

ARTICLES

The practical value of a life: priceless, or a CBA calculation?

Prof Dr B.J.M. Ale^{1*}, Dr D.N.D. Hartford², Prof D.H. Slater³

Authors' Affiliations:

¹ Technical University Delft, PO Box 5015, 2600 GA Delft, Netherlands,
E-mail: ben.ale@xs4all.nl

² BC Hydro, 6911 Southpoint Drive, Burnaby, BC, V3N 4X8, Canada

³ Cardiff University, School of Engineering, Queen's Buildings, 14-17 The Parade, Cardiff CF24 3AA, Great Britain

* **Corresponding author:** Prof Dr B.J.M. Ale – e-mail: ben.ale@xs4all.nl

ABSTRACT.

In a previous paper, we discussed that the application of cost benefit analysis (CBA) often incurs setting a value to a statistical human life (VOSL). This led to decades of research into what a reasonable value should be. These evaluations of the VOSL lead to widely varying results. Rather than attempting to harmonize on an average with large margins of uncertainty, the conclusion can be drawn that indeed there is no law of nature that determines what risk is acceptable and that, therefore, a consistent valuation of a human life cannot be expected. Nor can it be expected that there is a universally valid number for the acceptability of a risk. We argue that one should accept that standardization of acceptable risks has its practical limitations given by the – lack of – similarity in nature of the activity and the nature of the risk. In fact, attempts to force standardization are counterproductive. In many cases, one has to accept the only available alternative not involving violence, which is a political debate, terminated by the more general rule of law or constitution on how to settle such a debate and then accept the decision.

1. INTRODUCTION

In a previous paper¹ we have discussed the relationship between the principle of reducing risk as low as reasonably practicable (ALARP) and the method of CBA. We highlighted that CBA not only is a method to evaluate costs and benefits, but that it is also often used as a guiding

principle saying that costs and benefits should be in balance. The value of a statistical life (VOSL) arises in deliberations associated with CBA, and frequently, apparent precedents in one domain such as healthcare are often presented in another domain such as safety of hydropower dams, nuclear power plants or transportation as justification for some

proposed limit on expenditures on safety. This reading across domains of endeavours is done regardless of the entirely different contexts between the domains, and this paper questions the validity of such attempts of justification.

We argued that guiding principles such as ALARP and the precautionary principle are expressions of ethical points of view, but that these terms are not operational in real decision making. What in ALARP is Reasonably Practicable needs further definition. The verdict in the UK case law in the case of *Edwards v. National Coal Board* in 1949² is generally understood to imply that the principle of ALARP is fulfilled when the point is reached that the cost of further reduction of a risk is disproportionately larger than the quantum with which the risk is reduced³, lacks similar operationality, because disproportionate is not defined¹. Also, it does not specify how the costs of risk reduction should be determined or how the quantum of risk should be specified in order that it could be considered as reasonable, or proportionate.

In many papers the issue of deciding on the acceptable level of risk is treated from the point of view of society and its key stakeholders, authorities and public; thus attempting to find a methodology to reach a decision that is satisfactory for all parties involved. At the same time, in practice, many of the problems used in these papers, such as the construction of a nuclear power plant at a certain location, the storage of nuclear waste in the Yucca Mountain, the expansion of the airfields at London,

Amsterdam and Zurich, remain contentious and large sections of society, its different groups and many stakeholders, are left dissatisfied as to whether the decision was positive, negative or no decision was taken at all. Therefore, it is often advocated that a more pragmatic or mechanistic approach should be taken, even by those authorities that claim to have ALARP as their guiding principle, and base the decisions on a rigorous cost benefit analysis; under the often implicit assumption that there cannot be any reasonable objection against using the principles of the market, in which everything is for sale, and everything has a price which is set by market forces. This vitally important assumption, which is vital to the cost-benefit argument is not universally held (4) and is considered in more detail in section 5 below.

In this paper, we consider this decision problem from the narrower perspective of a decision taker, be it in government, in the judiciary or in an industry, who cannot avoid the need to decide. We will investigate the “force field”, or social pressures, from his/her- perspective and the usefulness of cost benefit analysis. In particular we will look at the issue that appears in every cost benefit analysis, which is the valuation of human health and life. We will extend the survey given in our previous paper¹ regarding the sources of data and the numbers used by various institutions to answer the question whether these sources of information are pertinent to certain decisions outside the original field of application and outside the jurisdiction where the values were used.

