risk does not arise as a result of a life cycle analysis, and therefore eco-conception norms recommend that the precautionary principle is applied when justifying the choice of impacts." (pp. 178-179)

The applications of the precautionary principle with respect to environmental hazards and their uncertainties only began to surface as a clearly and logically expressed concept within environmental science during the 1970's, with the environmental movement in Germany. The precautionary principle originated from the initial German formulation *Vorsorgeprinzip*, which essentially translates more appropriately to 'forward looking caution' or 'foresight'. This is from the German Clean Air Act of 1974 (Harremoes *et al.*, 2001). The main element of the principle was a general rule of public policy action that was to be used in cases of irreversible threats to health or the environment; where potential hazards were to be reduced before there was a strong proof of harm. Since the '70's, the precautionary principle has quickly become a part of political agendas and has been incorporated into many international agreements (Harremoes *et al.*, 2001). The precautionary principle has had many applications: in

environmental policy decisions (chemical contamination), socio-economic decisions (fisheries - quotas), technology issues (Y2K bug), health safety decisions (bovine growth hormone), economics (inflation regulation), and physician's patient care (physician's obligation to 'first do no harm') (DdeFur & & Kaszuba, 2002). The precautionary principle has become, in European regulation of science and technology, a general principle for the protection of the health of human beings, animals, plants, and the environment (Tallachini, 2005). In essence, the precautionary principle responds to a predicament of long-term, invisible dangers that humanity (or the earth in general) has not yet experienced. This environmental dilemma is unprecedented, just as the methods of decision making for managing such situations are (Whiteside, 2006). Two fundamental questions arise from this, which will be explored throughout this paper: (1) how can humans take responsibility for the surroundings so that life can continue to grow; (2) how much consideration should stakeholders have in traditional approaches in decision making?

According to Harremoes (2003), the precautionary principle is a way to formulate an approach to situations where uncertainty beyond statistics, ignorance and indeterminacy dominate the cause-effect relationship. The precautionary principle invites a reflection on the limits of the use of all living systems and natural resources. Often actions to prevent harm are only taken after substantial proof of harm is shown. Usually at which point it is often already too late for the action. The precautionary principle encourages a scientific comprehension of potential risks, where possible with a participatory democratic decision process to arrive at a precautionary decision. It encourages innovation since when such a situation is identified, a requirement of action ensues, and innovative solutions must be identified, evaluated and finally implemented.

A more general framework for a democratic governance of science is necessary in situations of uncertainty. In a democratic society, science may still have an authoritative voice, but it cannot have the ultimate word on decisions that only the broader society may make. Therefore, the current precautionary model of scientific regulation needs to be informed by an extended participatory model of the relationship between science and society. Additional criteria, such as social issues, and new methods of decision making, such as participative democratic processes, are perceived to be indispensable for arriving at fair, just, and non-discriminatory decisions.

According to Lascoumes (1996), the emergence and formalization of the precautionary principle have revealed several shifts in our comprehension of uncertainty and risks. First, decisions cannot be taken only with current knowledge; an attempt must be made to project in the future any long-term effects that may appear to be probabilities of risk. Second, the scientific model of risk assessment is no longer viable; the reality of risk is not limited to an objective rationalization. Preventing known risks is not sufficient, it is necessary now to integrate the notion of an acceptability of risks. Third, the consequences in terms of attribution of responsibility demonstrate another shift. And fourth, a shift in the management of risks and the forms of cooperation that deal with the assumption of responsibility.

IMPLEMENTING THE PRECAUTIONARY PRINCIPLE

An implementation of the precautionary principle cannot be based solely on a risk analysis procedure since the lack of data renders this approach problematic. There are several alternatives to approaching the precautionary principle that will encourage innovation. The two main perspectives for the implementation of the precautionary principle are risk analysis and social heuristic concepts. Godard (2005) claims that the analytical tools of the economic risk analysis approach can provide useful insight on key contentious issues that would help in the implementation of the precautionary principle as a social norm. Table 2 indicates some of the differences/similarities between the two approaches based on Godard (2005). This table will also help to understand the fundamental differences between a precautionary approach and a preventive approach to decision making in situations of uncertainty of harm. Godard (2005) uses a risk analysis approach framed in a Bayesian (statistical) framework to estimate the uncertainty of harm; it is a rational method which provides some level of credibility to the argument for precaution. However, he defines this rational approach to precaution as "'*more prevention in the short run*"' (p. 5). In this approach, Godard does not distinguish between risk and uncertainty; therefore his definition of the precautionary principle implemented in this manner responds more appropriately to the prevention principle. A precautionary approach is invariably based on ethical considerations because of it lack of quantifiable data, which is similar to the social heuristic approach he describes. A preventive approach is based on measurable and quantifiable data, which is similar to the rational risk analysis approach he proposes. Table 4 will

further clarify the differences between these two complementary approaches to uncertainty. (SEE TABLE 2, p.112)

Godard (2005) attempts to gain an in-depth understanding of the complexity of the implementation of the precautionary principle by finding relationships between the formal approach of risk analysis with the reasoned social heuristic concepts that are recognized in Europe. Although the economic risk analysis theories are relatively independent on one hand, the social heuristic concepts that are reasoned can be used for interpreting new social norms within a precautionary attitude. There could be great benefits from cross-fertilization of these two perspectives. The complexity is that the 'language' that each side speaks is different, and therefore a fusing, merging, or mapping of ideas would benefit the implementation of the precautionary principle.

