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Is ALARP applicable to the management of terrorist risks?

S.D. Guikema [a,b,*], T. Aven [b]

[a] Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore, MD 21218, USA
[b] Department of Industrial Economics, Risk Management and Planning, University of Stavanger, Norway

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ABSTRACT

In this paper, we discuss the applicability of the as low as reasonable practicable (ALARP) principle to terrorist risk management. ALARP is a commonly used framework for managing risk due to non-intelligent threats, but terrorism introduces difficult issues, both technically and socially. In particular, the probability of a terrorist attack is difficult to define, terrorist threats are adaptive, and some terrorist risk management actions raise issues of loss of civil liberties not raised by risk management measures for other types of risk. We discuss these issues and their implications for risk management. After showing how ALARP is used to manage the risk from other hazards in different economic sectors, we discuss both the benefits and difficulties associated with extending the ALARP framework for terrorist risk analysis. We conclude that the ALARP framework can be modified to make it appropriate for risk management for adaptive risks, provided that care is taken to explicitly consider adaptive reallocation of risk in response to risk management actions, to account for perceived or actual loss of civil liberties resulting from risk management actions, and to consider the difficulties associated with using probability to measure uncertainty in adversary actions.

1. Introduction

The as low as reasonably practicable (ALARP) principle is a common approach underlying risk management for what we will term safety risks—risks that occur due to accidents. Examples include transport safety, offshore platform safety, and environmental health safety at sites with contaminated soil. ALARP has been a successful and widely used principle for risk management, particularly in Europe and UK where ALARP has been defined in case law related to its implementation: risk reduction measures should be taken unless it can be shown that the costs of these measures are "grossly disproportionate" (*Edwards* vs. *National Coal Board*) or "disproportionate" (*Marshall* vs. *Gotham Co. Ltd.*) to the benefits of the measure. While there is ongoing debate about how costs and benefits should be measured and compared, the underlying principle is to reverse the burden of proof with safety measures implemented unless it can be shown that they are not appropriate based on cost and benefit comparisons [1].

In this paper, we address the question of whether or not ALARP is an appropriate principle to guide risk management for threats of an adaptive nature such as terrorism and sabotage. This is an important and open question. ALARP to date has been applied primarily to threats of a safety risk nature. Threats such as terrorism and sabotage are substantially different, in that they adapt. Actions taken to reduce the risk associated with these types of attack may induce the adversary to change their focus to a different type of attack, increasing the associated risk. In addition, there is considerable controversy over how or even if probabilities should be used to describe adversary's actions (e.g., [2–4]). The substitution affect combined with the challenges associated with defining probabilities of attacks pose challenges in attempting to use the ALARP framework as a basis for managing risks associated with adaptive threats.

We argue in this paper that despite the challenges posed by adaptive threats, ALARP is still a useful and well-defined framework for risk management for adaptive threats, provided that the costs and benefits are defined in a broad enough manner and that the displacement of risk to other types of attacks is explicitly accounted for. Furthermore, using the ALARP concept may avoid some of the controversy involved in using probabilities to describe adversary actions. We begin by providing an overview of the application of ALARP for threats of a safety risk nature. We then discuss the differences between adaptive and safety risk threats in more detail before presenting a framework for how ALARP can be used within the adaptive threat setting. We close with a discussion of the advantages, disadvantages, and challenges of using ALARP to manage risks of an adaptive nature.

2. ALARP background

ALARP is a principle of risk management expressing that risk should be reduced to a level that is as low as reasonably practicable. The principle has arisen from UK legislation (the Health and Safety at Work etc. Act 1974). The key question in

* Corresponding author at: Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore, MD 21218, USA.
E-mail address: sguikema@jhu.edu.

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determining whether the risk is ALARP is the definition of *reasonably practicable*. This concept originated in a 1949 Court of Appeal decision, which concluded that [5]:

"'Reasonably practicable' is a narrower term than 'physically possible' and seems to me to imply that a computation must be made by the owner, in which the quantum of risk is placed on one scale and the sacrifice involved in the measures necessary for averting the risk (whether in money, time or trouble) is placed on the other; and that if it be shown that there is a gross disproportion between them – the risk being insignificant in relation to the sacrifice – the defendants discharge the onus on them".

In addition, the issue of reasonable practicability was considered by the House of Lords in a 1954 case, the head-note of which states:

"The test of what is (reasonably practicable) is not simply what is practicable as a matter of engineering, but depends on the consideration, in the light of the whole circumstances at the time of the accident, whether the time, trouble and expense of the precautions suggested are or are not disproportionate to the risk involved, and also an assessment of the degree of security which the measures may be expected to afford".

