

LEGAL LIABILITY IN TECHNOLOGY AND SCIENCE IN VIEW OF PEACEFUL COEXISTENCE AND PROGRESS

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Summary

The expectation that science and technology contribute to progress and peaceful coexistence, rather than to retrogression and/or war, is only warranted if certain conditions are satisfied. One condition concerns the legal liability for risks and negative side effects of technology and science. It is explained that current liability law does not live up to requirements that are necessary for peaceful human coexistence and progress. These requirements are the requirement of informed consent and the requirement of liability in the absence of informed consent. Taking into account that scientific and technological activities are regulated on the basis of national political decision making using majority rule, these requirements imply that the default liability rule for these activities in the legal systems should be unconditional (absolute, strict) and unlimited (full) liability.

Actual liability law does not live up to these requirements. This is shown for examples from international environmental law. It is concluded that there is an enormous potential for improvement of liability legislation. But there are also fundamental limitations to liability as a means to safeguard peaceful coexistence and progress. These limitations can only be removed through decisions that should be taken before risk or harm generating activities can proceed, and that should be unanimous among all who are subjected to those risks or harms. It therefore remains an important goal to bring actual political decision making closer to the ideal of unanimity decision making.

The above has important implications for engineers and scientists and their organizations, as well as for the education of engineers and scientists and of the general public. These implications are presented here in the form of recommendations.

1. Introduction. Purpose and overview

Science and technology have many positive effects on human well-being, but there are also undesired and unforeseen consequences that endanger social progress and peaceful coexistence. The magnitude and scope of actual and possible negative effects of the use and development of science and technology may well be increasing. It is therefore of utmost importance to have insight into the conditions that must be satisfied in order that science and technology will contribute to progress and peaceful coexistence, rather than to retrogression and/or war. The focus of this chapter is on an aspect of the national and international legal systems that is a crucial element of these conditions: the liability to repair or compensate for harm caused by human activities. The main questions are these:

- Which requirements should be imposed on legal liability in order that it can be reasonably expected that the use and development of technology and science lead to peaceful coexistence and progress rather than to war and/or retrogression?
- In which ways are the current liability rules in national legislations and in international law deviating from these requirements, and what are the historical developments that have led to the current situation in national and international law?
- What are the fundamental possibilities and limitations of liability as a means to satisfy the requirements for peaceful coexistence and progress? How, as a consequence, can the existing liability laws be improved to promote the use and development of science and technology for progress and peaceful coexistence?

The first question will be answered in Sections 2-4. In these Sections, the evaluative framework will be established for the remainder of the chapter. The second and third question will first be addressed for technologically enabled activities. This is the subject of Sections 5-8. In Section 9 the analysis is subsequently extended to scientific research, conceived as an activity that produces potentially harmful technological feasibilities or knowledge, and that hence potentially leads to harmful outcomes. Section 10 deals with implications of the preceding analyses for scientists and engineers and their organizations, and for education.

In this chapter, the liability for technological activities (Sections 5-8) and for scientific research (Section 9) is discussed separately. This is a practical choice that is not imposed by any fundamental differences that would exist between both activities. For

considered from the perspective of the requirements for peaceful coexistence, technological activities, such as the exploitation of fossil fuels or the development, production and use of chemicals for various purposes, do not fundamentally differ from scientific research. Both activities may lead to harm and negative side effects for others. There may be differences in the scope and predictability of the harm, though. Also, historically, the creation of knowledge through scientific research has not been considered as something for which the issue of liability might arise. Therefore, a survey of historical and actual legal liability related to technology and science (Sections 6 and 7) is naturally restricted to liability for technological activities. Also, the considerations in Section 5 on the role of liability and insurance for the assessment and management of risks, though not invalid for scientific research as an activity potentially leading to harmful outcomes, can be more easily applied to risks of technological activities, because of the (relatively) better predictability of those risks in terms of possible negative events and associated probabilities.