The complementary approaches for the implementation of the precautionary principle based on Godard (2005) can provide a basic level of distinction between a precautionary approach and a preventive approach for situations of uncertainty of risk of harm. These complementary approaches can be similarly mapped onto a solution based approach (such as the "«sufficiency approach"» proposed by Princen, 2005) for precaution, and problem optimization approach (such as an efficiency approach) for prevention. Tickner & and Geiser (2004) claim that to achieve more sustainability, we need to focus on solutions based policy. Most of the work done in environmental policy focuses on the investigations of the problems and their optimization at the expense of investigations of new or alternate solutions; a shift from problem-based to solution based is necessary. This approach redirects environmental science and policy debates from describing problems to identifying solutions. According to Tickner & and Geiser (2004), the alternative assessment process should be a public process. Therefore a collective approach should encourage the participation of various actors including non-scientific individuals that may be affected by the proposed scenario; and where decisions are made in a participatory democratic forum (Sclove, 1995).

The authors claim that a global integrated policy approach is inherent in the original conceptualization of the precautionary principle. The role of the precautionary principle in stimulating a search for alternatives to prevent harm has been introduced in relatively few interpretations of the principle. The most appropriate and effective form of implementing precaution is through a conviction for a search for alternatives to avoid potential harm. Tickner & and Geiser (2004) propose the following to justify the use of an alternative assessment approach:

- focuses on solutions rather than problems
- stimulates innovation and prevention
- multi-risk reduction
- greater public participation and burden shifting

Because of the greater public participation, the burden is now in fact shifted to the public (Tickner & & Geiser, 2004). Assessing alternatives does not eliminate the need to assess risks, because comparisons and sometimes permissible exposures are the best alternative, but this risk assessment will be done through a multi-criteria approach, such as an LCA. A public participation will allow a comprehension of the unresolved issues among participants that is not possible through a risk assessment alone. According to Tickner & and Geiser (2004), there are three (3) benefits of public participation for alternative assessment:

- those who may be adversely affected can provide potentially better solutions
- will draw on a wide set of 'experts' and sources of experience
- public becomes aware that environmental impacts are not inevitable, but that there are choices

With respect to sustainable development, a disclosure of the different perspectives of humanity is also needed, which can be revealed through such a participative approach. According to Sclove (1995), there are several reasons for a greater public participation in research, development and design: (1) a larger number and more diverse range of participants increase the chance that someone will come up with a creative insight; (2) a more diverse range of social needs and concerns are reflected in the design process; (3) can provide enhanced opportunities for rich cross-fertilization of ideas,; and; (4) broadened participation will allow an improved response from markets to the needs of everyone; not only the wealthy, but also the economically deprived.

When compared to Tickner & and Geiser's (2004) reasoning for participation, similarities exist with respect to the emergence of the various points of view. This may have as a result the widening

of a society's moral scope, and therefore a better capacity to comprehend the knowledge that materializes through such participation. From this perspective, public participation becomes a way to expose and deliberate the different ethical positions of each stakeholder (De Coninck, 1997, 2000, 2005).

THE NEED FOR AN ETHICAL FRAMEWORK FOR THE PRECAUTIONARY PRINCIPLE

By focusing on situations of scientific uncertainty where data are lacking, insufficient, or inconclusive, the principle introduced a shift from a neutral attitude towards decision making to a bias in favor of safety. This also had the effect of a paradigm shift from the certainty and objectiveness of known risks to the awareness that decisions based in uncertainty involve considerations about values. The main problem with the precautionary principle is that issues associated with this principle lie outside the epistemological awareness of the average decision maker or designer. There needs an appreciation of uncertainty and basic ethics in decision making with respect to this principle. Why does the precautionary principle need an ethical perspective? According to Whiteside (2006), there are several reasons for an ethical perspective with respect to this principle. The following briefly summarizes his justifications:

- Traditionally environmental problems have had a temporal immediacy; in contrast to current environmental problems which have an undefined (often long-term) temporality.
- The uncertainties that exist in scientific observation, and the often long-term invisible effects from technological innovations, result in the need for a new relationship between popular participation, scientific advice and political decision making.
- There are problems that require global consideration and cooperation, therefore a need to serve the interests of citizens at the international level.
- The global (social and environmental) degradation that is occurring is often a result of multiple factors, and it is not clear who is responsible. So such concerns necessitate a new ethical approach that considers this complex condition of responsibility.
- Traditionally, the idea that nature was an immutable force external to humans was common. However, the idea that nature is a constant and that humans cannot fundamentally change it has been challenged in the past century. In fact, scientists have also had to admit that there exist uncertainties in their discoveries, and that nature cannot only be looked at in an objective way (pp. 30-37).

According to Jonas (1985), the precautionary principle opens up the question of ethics. What Jonas asserts is the sense of responsibility that humans must develop with respect to technological progress. He argues that this condition is new to our contemporary industrial society and therefore presents a need for ethical innovation on many levels. Jonas claims that the greatest moral duty in the technological age is that humankind cannot put its survival at risk for the sole purpose of the continued growth of technological progress. From this perspective, Jonas' view of ethics for the future is a deontological ethics because it deals with responsibility and therefore a sense of duty. This implies that humans are responsible for their actions and therefore for their failures or successes. So the new theme to consider in the ethics of such decisions of uncertainty rests on the duty of responsibility. Ethics can no longer be limited on the actions of the immediate reach and close proximity of time and space (as been historically done), but has expanded to match the scope of human influence in both time and space (Adams, 2004). This scope of responsibility limited to the present context of time and space is no longer sufficient, since the consequences of technological innovation go beyond this temporality and spatiality. The irreversibility of actions based on technological innovations is a question raised for consideration, and therefore places responsibility at the center of the ethics concern.

