

The Implementation of New Technology: Ethical Principles and Ethical Reasoning Elements

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ABSTRACT

We explored valuable ethical issues on the New Technology Implementation (NTI). A successful approach to assess and manage health-related issues associated with the installation of new technology (specially those related to chemical process industries) requires the integration of risk assessment, risk management, and risk communication procedures on an overall process to address the specific concerns. Although the literature about risk assessment, risk management and risk communication is increasing, relatively little has been done in attempting to address either their ethical aspects or implications. To facilitate new ways of thinking, New Technology Implementation and its integration with risk communication based on ethical principles is necessary. Established utilitarian, deontological and informed consent principles are shown to be applicable to the integration of NTI and risk communication strategies. The feedback control about risk communication strategy is crucial to obtain an adequate integration. Further expanded research effort to give adequate insight into the social process of these ideas is necessary.

SINOPSIS

En este artículo se presenta un estudio de los aspectos éticos durante la Implementación de una Nueva Tecnología (INT). Una aproximación exitosa para evaluar y manejar los aspectos relacionados con el cuidado de la salud asociados a la instalación de una nueva tecnología (especialmente aquellos relacionados a las industrias de procesos químicos) requiere la integración de la evaluación de riesgo, el manejo de riesgo y los procedimientos de la comunicación de riesgo dentro de un proceso global enfocado a situaciones específicas. A pesar de que la literatura sobre la evaluación de riesgo, manejo y comunicación de riesgo está en aumento, se ha hecho relativamente poco concerniente a los aspectos éticos y sus implicaciones. Para facilitar nuevas formas de pensamiento, es necesaria la

Implementación de la Nueva Tecnología y su integración con la comunicación de riesgo basado en principios éticos. Los principios filosóficos establecidos por el utilitarismo, los principios deontológicos y el consentimiento bien informado se pueden aplicar en la elaboración de estrategias para integrar la Implementación de una Nueva Tecnología y la comunicación de riesgo. La retroalimentación en estos aspectos es fundamental para obtener una integración adecuada. Esfuerzos posteriores son necesarios para lograr un discernimiento adecuado en el proceso social de estas ideas.

I- INTRODUCTION

There are certain trends in the contemporary society that are generally accepted as facts. One of them states that our society is made up of institutions. Among the most important institutions are the family, the government and the establishment of the religion, education and economics. Technology affects all of these components. Technology is defined as the knowledge used to change various resources into many goods and services used by society [19]. In this manner the NTI affects every part of our lives because of its influence on our social structure, political system and economic development

All the consequences of the New Technology Implementation have an effect on the environment in which we live. If we do not improve our understanding of these interactions through a good structured plan of risk communication of all impacts to maintain the delicate balance in this ecological arena, a technological disaster could occur. Because NTI affects us at every level, every step of a risk communication strategy based on ethical principles is essential.

This paper seeks to identify the ethical reasoning elements (ERE) implicated in the risk communication strategies so as to be successful in establishing a new technology. This will benefit both the community and the agency and it will help determine the appropriate policies for risk reduction. The goal, then, is to integrate the

management of NTI with the risk communication strategies; both based on ethical elements of reasoning.

II- THE IMPLEMENTATION OF NEW TECHNOLOGY MANAGEMENT IN ETHICAL PRINCIPLES

Extracting from the major ethical theories in philosophy, the management of NTI (specially concerning to chemical process industry) may be analyzed within the following three ethical paradigms:

A- UTILITARIANISM

The utilitarianism is the most studied teleological theory, which holds that an action or practice is right (when compared to any alternative action or practice) if it leads to the greatest possible balance of good consequences or to the least possible balance of bad consequences in the world as a whole [2, 12, 16]. The major theoretical exponent of utilitarianism is Stuart Mill (1806-1873). The teleological theories hold that the moral worth of actions or practices is determined by the consequences of the actions or practices. In taking this perspective, the purpose of the NTI will be to promote human welfare by minimizing harms and pollution and maximizing benefits to both the utility and the community. Whatever promises the most benefits for all parties involved, is also the most desirable arrangement for the proposed establishment of the new technology.

B- DEONTOLOGY

Deontologic theories (derived from the Greek "duty") maintain that the concept of duty is in some respect independent of the concept of good, and that some actions are right or wrong for reasons other than their consequences [3, 6, 12, 16]. Immanuel Kant (1724-1804) is the most famous of the ethicists that emphasized duties as more important than the goal of producing good consequences. In Kant's view to make a moral judgement is to categorically prescribe or command actions which can be willed universally. According to these theories based on honesty and moral imperatives (accepted norms of decent behavior, civil rights and moral autonomy), arrangements in the NTI will be acceptable only if they meet these standards with honesty and to protect human life, regardless of actual outcomes.