Note that the first of these legal judgments refers to "gross disproportion" while the second requires only that costs should not be "disproportionate" to the risk reduction concerned. Most interpretations of the principle today are based on the concept of "gross disproportion". For example HSE UK (see e.g., [6]) always refers to gross disproportion. However, this term is not more precise than "disproportionate" and the question of what "gross disproportion" means is decidedly ambiguous. In the following we briefly review some common ways of interpreting these concepts, and hence ALARP.

2.1. An economic analysis perspective

It may seem reasonable to interpret the requirement that costs should not be disproportionate to benefits as entailing that the former should not exceed the latter (as required by the standard cost–benefit analysis criterion). However, this means that the benefits, including the risk reduction, must be transformed to costs as in cost–benefit analysis, for example, by calculating the expected net present value E[NPV]. It is well known that there are considerable difficulties in this transformation, see e.g., Melchers [7]. The problem is particularly sensitive to the analysis of activities, where the value of human life and the cost of suffering and deterioration of the quality of life may play a major role in the analysis. In protecting against attacks, we also have the problematic issue of potential loss, or at least perceived loss, or personal liberties due to certain types of protective measures such as data mining based on intercepted electronic mail or phone conversations.

A common approach is to use cost-effectiveness indices, such as the implied cost of averting a fatality (ICAF), defined by the expected cost per expected number of saved lives. If the ICAF of a risk reducing measure is not too high, the costs are not (grossly) disproportionate to the benefits gained. Typical threshold values are £1–2 million [8,9]. For certain applications the numbers are much higher. For example, in the UK offshore industry, it is common to use £6 million [8]. This increased number is said to account for the potential for multiple fatalities and uncertainty, and this may be viewed as an extra weight justified by the gross disproportion criterion.

Following this perspective the issue is what factor to use to reflect gross disproportion. For the offshore industry the factor is about 6, but more common factors are 2 and 3. It is acknowledged that 'gross disproportion' essentially takes the form of a multiplier applied to the value of the health and safety benefits and increasing with the level of risk. Precise values for this multiplier have never been defined by the courts.

2.2. A broader integrated risk and economic perspective

It is acknowledged that the outcome of cost–benefit type of analysis is only one of several considerations that go towards the judgment that the risk has been reduced ALARP. These analyses have limitations. Reducing risk cannot be measured only by reference to expected values as is typically done for economic analysis. To reflect this, broader evaluation processes are required than prescribed by economic analyses in isolation. A procedure in line with this is summarized in the following steps [9] and is also shown in Fig. 1.

- Perform a crude qualitative analysis of the benefits and burdens of the risk reducing measure. If the costs are not judged to be large, implement the measure. Gross disproportion has not been demonstrated.
- If the costs are considered large, quantify the risk reduction and perform an economic analysis as indicated above (computing for example E[NPV] or ICAF). If E[NPV] $>$ 0 or ICAF is low (typically less than some few £ millions), implement the measure. Gross disproportion has not been demonstrated.
- If these criteria are not met, assess uncertainty factors and other issues of relevance not covered by the previous analyses. A check list is used for this purpose. Aspects that could be covered by this list are:
  - Is there considerable uncertainty (related to phenomena, consequences, conditions) and will the measure reduce these uncertainties?
  - Does the measure significantly increase manageability? High competence among the personnel can give increased assurance that satisfactory outcomes will be reached.
  - Is the measure contributing to obtaining a more robust solution?
  - Is the measure based on best available technology (BAT)?
  - Are there unsolved problem areas: personal safety-related and/or work environment-related?
  - Are there possible areas where there is conflict between these two aspects?
  - Need for strategic considerations?

  If the risk reducing measure scores high on these factors (many yes answers), gross disproportions have not been demonstrated.

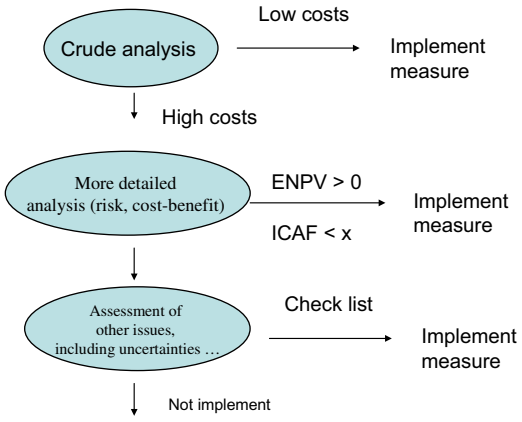

Fig. 1. Procedure for verifying gross disproportion [9].