The ethical framework of the precautionary principle is based on a sense of responsibility. However, since responsibility implies duty, and therefore societal norms, the ethical foundation can be assumed to be deontological. It is not as simple as that. A brief presentation of various ethical theories will serve as an introduction to the comprehension of the ethical framework of the precautionary principle.

Deontological Ethics

This theory believes that there are certain ethical principles that are universal and that impose an absolute duty on a person. Kant referred to such duties as 'categorical imperatives' because they allow for no

exception. This theory maintains that whether an action is right or wrong is for the most part independent of whether its consequences are good or bad. From the deontological perspective, there are several distinct moral rules or duties (e.g., not to kill, not to lie, respect the right of others, to keep promises…), the observation or violation of these is intrinsically right or wrong (Brennan & & Lo, 2002)

Utilitarian Ethics

This theory requires the ethical person to evaluate the likely consequences of contemplated conduct and weigh the good the act may produce against the harm it may cause. This refers to 'the greatest good for the greatest number.' This is the claim that an act is morally right if and only if that act maximizes the good, that is, if and only if the total amount of good for all, minus the total amount of bad for all, is greater. Classic utilitarianism denies that the moral rightness depends directly on anything other than consequences (Sinnot-Armstrong, 2006).

Virtue Ethics

This is an Aristotelian approach, recommending the virtuous way of life by its relation to happiness. He ties happiness to excellent activity of the soul, which is tied to moral virtues and the virtue of practical wisdom. This is excellence in thinking and deciding about how to behave (Parry, 2004).

Contractarianism (Social Contract Theory - SCT)

Social Contract Theory begins with the observation that the existence of an enforced moral code is to our mutual benefit. The purpose of an SCT is to facilitate social living. SCT does not assume that there is one correct conception of the good, unlike utilitarianism. People can agree to a social contract theory because it is rational to do so given that the contract will help them pursue the good as they see it. An SCT is not an explicit contract, but implicit because someone chooses to enter in this contract when they want to participate in society and enjoy its benefits. This theory assumes people to be self-interested in order to justify rules of morality or justice. Persons are presumed to want the benefits of social interactions if they can be had without sacrifice of individual self-interest. Justice, and so a social contract, is only possible where there is some possibility of benefit to each individual from cooperation. Social contract theories take individuals to be the best judges of their interests and the means to satisfy their desires. For this reason, there is a close connection between liberalism and contractarianism. A social contract theory is basically a moral contract and lies within the moral theory of contractarianism (Cudd, 2003).

The above definitions help to clarify some basic ideas so that it becomes increasingly clear on how to proceed with an ethic of sustainable design. An entirely utilitarian approach is not adequate since the process of getting to a good solution is as important as the solution. The utilitarian ideal is a persuasive one and has been very influential in individual morality and public policy in the U.S. in the twentieth century. It is an essential perspective in engineering ethics, where technological decisions are often made in terms of cost/benefit or risk/benefit analysis. These types of analysis are simply applications of utilitarianism. However, there are two major drawbacks to the utilitarian perspective on morality. The first requires extensive knowledge of facts, and sometimes this knowledge is not available. The second is that it may lead to injustice for certain individuals. A mining operation that is unsafe and leads to black lung disease for some of the miners may produce more utility than harm, from an overall standpoint, but it may be unjust to the miners themselves. Table 3 summarizes the various ethical theories. (SEE TABLE 3, p.113)

The most important difference between deontological and utilitarian ethics is that in deontological ethics, basic rights to individuals may not be sacrificed for the greater overall utility. One individual's rights may be overridden to protect another individual's (or group's) rights that are considered to be more basic, but not merely to provide greater utility for the other individual. Therefore a deontological approach to an ethic of sustainable design is also necessary. The difficulty with a deontological approach is that it may be hard to apply in a way that leads to a clear conclusion. Therefore, this as well may not be sufficient, since the outcomes of a good process may cover a wide spectrum, of which some outcomes may be less than what is considered good. So it seems an impossible dilemma as to which ethical theory to abide by in the realization of an ethic of design; a utilitarian approach disregards the means used to arrive at the end; a deontological approach is primarily concerned with the means often at the expense of a clear achievable goal.

COMPARISON OF ATTITUDES BASED IN PRUDENCE FOR A CLARIFICATION OF PRECAUTION

In many technological innovations, the complexity of the societal and biospheric effects is immense and defies all calculation (Jonas, 1985). Uncertainty becomes a weakness when it has to serve as a predictor by which to take action. As Hans Jonas has stated, the ethics that is needed in this technological age is an ethics of the future; the future must become the major object of our concern and this concern must start from a philosophical perspective. Jonas claims that the greatest moral duty in the technological age is that humankind cannot put its survival at risk for the sole purpose of the continued growth of technological progress. The nature of this responsibility lies in fear; humans have the capacity to destroy the existence of life, and are conscious of this capacity (Ewald, 1996). This consciousness is embedded in distress because of the complexity of this situation; it is unprecedented. To add to this distress, man is faced with the need to find moral rules to limit his powers - an ethic of responsibility (Ewald, 1996; Jonas, 1985).

According to Ewald (1996), the attitude of prudence defines the actions of humans when confronted with uncertainty. Historically there have been three concepts based in uncertainty: foresight[7], prevention, and precaution. Foresight is a liability plan that is based in fault. Prevention is a solidarity plan based on known risks. Precaution is a safety process based in the notion of potential risks. The current global situation has resulted in a profound transformation and reformulation of the problematic of responsibility (Ewald, 1996).