2. THE FORCE FIELD

There are obviously and fortunately, many decisions that are not contentious. There is no reason to afford much effort to these decisions in this paper. More interesting are

¹ In British case law, the test of proportionality has been taken as the same as “reasonableness”. The test for this is laid out in the so-called *Wednesbury* judgement. Here it was notoriously but deemed acceptably, ruled that this meant it would be reasonable in the opinion of the “man on the Clapham omnibus”.

those decisions, which are contentious. These are generally decisions where there are a number of stakeholders who have different opinions about the preferred outcome of the decision making process; and under which decisions the persons finally responsible have to sign up to formally.

In such situations there are often more issues to consider than the opinions of the stakeholders alone. There are the constraints imposed by the legal environment. Then there may be constraints imposed by the financial environment and finally there may be ethical constraints, not covered specifically by law, or by the bank, but by the mores of society, the church, or the personal beliefs of the decision maker.

Typically, the latter issues arise when the costs and the benefits, however expressed, do not fall to the same party; but one party will reap the benefits and another party will bear the costs. These issues arise even more contentiously when the costs involve human life and health. Also, any difficulties in the decision making process will be aggravated when there are items on the balance sheet that are uncertain. The worst case scenario for any decision process is when there are items on the balance sheet that involve indirect benefits, but also potential threats to human health and life in an uncertain future for one party, while the benefits are tangible, relatively certain and immediate for another.

Large technological risks are of this type. A chemical factory makes products that are wanted by society as a whole; it provides employment and makes profit for its shareholders. Some members of the workforce run the risk of being exposed to hazardous chemicals and lose their health or their life. These usually do not comprise the plant's management. Some members of the public, those in the immediate surroundings

also run this risk. From a direct cost benefit point of view it is a no risk, only profit situation, even if it is considered that in theory management may be involved in criminal procedures after an accident. As long as an adverse event is really an accident and the situation can be argued to be ALARP, there should not be any consequences for the management.

Given that, under those circumstances, it is tempting for management to take risks, it falls to the authorities to curtail this risk taking if it is deemed in the interest of society to limit the risk. It could be argued that the management of hazardous facilities have a duty of responsible care for the whole package of costs and benefits. It could even be argued that many entrepreneurs take this responsibility very seriously and would not expose others to undue risk. It cannot be denied though, that there is no reason to assume that that holds for all entrepreneurs at all times. There was and is sufficient evidence to warrant rules, regulations and governmental control^{5,6}.

This in turn raises the questions for decision makers in public office, where their tipping points of ALARP, their balance points of cost and benefit are and where their ethics lead them.

For public office there are even more issues to consider. Usually a constitution or similar arrangement states that all men are created equal and therefore should be treated equally. Similarly entrepreneurs should be treated equally. Every decision has a bearing for the decision space in the future as it sets a precedent. This means that as long as the rules are not changed explicitly equal treatment not only applies over individuals and companies but also over time.

3. DECISIONS

Many decisions that are taken are actually hardly decisions at all. Given the regulatory context and the demands of the market, the decision space usually is limited. But even under those circumstances the majority of decisions are not based on an exhaustive analysis of all boundary conditions to be fulfilled and all options possible within those conditions. Decision makers rely on heuristics and experience to decide what looks like the best course of action that they think, but not necessarily know, is within the accepted social constraints.

Decisions that are taken after almost exhaustive analyses are those that lead to laws and regulations, and decisions on unprecedented applications of technology, such as the construction and siting of nuclear power plants and hydropower dams.

In these decisions, generalized policy statements such as “safety first”, “precautionary principle”, “responsible care” and ALARP are converted into observable actions, acts and constructions. Each decision is an operationalization of one or more of these principles.