Detailed overview. In Section 2, the author presents and discusses the ethical basis of the two requirements that must be imposed on any activity that may generate risks or harm for others, if that activity is to be expected to lead to peaceful coexistence and progress. These are the requirement of informed consent and the requirement of liability in the absence of informed consent. These requirements are related in Section 3 to economic theory. The requirements serve as the evaluative framework for the subsequent Sections. In Section 4 the implications of these requirements for legal liability are stated, given that, at the level of nations, political decision making on risk generating technological and scientific activities proceeds on the basis of majority rule instead of unanimity rule. An implication is that liability for these activities should be unlimited (full) and unconditional (absolute, strict). However, because of problems and limitations that are attached to liability, no liability law can fully compensate for the absence of unanimity decisions among all those who are subjected to the risks. Therefore, certain unanimity decisions will always be required or at least highly desirable to satisfy the requirements for peaceful coexistence and progress. The nature of these decisions is pointed out. In Section 5 we assess the potential role of liability and private insurance as an instrument for bringing about credible and ethically sound risk assessment and risk management practices. This instrument is currently under-employed, due to inadequate liability laws and counter-effective government interventions. Section 6 provides an overview of the historical development of legal liability for technological activities. The focus is on developments since the 19th century in which the actual law moved away from the standard imposed by the requirements of peaceful coexistence and progress. These developments took place in the legal systems of all Western countries. The Section provides background for Section 7 where the aim is to assess the current state of liability rules for risk and harm generating technological activities. While focusing on international environmental law, it is concluded that there is an enormous potential for improvement. Section 8 confronts the two basic strategies that are available to satisfy the requirements of peaceful coexistence and progress, given the problems and limitations of liability that were identified in Section 4. These strategies are, either to adjust/improve/amend the relevant liability laws so as to make the risks generated by the activities more acceptable to those who are subjected to the risks; or to introduce activity restricting regulations to make the activities less dangerous and therewith more acceptable to all those subjected to the risks. Hence also such

activity restricting regulations require the consent of all who are subjected to the risks. If such consent is not obtained, the rule of liability in the law should be unlimited and unconditional liability, notwithstanding the shortcomings and vagueness of that rule if the problems and limitations of liability had not been solved by prior decisions having the approval of all those subjected to the risks. In Section 9, we discuss the implications of the requirements for peaceful coexistence and progress for science, using the problem of dual use of biochemical knowledge as an example. Section 10 presents implications of the analysis for engineers and scientists and their organizations, and for education.

2. The Two Necessary Requirements for Peaceful Coexistence: Informed Consent and Liability in the Absence of Informed Consent

The following two requirements are necessary for peaceful coexistence:

- (1) *The requirement of informed consent:* For all (technological) activities, all those who may experience the effects, including the risks caused by the activities, must have given their informed consent to the activities and to the conditions under which the activities are performed.
- (2) *The requirement of liability in the absence of informed consent:* Those who engage in activities without the informed consent of those who may experience the effects should be fully and unconditionally liable for any negative effects that their activities may cause to those who did not give their informed consent.

It is assumed that (informed) consent is by definition *free* informed consent. (There is no such thing as unfree consent.) The requirements are implied by the ethical principles of restricted liberty and reciprocity. Van Velsen (2000, 2003) showed that restricted liberty, which he called the right to be safeguarded, and reciprocity together are necessary and moreover sufficient for peaceful coexistence. Below we will briefly discuss these principles and how they imply the two requirements stated above.

Restricted liberty and informed consent. The principle of restricted liberty holds that *everyone is free to do what he/she pleases as long as he/she does not harm others*. It is also known as the no harm principle. The principle has a long history. It was included as Article 4 in the *Déclaration des droits de l'homme et du citoyen du 26 août 1789* of the French Revolution. The philosopher J.S. Mill defended the principle in his essay *On liberty* published in 1859. The restricted liberty principle contains the principle of equal rights but is not equivalent to it. We assume here that peaceful coexistence requires certain equal rights, but it is not at all true that all possible equal rights lead to peaceful coexistence. Thus, "Everyone is free to act as he/she pleases (irrespective of whether he/she is harming others)" respects the equal rights principle, but does not render peaceful coexistence unless at least part of the people are absolutely tolerant to what others do to them. It can therefore be seen that the goal of peaceful coexistence leads to the selection of a particular principle of individual freedom. If everyone respects the restricted liberty principle stated above, then peaceful coexistence is guaranteed, but the same does not hold for a "liberty" principle that does not in this way restrict people's actions towards each other. It is assumed here that harm is ultimately a subjective notion: whether and to which extent someone is harmed by something is subjective, or at least has subjective elements. (A precise definition of "subjective" is provided in

Section 5.1 and in the Glossary.) From this it follows that it is not the actor who can determine whether the effects of his/her actions are harmful, but only those who experience these effects. (A precise definition of “subjective” is provided in Section 5.1 and in the glossary.)

An equivalent formulation of the restricted liberty principle is the right to be safeguarded presented by Van Velsen (2000, p 96): *Everyone has the right to be safeguarded from the consequences of another person's actions.*

Because it is assumed that there are always subjective elements to the question whether someone is harmed by something, only two ways are open for ascertaining that other people are not harmed by an activity. Either, there are no (actual or possible) consequences for others. Or there are such (actual or possible) consequences, but those who may experience these consequences have given their informed consent to the activity. Hence, the right to be safeguarded (together with the subjectivity assumption stated above) implies the requirement of informed consent stated at the beginning of this Section.