An important difference between utilitarians and deontologists arises from the characteristic

means/end reasoning used by utilitarians. Utilitarians focus on goals and on the most efficient means to achieve goals that maximize value. Deontologists, however, think it is a mistake to conceptualize the moral life in such terms.

C- INFORMED CONSENT

Viewing engineering as an experiment on a societal scale, informed consent places the focus where it should be: on the human beings affected by the implementation of new technology. Informed consent involves two main elements: knowledge and voluntariness. First, subjects should be given not only the information they request, but also all the information needed for making a reasonable decision. Second, community must give its consent without being subjected to force, fraud, or manipulation [2, 6, 11, 12, 15, 17]. Because the NTI as a "social experimentation" is performed on persons and not on inanimate objects, we believe that informed consent is vital for making decisions about the NTI; at the same time all arrangements about the NTI are ethically acceptable if all parties, explicitly or implicitly involved, give prior consent to them. Usually, when the public is well informed, the NTI responsible person has to look for an agreement regarding the shared risk and benefits of trying out the technological implementation.

The application of each principle implies different procedures and methods. If a utilitarian perspective is accepted, options for arranging the NTI would be evaluated according to their cost/benefit ratio, and the measures to increase safety or environmental quality would be evaluated according to their cost-effectiveness. A criticism worth noting is that the utilitarian risk approach does not include in its computations the risks for future generations.

In contrast, the deontological principle would oblige the parties to meet special ethical criteria; for example to reduce the risk to some acceptable level or to implement the best available pollution control technology. The obligation to achieve equivalent safety and environmental protection levels (equal ends through possibly different means) in the community and the new industrial Technology Company will be a typical criterion based on deontological reasoning.

Finally, informed consent principles focus on the procedures for reaching an agreement. All parties involved should be given the opportunity to review the present knowledge of potential impacts of the new technology and then to select implicitly

or, even better, explicitly, select an arrangement that they all regard as beneficial.

III- RISK COMMUNICATION-THE ETHICAL REASONING ELEMENTS (ERE).

Risk Communication strategies have been discussed in the literature [4, 5, 8, 9, 10, 13, 15, 18], including some ethical concerns [13], but particularly there is no information about how to inform the population exposed to environmental impacts in NTI under ethical guidelines, and to justify an acceptable level of exposure is not an easy task. To establish a risk communication plan we must consider the risk assessment procedure that is based on studies that demonstrate a fairly consistent toxicity relationship [1]. Even in this situation, the risk assessment is limited to determine the potential risk of an environmental contaminant and not to prevent the disaster, for example in the implementation of new technology.

The ethical reasoning is based on premises and justifications that are the objects of a rational exam. Ethics is placed, for excellence, on the domain of dilemma and decision [7]. A moral problem is usually presented under a plurality of forms of possible actions. Its resolution consists in choosing a given attitude and in the adoption of certain conduct guidelines; ethics is perceived in this way as a coherent and logical concern. The ethical reasoning searches to clarify the rational mechanisms to take the moral decisions on risk communication concerning NTI.

Figure 1 illustrates a model of ethical reasoning analysis that is useful to interpret the moral dilemma in communication.

This model has four ethical reasoning elements (ERE) corresponding to the same number of steps of moral reasoning:

- 1- A definition of the situation.
- 2- A determination of human values to carry on the elements of this situation.
- 3- The identification of principles based on the ethical conducts.
- 4- The establishment of allegiances or loyalties according to these decisions.

The usefulness and theoretical value of the ERE model as an analytical instrument of ethical reasoning on risk communication of NTI is illustrated in Figure 2. This model has a logical integration with respect to the formulation of the risk communication strategy on NTI. At a practical level, it is necessary to keep in mind that the ERE model would be useful not only to evaluate events *a posteriori* but also to appreciate (according to a moral point of view) different possibilities to make decisions that have not yet been accomplished.

Another advantage of the ERE model is that it clarifies the point of view, that ethics in communication -as in other fields- is an alternative concern among at least two different possible decisions. The ERE model distinguishes between fact statements (definition of situation) and values statements (human values and principles), indispensable on the adequate theoretical treatment of all moral questions. Finally, the considerations of sociological order are very important. The allegiances or loyalties involved in an ethical decision may be, in the some manner, related to a social system.