The more novel, or unprecedented a proposition is, the less historical information is available or applicable, to evaluate the probabilities and extent of adverse outcomes. On the other hand, the more these adverse outcomes include potential damage to life and health of third parties the more there will be a demand for transparency and dialogue: and a need for a statement by the authorities as to whether they judge the proposition to be acceptable. This also applies to propositions for regulating simpler but more widely spread technologies, such as driving cars, storing hazardous materials or the demands on household electricity installations. If the proposition is novel but the effect is of the

same scale as more complicated technologies, or these “simple” activities are performed on a nationwide or world wide scale, this makes adverse consequences felt on the same scale. And depending on the way one measures adverse effects, the adverse effects of widely spread simple technologies can be orders of magnitude larger than that of the larger technologies. What seems to set larger technologies apart is that their hazards can have catastrophic potential, but a decision for instance to allow a certain crop protection agent may have catastrophic effects as well, be it that the many casualties fall one by one.

The potential of a catastrophe usually attracts the attention of all stakeholders involved. The art of survival is not necessarily the art of being the fittest⁷. More often, it is the art of not being involved or killed. Recent studies into past decisions show that avoidance of large, potentially catastrophic, losses is a consistent pattern in decision making, when those who may incur the losses are consulted. In the financial world, however risks with catastrophic outcomes were recently taken and large losses materialized and had to be paid for globally by taxpayers, who were not consulted, before the risks were taken.

Given that decision makers are required to take into account factors regarding the equity, ethics, predictability and legality of their decisions, it is not surprising that these decision makers search for benchmarks against which they can justify their decisions.

Rarely is the argument developed *ab initio*, such as is the case for third party risk in the Netherlands. When the potential outcomes of a decision involve the gain or loss of items that are of different nature some form of weighting needs to be done. How many

apples are equal to how many oranges? This is a matter of taste, or risk appetite as it is called recently. There is no law of nature that determines what risk is worth taking especially when the negative outcomes include the loss of health or life of third parties, who are not directly engaged in an activity, although they may besides the potential loss also receive – part of – the benefits.

Since in most decisions at some point monetary items are in the balance, it is not surprising that there is a general tendency to try and express all items in the balance in terms of money. In order to find a justification for a decision it then is shown that in the overall balance, costs outweigh the benefits. Usually an additional argument is found by comparing the costs of further improving safety which are higher than the costs of similar risk reductions in other fields, health care being the favourite benchmark. When these arguments succeed, the decision maker can reduce his own responsibility. His decision is justified by the decision of another. The infamous limit of one in a million for individual risk is such a decision. It is either based on a non-existing previous decision⁸ or it is based on the policy document by the Dutch government^{9,10,11}. It can also no longer be a surprise that draft decisions made on the basis of monetarized imponderables are met with sometimes fierce resistance.

The criticisms have among other these elements

- Items are under or over valued
- It is not ethical to express the value of certain items in terms of money
- It is a trick to get a decisions passed
- Comparisons between valuations in different fields are invalid.

- The fact that somebody else decided on similar grounds or accepted a similar risk is not accepted as valid

We have already described in the previous paper how there is not really a scientific basis for a generalized value of a statistical life. In the next section we will investigate whether comparison between different fields is a potential justification for decisions in another field.

4. THE VALUE OF A STATISTICAL LIFE

Morall^{12,13} was as far as is known, the first to publish a table in which he presented the costs of saving lives. The values were derived before 1984 and would have to be adapted for inflation, which is in itself controversial, and the absolute numbers Morall found are not really important for the argument. He also indicated what regulation was actually adopted and what regulation was rejected and found that at that time there seemed to be consistency as so far as measures that would have cost less than about 140M\$ US, per live saved, were adopted and measures that cost more, were rejected.

Tengs et al.¹⁴ produced a more extensive list with some 500 measures aimed at saving lives. Their purpose was also clearly stated. They thought it would be beneficial if governmental decisions comprised an element of human lives and health and that human lives should be valued equally, regardless the decision. What they found was that the value varied by orders of magnitude. In traffic, the cost per life saved were much smaller than in medical interventions; smaller in preventing injury than in control of toxins in the environment. They also found that the order in which certain activities were cost effective, could be changed by looking in more detail. In

occupational health and safety, repairing the damage as far as possible was more cost effective than prevention, while in general medicine prevention it was found to be more cost-effective than the cure of the ill.

In 1998, these estimates were criticized by Heinzerling¹⁵. She argued that that many of the estimates in these tables were wrong and using these tables as an argument for regulatory reform, i.e. base regulation on cost benefit reasoning, was invalid; because the tables show that measures entailing obvious excessive costs were rejected already. Moreover, she argued that using the table as a starting point for a discussion and using 7M\$US as a fixed criterion for the acceptance or rejection of measures, forgoes the – ethical – discussions that preceded each of the separate decisions.