Reciprocity and liability. The right to be safeguarded does not specify how a violation of that right may be reacted to. There is hence a need for a second principle that deals with violations of the right to be safeguarded. Such a principle is the reciprocity principle specified by Van Velsen (2000, Section 7): *He/she who violates a right of another may be reacted to in a reciprocal way. This means that somebody who infringes a right of another, himself loses that same right insofar as that is necessary (and no more than that) in order to restore the situation existing before the violation or to compensate for it, and, if necessary, in order to prevent further infringement.*

Assuming the right to be safeguarded, the reciprocity principle implies that anyone who did not respect another person's right to be safeguarded and who caused that other person harm may be forced to repair or compensate the harm. Hence the reciprocity principle implies the requirement of liability in the absence of informed consent stated at the beginning of this Section. This requirement gives anyone who had not given his/her informed consent to a risk generating activity the right to recover (to the extent that this is possible) from any harm ensuing from the activity that may fall upon him. But there is no obligation to execute this right.

As was stated above, Van Velsen (2000, 2003) has shown that restricted liberty and reciprocity together are necessary and sufficient for peaceful coexistence. The reader is referred to that source for his detailed exposition, which cannot be repeated here. The author confines himself to a restatement of some of the central concepts. Different people or groups of people can be said to live in peaceful coexistence if (and only if) they do not use or threaten to use violence against each other. Violence is here defined as any act against others that reduces the well-being of those others and that those others have not consented to, and that cannot be justified by the reciprocity principle. A person's well-being is that person's valuation of his/her situation (as compared to other possible situations) in his/her own judgment, i.e. with respect to his/her own (system of) values and norms. Individuals need not to assess their well-being in purely financial or material terms. It is assumed here that the (systems of) values and norms with which

people value their situation are subjective and may differ from person to person. Therefore, also the well-being of an individual is subjective. It is not assumed that there exists an objective yardstick with which the well-beings of different persons can be compared. As well-being is subjective, also violence is a subjective concept. Fundamentally, it is not the actor but the person (or group) who is subjected to the actions who determines whether the activity is violent.

Peaceful coexistence is more than the mere absence of open conflict or war. Thus, according to the above definitions, threatening with violence is also violence. Also, people or groups of people who experience violence may choose not to react, not because they do not feel harmed, but because they consider too high the costs or risks attached to their resistance or reciprocal action.

The concepts of peaceful coexistence and violence can be applied to individuals, but also to groups consisting of individuals who agree on the values and norms with which they evaluate the behavior of other people. Such groups can be called cultures. States need not be cultures in this sense, as the members of a state may differ about which behavior is allowed/acceptable and which behavior is not.

This completes our exposition of the two requirements for peaceful coexistence and their ethical underpinnings. In the next Section we will explain the relation between these requirements and certain fundamental principles that are at the basis of economic theory.

3. The Relationship of the Requirements with Economic Theory. External Costs and Progress

In Section 3.1 the requirement of informed consent is restated in the language of economic theory, and it is shown that the requirement is necessary for progress. The crux of the argument is that the requirement of informed consent is needed to secure that transactions or contracts lead to Pareto improvement if external costs are present. In Section 3.2, methods proposed in the economic literature for managing external costs are scrutinized in the light of this finding. In Section 3.3 the author states the implications for the analysis of the opposite of external costs, which are called external benefits.

3.1. Informed Consent and Progress

The following fundamental assumptions of economic theory have an explicitly ethical dimension:

1. If people freely enter into a transaction or contract (and if moreover the parties to the transaction or contract have adequate information, do not cheat, and keep their promises), then this makes all parties better off, i.e. increases the (self-perceived) well-being of all parties. (Otherwise, they would not enter into it.)
2. People should be the sole judges of their own well-being, hence not of the well-being of others.
3. People have the right to improve their own well-being, at least as long as they do not harm others.

A change is called a Pareto improvement if at least one person is made better off by the change, in his/her own judgment, and if no one is made worse off, in his/her own judgment. “Better off” and “worse off” can be taken to refer to changes in the well-being of the persons involved, in their own evaluation, that is with respect to their own (system of) norms and values.