Foresight was based in an ethics of virtue; linked to chance or fate. Foresight encouraged the integration of the future with the present on an individual level. Prevention, on the other hand is a rational behavior that science could objectify and quantify, in the face of a risk. Foresight was not aware of any existing risks; prevention developed from a certainty of risk through scientific analysis. Prevention speaks the language of science; it is the concern of scientific experts. Precaution, as it is emerging currently, deals with another type of uncertainty; it is the uncertainty of science itself (Ewald, 1996). Precaution deals with the more global idea of human and environmental safety in contrast to prevention which deals with known risks which are measurable.

Therefore, precaution refers to conditions that have not been used in the idea of foresight, nor by prevention (Ewald, 1996). Precaution is not based in an individual ontology as is prudence. The potential dangers that it deals with are collective; not only regional, but international. Precaution does not either participate in the realm of prevention because the threats that are dealt with by precaution cannot be proven or quantified. According to Ewald (1996), societies are threatened with risks that can be of a catastrophic nature; introduced in an act that itself tries to reduce such risks (science based activities). The act of precaution starts when a decision must be made in the context of scientific uncertainty; not in a context of certainty, but in a context of doubt, suspicion, defiance, concern, fear, mistrust. Precaution is therefore caught in a kind of suspension and shift between the requirements of action and the certainty of knowledge (Ewald, 1996). Table 4 illustrates the differences among foresight, precaution and prevention, all based within the attitude of prudence.
(SEE TABLE 4, p.114)

When seeking to move toward sustainable development, what tools and/or framework can be used to assist decision makers make just and fair decisions that consider the common good for present as well as future generations? A preventive approach to situations of uncertainty can be dealt with using tools like LCA. What tool or framework is available for dealing with a precautionary approach to situations? Responding to these questions requires further research and debate, and areis therefore outside the scope of this paper.

CONCLUSION

Sustainable development concerns have expanded from considering environmental issues alone, to considering social concerns and in particular concerns for the future of humanity. Although there is much value in the earlier approaches for addressing environmental issues, current discourses are challenging traditional thinking with respect to design, production and consumption practice and seeking solutions at the source; where fundamental changes in human behavior have to occur, if lasting effects to the environmental crisis are to happen (Madge, 1997).

The participatory democratic approach, an ethical approach to decision making, favors a conceptual openness and allows the emer-

gence of various points of view and logic (Droz & & Lavigne, 2006; Fuji Johnson, 2006). Some crucial questions for this approach are: Through which debates (actors and/or issues) can the plurality of this knowledge be revealed? How can this process be defined so that it is effective in including the divergent visions of the world? When taking into account the various actors and the plurality of their knowledge, complexity arises from the decision making process since a practical decision must be made that will result in some action. With an ethic that takes into account the opinions of each seriously; considering which/whose ethic will be used/sacrificed in the process requires methods to go from a diversity of opinions to a practical concrete decision (Droz & & Lavigne, 2006).

The critical issues with the precautionary principle are: (1) it's diverging interpretations result in confusion with regards to its implementation; (2) the limitations that science based analysis imposes on decision making; renders it difficult to arrive at a just decision; (3) the inability to arrive at a decision because of a lack of ethical knowledge; and (4) the antagonisms, contradictions, and uncertainties that exist between intent, action/decision, and outcome of action. The precautionary principle is intended to help make decisions in cases of uncertainty of harm, yet there is no guideline available in which to base such a decision.

Uncertainty of harm is at the core of the precautionary principle. Defining an action in such situations is an imperative, because of the inherent potential risk. Status quo cannot do; an alternative course of action is needed. However, a lack of scientific data renders the decision making process problematic. This is because experts cannot agree on the long-term consequences of new technologies. So the community has the right to be engaged within a process of searching for new solutions. This implies aAlternative means of decision making are required, since it is not evident what action to take based on scientific data alone. Ethics allows for a decision making framework that can contribute to a fair and just course of action. The question is: What is the ethical framework of the precautionary principle so that decisions made in situations of uncertainty of harm will consider the common good? A sense of responsibility towards others (current and future) is at the core of this framework. Even with this basic value, it is not evident what the best course of action is, since what may seem a responsible action to someone, may be considered irresponsible to someone else. How may a decision then be taken if it is to be based on a common good for both inter and intra generations? A collective discourse process that seeks consensus on sustainability issues is one ethical approach. In such a collective forum, the various stakeholders reveal their ethos and seek to comprehend the ethos of other stakeholders within the discourse. It is this sense of comprehension that may allow a decision to be made that will ultimately be based on a common good. This principle cuts across all issues of sustainable development since all decisions have, to some degree, an uncertain outcome.

Stakeholders should be able to rely on a general conceptual framework that would allow them to realize projects, define procedures for participation, and to respond to crucial issues of sustainable development. This will result in a common philosophy, as well as a dialog among stakeholders. This basis of collaboration and exchange among partners will encourage an emergence of co-creation processes of projects and co-formulation processes for solutions and projects. These processes are based on dialogue and will encourage a larger mutual comprehension of new perspectives and an increased level of responsibility among actors (De Coninck, 2005; Boatright, 2006).

To obtain objectives within a sustainable development paradigm, it becomes essential not only to establish a new dynamic among stakeholders, but also to establish a relation where it is possible to comprehend, consider, and debate, before any decisions are reached. It is therefore necessary to set up structures and processes that will allow such stakeholders a venue where a particular referential paradigm will be used as a basis for their discussions; their individual value systems (De Coninck, 2005).

The lack of an existing decisional framework in a context of uncertainty of harm, and the lack of an ethical knowledge base for developing sustainable solutions imply that there is a gap in decision making processes for designers and innovators. A discursive method is recommended to allow a decision process that will include the ethics of all the stakeholders involved. Although an expert ethic could in essence make a decision in a precautionary situation, he/she will only provide one perspective of the global vision necessary to make

a fair and just decision. Every stakeholder in a situation of uncertainty has an ethical foundation that contributes to the global vision and complexity of the situation. Without this collective approach, the complexity of the situation may be compromised.