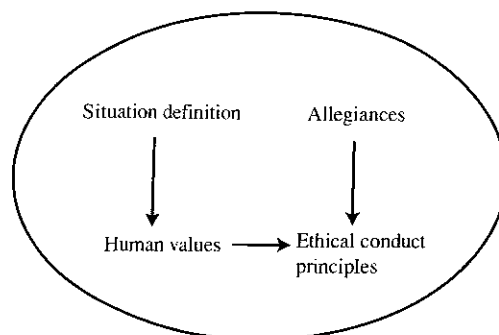


Figure 1: Model of analysis of Ethical Reasoning Elements (ERE), useful to interpret a moral dilemma in risk communication concerning New Technology Implantation (NTI).

Although there are some imprecisions or ambiguities in this model, the concepts of human values and principles, among others, will be characterized more precisely, specially those covering a plurality of concepts (substantial values and contextual valorizations; principles of the theoretical nature and the conduct guidelines dictated for the common sense) that will be advantageous to distinguish and to make a hierarchical classification.

IV- INTEGRATION OF NTI MANAGEMENT AND RISK COMMUNICATION STRATEGY- THE ETHICAL PERSPECTIVE

The risk assessment and risk communication of the New Technology Implementation may be well integrated as Figure 2 shows. Here, the strategic position of ERE that controls the global situations regarding to the decision making is shown. It is very important to take into account the social aspects of ERE. A poorly planning of the risk communication strategies of the NTI will conduct to a lack of objectivity, which can lead to disastrous results. This is because there will be no opportunity for the establishment of new technology when the public decision is opposed.

Another concept that we can use concerning

integration of NTI and Risk Communication is the feedback control. In engineering the word *feedback* implies that something follows an unsuccessful effort [14].

Once the evaluation of the risk communication plan is complete, in order to obtain better results it is important to establish a risk-feedback component, which is based on risk perception and public participation of the community. The risk feedback and the public participation must have a structured process [4, 11]. Whereby the NTI responsible person requests, receives, and evaluates to provide additional citizen input (above and beyond the system input) for inclusion in a risk-management plan in order to solve problems related to the decision making process.

The correct use of feedback is important because it can be misused. If the risk feedback is used conscientiously, it will enhance the communication between an affected community and the person responsible for the NTI [11]. If the risk feedback in communication is evaluated under the premises of the ethical principles described above, the community and the NTI press agencies can reduce the public anxiety concerning environmental impacts of the technology by providing the public with a meaningful role in the decision making process and demonstrating

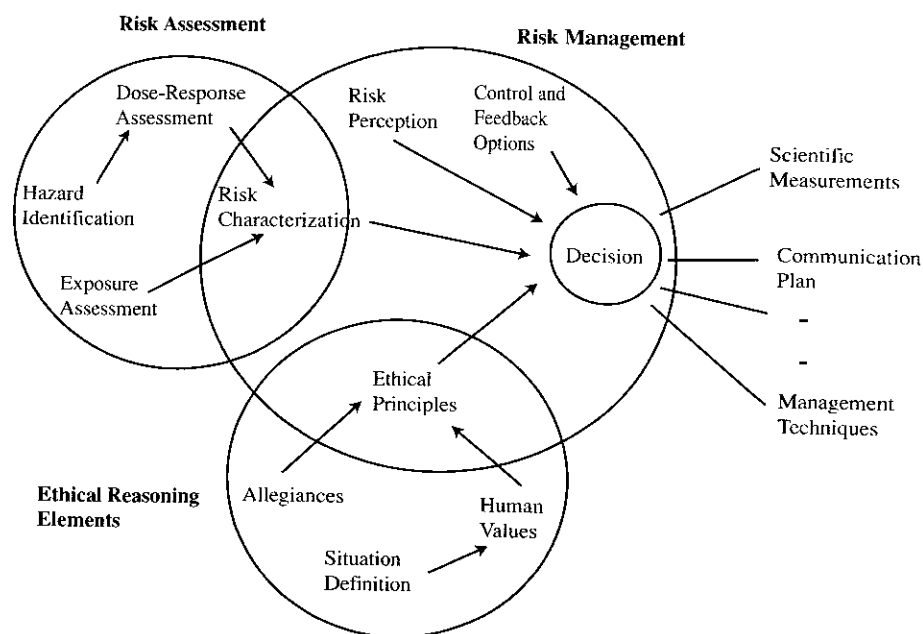


Figure 2: Integration of Ethical Reasoning Elements (ERE) into a risk assessment and management in the formulation of a risk communication plan, concerning the Technology Implantation (NTI).