It appears that everyone agrees that Pareto improvements represent social progress in an unequivocal way, hence are good. Assuming this, and ignoring any negative effects for non-transacting parties, it follows that free transactions among people render Pareto improvement, hence are good. This, together with an assumption regarding the potentially beneficial effects of specialization and innovation, is the basis for Adam Smith’s and later economists’ claim, known as the hypothesis of the invisible hand, that free markets and competition benefit everyone hence are good. The argument holds for contracts or agreements in general. It should be noted that, for the general case, the concept of an *expected* Pareto improvement should be used.

The conclusion that activities governed by free markets and competition render (expected) Pareto improvement only follows when negative effects for non-transacting parties, called *external costs or negative externalities*, are absent or at least sufficiently small. For many contemporary activities this may not be the case, as the actual and potential impacts of technology-enabled human activities upon others are large, and moreover growing.

An external cost of a human activity can be defined as a harmful effect of that activity that is not accepted by those affected as an element of a voluntary agreement, but instead is involuntarily imposed. This definition differs from definitions found in the economic literature such as Kahn and Beaumol and Oates, but it appears that it captures the same concept. Kahn’s definition of an externality, which he adopted from Beaumol and Oates, is this: “An externality is present whenever some individual’s (say A’s) utility or production relationships include real (that is nonmonetary) variables, whose values are chosen by others (persons, corporations, governments) without particular attention to the effects on A’s welfare.” If the effects on A’s welfare are positive, the externality is called positive, if the effect is negative, the externality is called negative. Our definition of an external cost differs from Kahn’s definition of a negative externality in that the basic condition for its application is the presence or absence of A’s informed consent to the activities, rather than whether the actors have particular attention for A’s welfare.

Classical examples of external costs are toxic smoke from chimneys or cigarettes causing harm or risks to people nearby. If the external costs of human activities are sufficiently large, then these costs may offset the (expected) gains from market transactions. Not merely passive “bystanders” may end up worse off, but also those who actively engage in the activities and transactions that generate the external costs. Free markets and competition hence do not guarantee expected Pareto improvement if external costs are present. The only way to secure that an activity renders expected Pareto improvement, is to ascertain the informed consent to the activity of all who may experience the external costs of the activity. This is the requirement of informed consent

stated in Section 2, now derived as a necessary condition for securing progress in the sense of expected Pareto improvement.

Involuntarily imposed risks are (equivalent to) external costs. This can be seen as follows. A risk is a cost not for sure but expected with some probability. For an individual who satisfies the “axioms of rationality” assumed in the theory of decision making under uncertainty (see for this theory e.g. French 1986), a risk is equivalent to a sure cost, in the following sense. If confronted with a risk, such a person is capable of identifying a sure cost, such that he/she is indifferent between the sure cost and the risk. If for instance, the annual insurance premium for an insurance policy (fire, theft, etc.) is, for a certain person, less than that sure cost, then that person will prefer to take insurance to bearing the uninsured risk. As any hazard (a thing or an activity that may cause adverse effects) can be evaluated as a risk, any man-made hazard is, in principle at least, equivalent to a real cost to anyone subjected to the hazard who satisfies the “axioms of rationality”. (The same holds for natural hazards, but these are *not created by humans* and for that reason, do not concern us here.) Examples of manmade hazards are a chemical or nuclear facility or an LPG filling station in the vicinity; air polluted by gases such as NO_x or by particulate matter from power plants or traffic; certain toxins in food; the enhanced level of CO₂ in the atmosphere potentially causing climate change. Therefore, for persons satisfying these axioms, the statement “The external costs of a hazardous human activity include the involuntarily imposed risks stemming from that activity” has in principle a crystal clear meaning. At the same time, the determination of the external costs stemming from such risks cannot be fully objective, because both the assessment of the risks in terms of the possible physical effects and the associated probabilities, and the evaluation of those effects in terms of costs or reduction of well-being is at least in part subjective. Also, because of unavoidable and sometimes enormous uncertainties in risk assessment, these costs are always vague or imprecise to a varying degree. Finally, there is no ground for assuming that such costs can (always or in general) be expressed on a finite monetary scale. Thus, it is possible that, for a certain person, the sure cost equivalent of a given risk exceeds all the money in the world.

For practical reasons, general rules are desirable that specify which (market) activities are allowed and under which conditions. Such rules can be introduced through laws. However, these laws must have the informed consent of all those who are subjected to the (possible) consequences of the activities that the laws allow. For otherwise progress in the sense of expected Pareto improvement is not secured. Such laws might impose two types of conditions upon activities. The first type of condition prescribes which actions are and are not allowed, and imposes restrictions and precautions that should be observed while performing allowed activities, meant to make the activities less harmful or hazardous for others. Safety and environmental regulations belong to this type. This type of conditions will here be called activity-restricting conditions. Conditions of the second type do not impose restrictions on activities in themselves, but impose on the actors a duty to repair or compensate for harm that may follow from the activities. Conditions of this type we will call liability conditions. Third party liability stipulations are examples. It is always possible to impose on an activity a combination of both types of conditions.