In 2003, Morrall¹⁶ answers this criticism and adds another limit by stating that spending 21M\$US on a health issue, takes away money elsewhere, which through “poverty” causes an additional statistical fatality.

Another conclusion follows from the analysis by Morall of a further 40 measures taken after the first paper, which shows that the spread in costs per life saved, did not decrease in the 20 years since the first paper¹².

Finally, he draws the conclusion that the Occupational Safety and Health Administration’s (OSHA) anti-carcinogenic measures are a waste of money. These conclusions are in line with the previous ones, that in occupational health repairing the damage is cheaper than preventing the damage occurring. Due to the policy and scientific language he employed, the

bluntness of his conclusion is somewhat masked. What he is concluding is that it is better that employers save money on anti-toxin measures and treat the cancer patients among the workforce that result, with their own money; because the total amount of money per life saved is less in the latter case than in the first. This completely ignores the question as to whether the money argument is sufficient to justify that an employer is entitled to impose a level of cancer incidence in his employees.

Heizenberg¹⁷ takes this argumentation to the limit by stating – quite rightly- that the logical consequence of this argument is that it beneficial to have somebody murdered, when the value of his death is worth more than his life. Heizenberg states therefore that a universal value of a statistical life does not exist.

In the meantime, other authors in search of an average value for VOSL gravitated on a value of around 7M\$US per life year, but they also stated that the spread in values found is large^{18,19}.

This is supported by the various examples set out in Table 1. There is a continued argument that in the long run, money spent on safety is well-spent. On the other hand, at least from Morall’s work, there seems to be a limit as to what society is prepared to spend. It should be noted that the figures in the money tables are costs of measures proposed, declined, or taken, in industries and activities that continue in existence. Moreover, safety and reliability often goes hand in hand, so that the returns are not only the saving of – statistical – lives, but also the direct return of improved reliability.

Table 1. Examples of life values

Country	Context	Situation	Life Value (VOSL) \$Million
OECD	Recommendations	General Industrial	1.5 – 4.5
US	Food and Drug Administration	Salmonella Intervention	7
US	Range depending on Risk	Furniture to Coal mining	0.2 - 13
US	Average		7
UK	Willingness to pay	Transport - DFT	2.3
Canada	2009 Report	General	3.5
Australia	Office of Best Practice	General	3.2
	Healthcare	Quality of life Year	QALY
UK	“Collective judgement of health economists”		0.03 – 0.05
Canada	No threshold, best practice	Medical intervention	0.015
US	If reasonable – no limit	Medical Intervention	None
Netherlands		Medical Intervention	0.08 – 0.5
	Value of a Death	Compensation payments	Per case
US	Military – combat deaths		0.25 – 0.5
US	9/11 casualties		0.25 – 7.1
UK	Similar		
Canada	27 years wrongful imprisonment		6

Source – Shannon Fischer – “What are you worth? *New Scientist*, 22 Oct. 2016

5. MARKET

As was mentioned earlier, the underlying assumption in cost benefit analysis and policy making is that everything is for sale and that the price is set by the forces of the market.

But people who are exposed, or will be exposed to “third party risk” did not put their lives on sale. Nor will the company or organization who puts third parties in harm’s way, normally offer them a price to buy their lives. There also is not any form of competitiveness in the sense that people exposed to risk can sell their lives to the highest bidder. In fact, the situation is completely reversed. The probability for people to lose their lives is about to be increased; and they are asked what they are prepared to pay for this increase in risk to

be as low as possible. Instead of comparing this to a market, it could be more justifiably compared to a ransom or protection racket situation, in which money is demanded of people for not being damaged or killed. In these situations, the value of life is not determined by what people would be willing to pay to have their lives saved, but what they can afford, as any would-be kidnapper understands.

6. HEALTHCARE

Health care is one of the most used references. In health care, the issue at stake is not a potential increase in the probability of damage or death in a particular time frame, it is about reducing the probability of damage or death in the same time frame. The primary purpose of health care is

preventing illness, repairing damage already done and in cases that these two efforts fail, minimize suffering.