This is why, a requirement beyond the optimization of mechanisms for dialogue and intersectoral approaches for the conception of products and services are necessary for sustainable and social development of communities. It is recommended that an ethical framework is established, that is based on the fundamental values of a society, and not only based on the respect of norms and practises; therefore to substitute a deontology with an axiology as a framework for the decision making process.

What this entails is not only addressing these issues from a perspective of searching for efficient solutions based on problem optimization approaches, but also implies dealing with such issues based on an attitude of sufficiency (Princen. 2005). This requires a shift in perspective of the problems that face humanity; by focusing on a transformation of human behaviour and their modes of consumption, then design can respond with innovative ways that will not only improve harmony with the environment and societies, but also responds to an improved quality of life for all.

Without a perspective of reducing the impacts as a result of human behavior and consumption habits in contrast to assessing impacts based solely on the production of goods and services, a fundamental perspective of possible alternatives may be ignored. Therefore a focus on improving human consumption patterns in an effort to reduce environmental and social aspects will encourage innovation at the source of the problem; changes in human behavior can provide global, long-term improvements to current social and environmental problems. Such an understanding can be based on the system of fundamental human needs. In seeking innovative solutions through this perspective, then very long term and global solutions can be found.

Therefore a precautionary approach supports innovation; in contrast to its detractors, which perceive this principle as a spoke in the wheels of innovation. And so it responds to the purpose of design and in particular contributes to the development of the well-being of individuals and society. Design can achieve this through a recommendation of new concepts and experiences that will ultimately change the world in a recursive way. However, tools or frameworks must be available for designers in this endeavour. This work cannot be done in isolation, since a comprehension of the various value systems based on the plural visions of the common-good will be necessary. Therefore current approaches to decision making when seeking to reduce environmental and social impacts remain insufficient on their own; current methods for decision making are predominantly preventive. This implies that they are based on quantifiable data, and when fundamental uncertainties exist, probabilistic methods are used; there is no consideration of values in this approach

Without the values of moderation and prudence, infinite sustainability is not possible. This requires a type of development that places an accent on projects that seek to improve the quality of life for current and future generations; where the effects are reversible. Flexibility, diversity, and adaptability are key elements of this type of development; a system that is adjustable and correctable is necessary when failure occurs. This is why, a requirement beyond the optimization of mechanisms for dialogue and intersectoral approaches for the conception of products and services are necessary for sustainable and social development of communities. It is recommended that an ethical framework is established, that is based on the fundamental values of a society, and not only based on the respect of norms and practises; therefore to substitute a deontology with an axiology as a framework for the decision making process.

Further research is required to understand the type of participative process necessary for such deliberation with the intent of reaching consensus. What can guide stakeholders in this process of deliberation? A consideration of the impacts of human consumption patterns seems pertinent in this reflection. Public participation using a precautionary approach for design within a context of sustainability therefore addresses issues and concerns on a human scale and not only on a product or service system scale. Solutions will reflect the global consideration of the current crisis; and therefore new conceptions of lifestyles will be considered as alternate solutions.

NOTES

[1] Also known as the Brundtland Report referring to the chairman of this commission Gro Harlem Brundtland.

[2] Kuhn (1970, p. 23) states that "…a paradigm is an accepted model or pattern". Paradigms can be defined by the predominant vision of human thought within a particular scope. Paradigms help to define the boundaries within this realm of thought. It can be thought of as a model of thought, based on a collective awareness. "Normal-scientific research is directed to the articulation of those phenomena and theories that the paradigm already supplies." (Kuhn, 1970, p.24). "Anomaly only appears against the background provided by the paradigm." (Kuhn, 1970, p65). Kuhn also states that (1970, p.48) "The pre-paradigm period, in particular, is regularly marked by frequent and deep debates over legitimate methods, problems, and standards of solution". "The successive transition from one paradigm to another via revolution is the usual developmental pattern of mature science." (Kuhn, 1970, p.12). A transition from one paradigm to a new one is not a cumulative process, but rather a process of reconstruction from a fundamentally new basis of knowledge. This transition often results in new methods, applications, and/or rules. During the transition from one paradigm to another, there will always be some overlap with the problems to solve, but there will be a definitive difference in the way solutions are found.

[3] The term was first coined in 1992 by Canadian ecologist and professor at the University of British Columbia, William Rees. It is used around the globe as an indicator of for evaluating environmental sustainability and is a way of determining relative consumption for the purpose of sensitizing people about their resource use.

[4] The carrying capacity of the Earth, based on the ecological footprint is (World Wildlife Fund for Nature 2002, from Schaefer, Crane, 2005): an average person worldwide is 2.28 hectares; the average U.S. American needing 9.7 hectares; the average UK citizen 5.35 hectares, and; the average person in Mozambique 0.47 hectares.

[5] For example: 80% of the world resources are consumed by 20% of the world population; the other 80% of the population want to achieve the same standard of living as the 20%; this is unattainable.

[6] This principle was defined as "In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation." (World Commission on Environment and Development, 1987, p.43).

[7] Ewald (1996) uses the French word 'prévoyance' in describing one of the three prudent attitudes related to uncertainty. We have used the word foresight as the translation for the word 'prévoyance', which in this context, is defined as 'providence by virtue of planning prudently for the future' (Fellbaum, 1998).

BIBLIOGRAPHY

Adams, B.arbara, 2004, «Minding Futures: An exploration of responsibility for long-term future», *ESRC PF Paper*.

Arendt, H., 1958, *The Human Condition*, The University of Chicago Press.