It must be stressed here that many authors on economics do not, or not consistently, support the third assumption of economic theory mentioned above: "People have the right to improve their own well-being, at least as long as they do not harm others". This is true, for instance, for those economists who defend social cost-benefit analysis as a method to take collective decisions on infrastructural projects, legal changes, or other collective issues. According to social cost-benefit analysis, a collective project can be executed if it increases the total sum of individual well-being or welfare. Net losses of specific individuals or groups are considered irrelevant, even though application of social cost benefit analysis can and will often lead to net harm for certain individuals or groups. Some cost benefit analysts have defended the above by stating that any injustices arising from the application of social cost benefit analysis could be corrected through other branches of government, such as the tax system. However, as the tax laws are governed by political majority decision making, it cannot be expected that an unjust distribution of costs and benefits arising from a collective project will (always) be corrected or compensated through the tax system. Similarly, the implicit assumption behind the so called "Coase theorem", described e.g. by Mueller (2003, p 28), is that the total sum of income or welfare should be maximized for maximum social benefit, that the way income or welfare is distributed is irrelevant, and more specifically that it is irrelevant whether in the "social benefit" optimizing process some are experiencing net harm.

The term "well-being" occurring in the three fundamental assumptions of economic theory represented above can be given a broad meaning consistent with the definition we provided above (and in the glossary). In particular, there is no need to assume that individuals assess their well-being in purely financial or material terms, or that a person's well-being purely depends on his/her own personal situation. If, for instance, a person considers the right to be safeguarded as an important human right, then whether or not this right is respected in the real world will affect his/her well-being.

The economist/philosopher Amartya Sen has challenged the idea underlying assumption 2 above, namely that individuals are always the best judges of the possibility of improvements or deterioration in their own well-being (e.g. Sen 1999). Instead, people's judgments of what is good for them can be easily swayed by mental conditioning or adaptation to oppressive situations. The truth of the latter is undeniable. This might justify interventions based on "enlightened paternalism", in addition to "redistributional" interventions aimed at correcting violations of the restricted liberty principle (see below). Apart from this, there lies a task for education to cognitively empower people for exerting the rights (and living up to the duties) that the requirements for peaceful coexistence and progress ascribe to them.

The above principles from economic theory do not address distribution issues. Also the requirements of informed consent and of liability in the absence of informed consent presented in the preceding Section do not directly consider the question of how goods and wealth should be distributed. However, our two requirements taken together do have important (re)distributional implications:

1. The principle of restricted liberty / requirement of informed consent does not allow wealthy people to use their wealth to engage in activities that cause harm to others. In the current technological globalizing society, many activities actually do cause

harm to others in the form of environmental or ecological harm, and/or the usurpation of natural resources. The principle of reciprocity gives those harmed the right to reparation or if that is impossible, compensation. The principle is not or only partially respected by the current legal systems. Chapter 7 provides important examples from international law that illuminate this.

2. Redistribution on a voluntary basis, i.e. other than reparation or compensation required by the principle of reciprocity, is always possible. Possible motivations for voluntary redistribution, including altruism and (perceptions of) fairness, were discussed by Mueller (2003, Ch. 3) in the context of an exploration of possibilities for just (national) taxation.

An essential difference between the principles from economic theory that have been discussed here and the requirements for peaceful coexistence and progress is therefore that the former do not contain (an equivalent of) the requirement of liability in the absence of informed consent. When economists have considered issues of liability, then merely as one possible method for what they have called internalizing external costs, and not as the subject of an independent principle. We now turn to this topic of internalizing external costs.

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Biographical sketch

Henk Zandvoort (1951) is an associate professor for Ethics and Technology at Delft University of Technology. He did his first degree in chemistry and a later degree in philosophy. His dissertation *Models of scientific development and the case of NMR* appeared in 1986 (Reidel, Dordrecht). Between 1986 and 1997 his main assignment was at the Dutch Ministry of Education and Sciences, where he had various functions as a civil servant in the area of higher education and university research. He has been associated with Delft University of Technology since 1991. He developed and teaches courses on ethical aspects of technology and engineering for different MSc programs. His research focuses at the risks of contemporary technology. The research aims at formulating conditions and methods for responsible and coherent decision making about risk generating technological activities, and for responsible and coherent risk assessment, management and regulation.