When it is about the health of a single person, again the money spent is what one can afford. A long healthy life is a universal wish. But there are people who can afford expensive doctors, or expensive health insurance and those who cannot. It may be a sobering thought but if you do not have the money to pay for a treatment, you will die.

In countries with a collective health care system, where money is raised by taxation, or by obligatory health insurance schemes, the policy issue is twofold: to best spend the money available and could more money be generated.

The latter issue is similar to the individual case, but on a bigger scale. And again it is not so much an issue of what society would want to spend, but what it can afford to spend.

In the larger context of a national budget, things obviously get more complicated. What would be the result of a completely economic trade-off between health care and defence? What is the economic value of being in control of your own border? In these larger contexts, it is taken as a given that society needs all sorts of services, without recurrent economic evaluation. The countervailing power is the taxpayer, who wants to pay as little as possible and wants value for money. The driving force behind decisions on spending money is customer complaints. If the taxpaying citizen is dissatisfied with a service, that service is allocated more money on the expense of another service until complaints arise on the latter. Extending the total budget, i.e. raising more tax is unpopular and therefore the last resort.

In terms of how the money is spent, the trade-offs are relatively direct. Say one can perform 1 expensive operation for the same money as 10 other less expensive ones. Both operations yield life years and one could, as a policy, prioritize the most cost effective operations. Similarly, there are many drugs that prolong life. They do so in different ways, to different extents and against different costs. So within a given budget there could be a simple trade-off mechanism determined by the relative costs.

In the UK, this year, the decision was taken to risk giving a trivalent (effective against three strains) flu jab, as opposed to the more expensive (£2 extra) quadrivalent (effective also against the most virulent strain), presumably on some kind of (non-transparent) CBA or National Institute for Health and Care Excellence (NICE) formula. The consequence was, however, that the resulting epidemic of the more virulent strain caused increased hospital admissions, mortality and put significant extra strain on already stretched resources with significant economic penalties.

However, although some cosmetic operations improve the mental health of a patient, many also do not improve health, but are carried out anyway. These could be justified by the fact that the latter operations are paid for privately, but this does not take into account that doctors and nurses are trained in universities and hospitals which are funded to a large extent by public money. So a strict trade-off would lead to a ban of these operations. In practice, this does not happen, and therefore even in a simple context such as this, completely economic optimization does not take place.

Given that most governmental spending decisions are not based on an economic cost – benefit analysis but on a least complaints analysis, the value of a statistical life does

not figure in the equation, it was never considered. It would therefore be a miracle if, retrospectively, calculation of these values would produce the same results. Such indeed is not the case in health care either. Some treatments are inexpensive, such kidney dialysis and some are extremely expensive such as some cancer treatments and the treatment of rare congenital diseases. But price alone has – up to now – never been the only reason to not allow the treatment to be performed. Although in the Netherlands the health committee advises not to exceed a cost level of 80000 euro per quality adjusted life year, in practice some patients require 500000 euro per year to keep them alive, which is paid for out of the national health budget.

The overriding boundary condition for health care in the public sector seems to be the total budget the government has set aside for health care. In the private sector the situation is similar. The costs are limited to what money customers have available.

7. NON HEALTH RISKS

In the next section, we discuss the way costs, including risk, and benefits are traded off in other sectors than health. Specifically, we discuss industrial risk and flood risk. The risk element of the costs is highlighted as this element is driven by the VOSL or a VOSL is derived from it.

In industrial risk, risks from traffic and many other activities, harm to health and life, are collateral. Reducing the risk and prolonging life is not the primary purpose of the activity. In these cases, loss of health and life is deemed unavoidable and the judgement call to make is twofold: whether, given this unavoidable loss, the activity should be allowed to be undertaken and whether there is enough done to reduce

these losses to an acceptable level. It should be noted that “unavoidable” has a particular meaning in this context.

Therefore, as a matter of principle, these systems could be absolutely safe. The sobering reality is that people violate rules and technology is not perfect. So although all accidents can be avoided in principle, they will not be in practice. The question to be answered is therefore, are we prepared to take the consequences of the imperfect reality to achieve a safety goal and if we do not what are we prepared to spend to approach the theoretically attainable perfection in practice.