Boatright, J.ohn, 2006, «Quel Avenir Pour La Gestion Des Parties Prenantes?», *Les Ateliers de L'Éthique*, vVolume 1, nNumberéro 1, sSpring 2006, pp.42-57.

Brennan, A.ndrew, & Lo, Y.euk-S.ze, 2002, *Environmental Ethics*, The Stanford Encyclopedia of Philosophy (summer 2002 Edition), Edward N. Zalta (ed.), URL=<http://plato.stanford.edu/archives/sum2002/entries/ethics-environmental/>.

Consoli F., Allen D., Boustead I., Fava J., Franklin W., Jensen A.A., de Oude N., Parrish R., Perriman R., Postlethwaite D., Quay B., Séguin J., & Vigon B. (eds.), (1993), *Guidelines for Life-cycle assessment: A "Code of practice"*, Society of Environmental Toxicology and Chemistry (SETAC), SETAC Workshop, Sesimbra, Portugal, 31 March - 3 April 1993.

Cudd, A.nn, 2003, *Contractarianism*, The Stanford Encyclopedia of Philosophy (spring 2003 Edition), Edward N. Zalta (ed.), URL=<http://plato.stanford.edu/archives/spr2003/entries/contractarianism/>.

De Coninck, P.ierre, 1996, «De la disciplinarité à la transdisciplinarité: À la recherche d'une panacée ou d'une attitude?», *Info-stoper*, volume 4, number 1, University of Sherbrooke, Sherbrooke, pp.1-7.

De Coninck, P.ierre, 1997, « L'implication des citoyens ordinaires dans le processus d'aide a la décision en santé publique», *Ruptures,* vVolume 4, nNumber .2, Universitéy of de Montréeal,, Montréeal, pp. 152-162

De Coninck, P.ierre, 2000, «Vers un cadre de planification participative – l'exemple de la conférence de consensus informé», Fiévet, C. *Invention et réinvention de la citoyenneté* – Actes du colloque international de PAU, Université de PAU et Pays de l'Adour, Éditions Joëlle Samnpy, Pau, pp. 471-480.

De Coninck, P.ierre, 2005, «De la conception écologique à une écologie de la conception: un nouvel univers de pertinence et un cadre conceptuel général de la conception», Stinckwich, S. (Dir.) *Réflexivité et autoréférence dans les systèmes complexes* - 12èmes Journées de Rochebrune, January 24 -28, pp.65-76.

DeFur, P.eter & L., Kaszuba, M.ichelle, 2002, «Implementing the Precautionary Principle», *The Science of the Total Environment*, 288, pp. 155-165.

Droz, Y.van & & Lavigne, J.ean-C.laude, 2006, *Éthique et Développement Durable*, Editions Karthala et Institut universitaire d' études du développement (IUED), Paris, Switzerland.

Ewald, F.rançois, 1996, «Philosophie de la Précaution», *L'année sociologique*, 46 no.2, pp 383 – 412.

Fuji Johnson, G.enevieve, 2006, «Deliberative Democracy and Precautionary Public Reasoning : Exploratory Thoughts», *Les Ateliers de L'Éthique*, vVolume 1, nNumberéro 1, sSpring 2006, pp. 81-87.

Godard, O.liver, 2005, «The Precautionary Principle, Between Social Norms and Economic Constructs»,, *EDF - Ecole Polytechnique*, Cahier no 2005-019, Laboratoire d'Econométrie de l'Ecole Polytechnique, Paris.

Harremoes, P., Gee, D., MacGarvin, M., Stirling, A., Keys, J., Wynne, B., & Guedes Vaz, S., (eds.), 2001, *Late Lessons from Early Warnings: the precautionary principle 1896-2000*, European Environment Agency, Environmental issue report, numberNo. 22.

Harremoes. P., 2003, «Ethical Aspects of Scientific Incertitude in Environmental Analysis and Decision Making»,, *Journal of Cleaner Production*, 11, pp. 705-712.

Heiskanen, E.va and& Mika P.antzar, 1997, «Toward Sustainable Consumption: Two New Perspectives», *Journal of Consumer Policy*, 20, pp. :409-442, Kluwer Academic Publishers.

Hertwich, E.G., 2005, «Consumption and Industrial Ecology», *Journal of Industrial Ecology*, volume 9, nNumber 1-2, Massachusetts Institute of Technology and Yale University.

Jackson, T.im, 2004, «Consuming Paradise? Unsustainable consumption in cultural and social-psychological context», in Hubacek, K, A. Inaba and S. Stagl 2004. *Driving Forces of and Barriers to Sustainable Consumption*, Proceedings of an International Workshop, Leeds, 5th-6th, March, 9-26.

Jackson, T.im, 2005, «Live Better by Consuming Less? Is There a "Double Dividend" in Sustainable Consumption?», *Journal of Industrial Ecology*, Massachusetts Institute of Technology and Yale University, vVolume 9, nNumber 1-2, pp. 19-36.

Jonas, H.ans, 1985, *The Imperative of Responsibility: In Search of an Ethics for the Technological Age*, translated by Hans Jonas with the collaboration of David Herr, University of Chicago Press, Chicago.

Ladriere, J.ean, 1997, *L'éthique dans l'univers de la rationalité*, Catalyses, Artel – Fides.

Lascoumes, P.ierre, 1996, «La précaution comme anticipation des risques résiduels et hybridation de la responsabilité», *L'année sociologique*, volume 46, numbero. 2, pp. 359 – 382.

Madge, P., 1997, «Ecological design: A new critique», *Design issues*, volume Vol.13, number °2, pp. 44-54.