precisely how public participation input is used. In essence, the use of risk-feedback techniques under the considerations of ERE is a clear demonstration for the respect of the public (according to Kantian theory) as well as an application of the consensual principle. This risk-feedback approach must be established in the deontological principles as a fundamental part of the risk communication process and can implicate changes onto the NTI management and in the risk communication strategies. Figure 3 shows the feedback step and how this affects every step of the risk communication strategies with implicit benefits for all parties in accordance with utilitarian principles.

V- DISCUSSION

Each one of the ethical principles described above has obvious advantages and shortcomings. If applied correctly, the utilitarian approach guarantees the optimal allocation of given resources for obtaining a specific set of objectives, but may not be equitable or may not respect individual rights. The pursuit of deontological criteria prevents or, at least, mitigates unwanted consequences, but may waste valuable monetary or material resources. Informed consent ensures that all parties perceive a subjective benefit from the selected arrangement, but this perception may be based on incomplete or biased information or may be wrongly inferred from indications of implicit approval, such as absence of public organized participation.

Given the imperfections of any one of these three principles, a combination is preferable in order to take advantage of the merits of each one and compensate for their shortcomings.

Irrespective of which ethical model is chosen, decisional autonomy implies the availability of information that is often scanty. Furthermore, population probabilities are difficult to interpret for individual subjects, and the procedures used in risk assessment and management are not easy to explain to the lay public. Beneficence, considered from the societal point of view, may easily be in tension with the individual interest, and the principle of distributive justice is often violated when acceptable levels of risk are established.

Considering ethical models to evaluate consequences of risk assessment and management is crucial. For example, in American society, a utilitarian approach has prevailed for some decades, whereas in Europe a deontologic model has been more popular. The deontologic approach is more concerned about respect for individual choices and informed decisional autonomy, whereas the utilitarian point of view tends to weigh more the societal good. (A particular decision that maximizes overall utility might violate the most fundamental rights of some individuals).

A strict utilitarian view, based on cost-benefit analysis, is unable to accord proper recognition to the value of fairness and to take seriously the "separateness of persons". For utilitarians, persons are receptacles from utility. A worthwhile criticism is that utilitarian philosophy applied to NTI

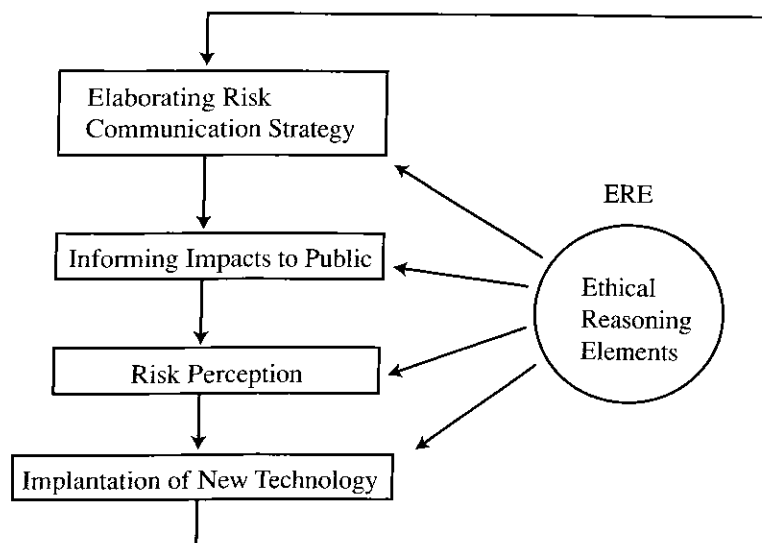


Figure 3: Ethical Reasoning Elements in feedback control, affecting all risk communication strategy, concerning the New Technology Implantation (NTI).

management does not include in its «computations» the risks for future generations.

If adopted, these principles would lead to a perspective that diverges from the current one, as far as risk assessment and management of NTI are concerned. Whereas current risk assessment and management of NTI tend to develop procedures to make defined levels of acceptable risk, a public health perspective would require a focus on what could be done to prevent exposure by informing the public on the basis of ethical principles. This would mean the protection of the public health by controlling the production and, hence, the generation of toxic substances rather than adopting methods for controlling releases.