It can be seen from the lists mentioned earlier that evaluating measures taken in retrospect the resulting VOSL vary widely. Measures in the realm of road safety usually are cheap, while measures involving toxic materials, usually, are on the expensive side of the spectrum. One could be tempted to translate this into the different values apparently attached to a statistical life in different environments. But another interpretation is also possible this being that it is much easier and cheaper to make a road safer than it is to make a chemical plant handling toxic materials safer.

There is no trade-off of safety between different sorts of activities. There are activities; they are made as safe as is deemed possible; and after that it is take it or leave it. Activities for which it was judged that they could not be made safe against a reasonable price are discontinued. The Zeppelin is an example. How many lives were saved and what it has cost to do so, cannot be evaluated, because there is no alternative world in which Zeppelins are the regular means of air transportation.

Although it is conceivable to make an industry less safe and spend the money to

improve road safety, in practice there is no method to make this work. It is equally not conceivable to justify an additional number of deaths in one country by efforts to reduce the number of deaths in another country even though in total the number of death would be less. To call that a statistical murder is a fallacy²⁰.

7.1. Industrial Risk

The acceptance of hazardous and other activities and the necessary operational measures required are often put down in standards and regulations. In terms such as the number of failures per demand, or the individual risk. The siting of hazardous activities can have an influence on the risk and in many countries such as the EU and Canada siting is regulated. The EU requires its members to reveal the criteria on which siting decisions are taken^{21,22}. These criteria vary and some include limits on individual risk. Criteria on disaster potential, also known as societal risk are only given in some countries, such as the Netherlands and the UK.

One can argue and it has been argued successfully, that all petrol stations are sort of similar and even that the risks of petrochemical plants, petrol stations and nuclear power plants are similar enough in nature, but not similar enough in extent to apply the same standards of third party risks to all of them.

7.2. Flood risk

The risk of flooding is an intermediate case. When it involves protection against flooding from the sea, or rivers, the situation is more similar to health risks. The source of the problem cannot be taken away, nor can a policy be developed against the natural geophysical behaviour of the sea. What remains as practicable, is a

defence policy. Although in the Netherlands attempts have been made to monetize the potential loss of life and use it as a cost item, in the end, the protection levels are based mainly on economic losses and the guarantee of a minimum level of safety for the most exposed individuals. Although the existing policy statements on acceptable individual risk from industrial installations as well as policy statements on the expenditure per life saved were taken into account, the final decision was based on available budgets. The Dutch National Budget just did not have room for further investments.

For floods caused by hydro-electric dams the situation is different in the sense that at the time when the decision is made to construct a new dam, a risk is imposed to the population and therefore the question whether it is justified to do so is a valid one. This is more similar to industrial risk. The product – energy – is desired, the technology cannot be perfect and the question whether the product is worth the risk is a valid one. Since the product is different from other industrial products, and the potential for risk reduction and the associated costs are different the justification of the acceptance of the risk cannot be based solely on risks accepted elsewhere. Unfortunately there is also not much room for standardization of dams.

8. CONCLUSION.

It is often the case that attempts are made to justify levels of safety of one activity or industry, by using the same number adopted for another. A popular route to justify/achieve such an equivalence is by the evaluation of the implicit, or explicit valuation of a life, a life-year, or a statistical life. These evaluations of the VOSL lead to widely varying results. In practice the budget available for an activity or a

development often determines the level of residual risk. Transfer of budgets to areas where more statistical lives can be saved for the same money seems not to occur anywhere.

Rather than attempting to harmonize on an average with large margins of uncertainty, the conclusion can be drawn that indeed there is no law of nature that determines what risk is acceptable and that, therefore, a consistent valuation of a human life cannot be expected, nor can it be expected that there is a universally valid number for the acceptability of a risk, even if in many instances a number such as 10^{-6} is considered “de minimus”.

One should accept that standardization of acceptable risks has its practical limitations given by the – lack of – similarity in nature of the activity and the nature of the risk. If one can justify bringing an activity under the umbrella of a class already decided upon, one is in fact lucky: problem solved.

If one cannot, one has to accept the only available alternative not involving violence, which is a political debate, terminated by the more general rule of law or constitution on how to settle such a debate and then accept the decision. In every politician’s life, there comes a point where she/he can no longer hide behind the decisions of another.

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