Marchand, A., Walker, S., De Coninck, P., 2004, *Buying Time: Defining the Characteristics of Sustainable Consumption, Creating a Culture of Sustainability,*

Highlands & Islands International Sustainable Development Conference and Exhibition: Conference Proceedings, November 3-5, Inverness, Scotland. (Accepted).
Marchand, A., De Coninck, & P.,Walker, S., 2005, «La consommation responsable: Perspectives nouvelles dans les domaines de la conception de produits», Séguin, M., De Coninck, P., Tremblay, F, (dir), Enjeux environnementaux contemporains : les défis de l'écocitoyenneté, *NPS*, volume 18, number 1., pp. 39-56.
Meadows, D.H., Meadows, D.l., & Randers, J., 1972, Behrens III, W.W., *The Limits To Growth*, New York: University Books.
Parry, R.ichard, 2004, *Ancient Ethical Theory*, The Stanford Encyclopedia of Philosophy (fall 2004 Edition), Edward N. Zalta (ed.), URL=<http://plato.stanford.edu/archives/fall2004/entries/ethics-ancient/>.
Princen, T., 2005, *The Logic of Sufficiency*, MIT Press: Cambridge.
Raeburn, J. and& I. Rootman I., 1997, *People-Centered Health Promotion*, John Wiley and Sons, England.
Resnik, D.avid, B., 2003, «Is the Precautionary Principle Unscientific?», *Studies in History and Philosophy of Biological and Biomedical Sciences*, 34, pp. 329-344, Elsevier Science Ltd.
Russ, J.acqueline, 1995, *Que sais-je? - La Pensee Ethique Contemporaine*, Presses Universitaires de France, Paris, France.
Schaefer, A.nja and& Crane, A.ndrew, 2005, «Addressing Sustainability and Consumption», *Journal of Macromarketing,* Volvolume. 25, No.number 1, June 2005, pp. 76-92, Sage Publications.
Sclove, R.ichard E., 1995, *Democracy and Technology*, The Guilford Press, New York.
Sinnot-Armstrong, W.alter, 2006, *Consequentialism*, The Stanford Encyclopedia of Philosophy (spring 2006 Edition), Edward N. Zalta (ed.), URL=<http://plato.stanford.edu/archives/spr2006/entries/consequentialism/>.
Stern, N., (2007), *The Economics of Climate Change: The Stern Review*, Cambridge University Press, United Kingdom.
Tallacchini, M.ariachiara, 2005, «Beyond and Before the Precautionary Principle: Epistemology of Uncertainty in Science and Law», *Toxicology and Applied Pharmacology*, 207, pp. S645-S651, Elsevier Inc.
Tickner, J. and& Geiser, K., 2004, «The precautionary principle stimulus for solutions- and alternative-based environmental policy», *Environmental Impact Assessment Review*, Elsevier Inc.
Tickner, J., and& Raffensperger, C., 2002, *The Precautionary Principle in Action: A Handbook*, First Edition, Science and Environmental Health Network.
Thøgersen, J.ohn, 2005, «*How may consumer policy empower consumers for sustainable lifestyles?*», *Journal of Consumer Policy*, 28, pp. 143-178.
United Nations Conference on Environment and Development (UNCED). 1992, *Rio Declaration on Environment and Development*.
UNESCO, URL=<www.unesco.org/education/educprog/lwf/doc/portfolio/definitions.htm>, accessed February 2006.
Vigneron, J., Patingre, J-F., & Schiesser, P., 2003, *Eco-concevoir Appliquer et Communiquer : nouvelles approches et examples d'application*, Economica, Paris.
Whiteley, Nigel, 1995, *Design for Society*, Reaktion Books, London.
Whiteside, K.erry H., 2006, *Principle and Practice in Confronting Environmental Risk – Precautionary Politics*, The MIT Press, Cambridge, Massachusetts.
Fellbaum, C.hristiane, 1998, Wordnet: An Electronic Lexical Database, URL=<http://wordnet.princeton.edu/>, Bradford Books.
World Commission on Environment and Development, 1987, *Our Common Future*, Oxford University Press, Oxford, England.

This part belongs here because it highlights the various issues related to the notion of precaution when compared to the traditional dominant paradigm of prevention. It can be considered as a summing up of the various ideas that have emerged in the discussion.

TABLE 1 : A COMPARISON OF PROGRESS AND SUSTAINABLE DEVELOPMENT PARADIGMS, (BASED ON HERTWICH, 2005; HEISKANEN & PANTZAR, 1997; JACKSON, 2004, 2005; MARCHAND, DE CONINCK, & WALKER, 2005; SCHAEFFER & CRANE, 2005).

	PROGRESS PARADIGM	SUSTAINABLE PARADIGM
ENVIRONMENT	Resources used for production of goods and services, at best, the idea of conservation	Resources are to be preserved or re-newed
TECHNOLOGY	Progress of innovation is an imperative; efficiency of resource use and production methods	Innovation based on an ethics of responsibility, beyond the idea of efficiency
ECONOMIC	Success is solely based on the continued economic growth – commodification of all needs	Idea of success spans the health of society, the renewal of primary resources and the growth of the economy (equally) – solutions for all needs based on elimination of resource use
SOCIAL	Attempt to deal with social issues as long as economy is not adversely affected	Social issues are a significant concern – equal concerns as economy and environment
GLOBAL VISION	Multi-national economic growth for affluent societies and support poorer societies through donations	Providing well-being for all societies across generations by encouraging all societies to prosper
CULTURE	Culture of obsolescence, high consumption, following the 'American Dream	Culture of sufficiency and of simplicity.
INDIVIDUAL	Individualist mindset; uninformed consumer	Works with community to contribute to social change; informed responsible citizen
NEEDS	Satisfied primarily by goods and services from the market economy	Finds alternative means to satisfy needs (if available not from the use of primary resources)

© Cucuzzella 2006

TABLE 2 : A COMPARISON BETWEEN A RISK ANALYSIS AND A SOCIAL HEURISTIC IMPLEMENTATION OF THE PRECAUTIONARY PRINCIPLE, (BASED ON GODARD, 2005, PP. 2-30).