VI- CONCLUSION

This study provides an opportunity for industries, consultants, administrators and academicians to discuss their perspectives; to review their experience with existing codes of ethical conduct; and to outline a list of principles, guidelines and procedures for responsible and mutually beneficial pathways to sustainable technology development in the community.

We need a greatly expanded research effort to give adequate insight into the social processes as they are related to the implementation of new technology. Such insights will help to evaluate the relative functionality of various factors and to set up machinery to implement a more efficient social interaction of NTI. Both research and an organization for "social engineering" to augment engineers in this arena are imperative if our quality of life must be adequately developed.

For New Technology Implementation it is essential to gain explicit prior consent insofar as this is technically and politically feasible. Informed consent can be accomplished through: accepting the community's standards and regulations; negotiating acceptable "arrangements" with legally responsible community's agencies; providing full information about potential impacts to all chemical components and all other choices left to the citizens should be made on the basis of utilitarian methods, i.e., cost-benefit, cost-effectiveness, and other utility optimization techniques. In addition, constitutional rights, international law and, to a lesser degree, the rule of equivalent safety and environmental quality should be regarded as inviolable values which should not be sacrificed for economic gain.

The guidelines outcome of ERE model will be useful to make a necessary adjustment and complete the risk communication program. The tendency of delaying the communication process

until the next crisis should be avoided. Commitment to an ongoing risk-communication program concerning NTI based on ERE may not have dramatic results at first but, with time, the benefits will be evident.

VII- REFERENCES

- 1- Abernathy Ch. O. and Roberts W.C. (1994) Risk assessment in the Environmental Protection Agency. *Journal of Hazard Materials*. 39:135-142.
- 2- Beauchamp T. L. and Bowie N. E. (1988) *Ethical Theory and Business*. 3rd ed. Prentice-Hal Inc.
- 3- Benjamin S. L. and Belluck D. A. (1990) Risk Feedback: An Important Step in Risk Communication. *Journal AWWA*. Nov. 50-55.
- 4- Covello V. T., von Winterfeldt D., Slovic P. (1986) Communicating Scientific Information about Health and Environmental Risks. Problems and Opportunities from a Social and Behavioral Perspective. National Conference on Risk Communication, Washington, D.C., Jan.
- 5- Covello V. T., McCallum D.B., Pavlova M. T. (1989) *Strategies for Effective Risk Communication*, New York, Plenum Publishing.
- 6- Flores A (1989) *Ethics and Risk Management in Engineering*, Edited by Alberto Flores, California State University Fullerton, University Press of America.
- 7- Gauthier G. (1990) L'ethique de la Communication publique. *Communication information*. 140-151.
- 8- Hall S. K. and Crawford C. M. (1992) Risk Analysis and Risk Communication. *Pollution Engineering*. Nov. 1:78-83.
- 9- Keeney R. L., von Winterfeldt D. (1986) Improving Risk Communication. *Risk Analysis* 6:417-424.
- 10- Lichten S. M. (1994) Risk Communication as a Key Component of Successful Remediation Project. *Remediation*. Winter 1993/94 4(1):1-22.

- 11- Malaver R., Racine L. and Heitz M. (1995) Development d'une strategie pour la communication du risque-Projet BIOSOV (biodestruction of volatil organic solvents in the industry). Report submitted to Minister of Faune and Environmental, Sherbrooke, (Québec) Canada.
- 12- Martin M. W. and Schinzinger R. (1983) Ethics in Engineering. McGraw-Hill Book Company NY.
- 13- Morgan M. G. and Lave L. (1990) Ethical Considerations in Risk Communication Practice and Research, *Risk Analysis*, 10(2):355-358.
- 14- Morris G. E. (1977) Engineering-A Decision-Making Process. Houghton Mifflin Co., NJ.
- 15- Otway H. (1987) Experts, Risk Communication and Democracy, *Risk Analysis*, 7:125:129
- 16- Racine L., G. A. Legault, L Begin (1991) Éthique et ingénierie, Mcgraw-Hill, Éditeurs. Montréal, Canada.
- 17- Racine L. (1991b) L'éthique et les affaires. *Gestion*, Mai, 51-56.
- 18- Santos S. L. (1990) Developing a Risk Communication Strategy, *Journal AWWA*, Nov 45-49.
- 19- Savage E., Rossner A. G., Finke G. D. (1993) Bio-related Technology. Delmar Publishers Inc. Albany, NY. 232p.
- 20- Slovic P. (1987) Perception of Risk, *Science*, 236:280-285.