RISK ANALYSIS APPROACH	HEURISTIC SOCIAL APPROACH
Analytical/rational	Strategic
Specific to context	General social norms adopted (may be specific in some cases)
Depends on the individual utility functions for specific agents	Common framework of action for collective welfare
Contributes to the establishment of further scientific developments	Used as a protection against limits from traditional scientific methods – encourages innovation
Is a provisional means of managing the wait by scientific progress	Is focused on early prevention because of the threats of irreversible losses
Precautionary action necessitates future improvement of information; prevention in the short term based on stronger preventive action in cases of more uncertain prospects.	Precautionary action may or must be taken in spite of existing uncertainty about the existence of a danger; does not necessitate future improvement of information.
Irreversibility effect is an amplifying facto	Irreversibility effect is a major trigger
Defined by individual expert decision maker in a statistical framework	Aims at public collective decisions regarding collective risks
Based on distinction between risks	Based on opposition of potential dangers

© Cucuzzella 2006

TABLE 2 : ETHICAL THEORIES: VARIOUS WAYS TO HELP DEFINE A GOOD ACTION, (BASED ON BRENNAN & LO, 2002; CUDD, 2003; FEISER, 2006; JONAS, 1985; LADRIERE, 1997; PARRY, 2004; RUSS, 1995; SINNOT-ARMSTRONG, 2006).

	DEONTOLOGICAL	UTILITARIAN	VIRTUE	CONTRACTARIANISM
HOW TO DEFINE WHAT IS GOOD AND JUST?	Set of universal laws imposed on individuals.	Action must result in the greatest good (benefit the majority of individuals).	Individual will use the particular situation to decide what is good.	Enforced moral code used to make a good decision. If individual wants to benefit from society then must enter social contract.
LIMITS TO THEORY	Consequences of actions are often unknown; therefore the action may result in a consequence that is not good.	Consequences of actions are often unknown; therefore it is not known if the decision will result in the greatest good.	Every moral dilemma must be re-evaluated for every situation; and consequences of decisions are often unknown.	When decisions are made outside the moral code, then decision is considered bad by society, even if it may not be.
BENEFITS OF THEORY	The action or decision taken will be universally good; since consequences are often uncertain, the action is the only certainty of being good.	When the consequences are near certain, then this decision will benefit a greater number of people.	Allows individuals to grow through the personal experience of resolving moral dilemmas.	Facilitates social living when making decisions within moral code.
BASIC ASSUMPTIONS OF THEORY	Reciprocity; individuals are humane; individuals have a sense of duty to others and self	greatest good;	individual growth; individuals seek excellence, are prudent, and have practical knowledge	individuals are self-interested; similar to liberalism

© Cucuzzella 2006

TABLE 4 : A COMPARISON OF FORESIGHT, PRECAUTION AND PREVENTION WITH RESPECT TO THE 4 POLES OF KNOWLEDGE (BASED ON ADAM, 2004; EWALD, 1996; JONAS, 1985

	FORESIGHT (prévoyance)	PREVENTION	PREVENTION
ONTOLOGICAL	Individual concern	Collective (expert) concern	Collective (stakeholders) concern
What is the form of the perceived world?	Based in ethics of virtue, integrates the future with present actions	Based on quantifiable, objective data, (deterministic)	Based in ethics of responsibility of the future and on the uncertainty of science (non-deterministic)
(what)	Based on the randomness of future events that have local and finite consequences	Known risks having harmful consequences vary in time and space	Potential risks may have global and infinite harmful consequences
EPISTEMOLOGICAL	Consideration for the reversibility of action	Reversibility of action is not a consideration	Consideration for the reversibility of action
What is the relation between the person that is constructing the knowledge and the perceived world?	Cautionary, decision based on an imaginable fate	Objective, rational, measurable decision	Anticipative, subjective decision
(values)		Based on single truth	Based on multiple visions of the truth
	Virtuous attitude (Axiological)	Prescriptive attitude (Deontological)	Heuristic attitude (Axiological)
	Based on randomness of events in the future	Based on a cause-effect chain of events (deterministic)	Based on a complex vision of the world
	Valorization of future needs for individual	Valorization of needs for current generations	Valorization of needs for future generations
METHODOLOGICAL	Normative (deontological) approach	Normative (deontological) approach	Adaptive as well as normative (deontological) approach
What methods are used to obtain the knowledge?	Need based approach	Problem based approach	Solution (result) based approach
(operational)	Projection tool	Tactic tool	Strategic tool
		Reactive	Proactive
	Future necessity is defined by individual condition	Risk defined by experts collectively	Levels of acceptability defined by stakeholders collectively
	Decision made in situations without potential or known risks	Decisions made in situations of known risks	Decision made in situation of potential risks
TELEOLOGICAL	No real requirement of action; probability of random future events initiates course of action	Requirement of action based on known danger	Requirement of action based on potential danger
What is the intention of the researcher?	Private decision	Expert decision	Public decision
(PURPOSE)	Liability plan(providing a better future for individual)	Solidarity plan(reduce or avoid consequences of known risks)	Safety process(reduce or avoid potential harm from uncertain situations)
	Individual plan for an inevitable imagined fate	Collective is involved in the implementation of preventive measures	Collective is involved in the definition of the levels of acceptability to be used as markers to help reveal potential problems

© Cucuzzella 2006