

Quantifying the Impact of Multiple-Fatality Events

Introduction: The purpose of this paper is to discuss approaches for quantifying the impact of multiple fatalities in risk assessment. The core question was posed by Slovic et al. (1984) as:

“How should a single accident that takes N lives be weighted relative to N accidents, each of which takes a single life?”

The answer to this question has important implications for risk-related decision making and resource allocation. All else being equal, disproportionate weighting of one event type can be assumed to generally lead to an increase in the other event type, assuming limited resources for risk mitigation.

Background: Historically various proposals on how to quantify the societal impact of multiple-fatality accidents have been along the lines of asserting that the social cost of N lives lost in a single accident is a function of N^a - it has been argued that a single large accident is more serious than many small accidents producing the same number of fatalities, hence $a > 1$.

Analysis of accident statistics led Ferriera and Slesin (1976) make the conclusion *that “the value of each additional life lost in a single accident is greater than the one before”* (as cited in Slovic et al. 1984). However, this was based on the assumption that the observed relationship between severity and frequency was reflective of the controlling influence of society’s value-system. Griesmeyer et al. (1979, as cited in Slovic et al. 1984) noted that the observed relationship could be due to many other factors, such as the cost of accident prevention and physical limitations on the number of situations that could lead to large consequence events.

Recent Developments: The UK Health and Safety Executive (HSE) conducted a review of related prior research, case studies and social impact assessments, publishing a report entitled *‘Evidence or Otherwise of Scale Aversion: Public Reactions to Major Disasters’* (HSE 2009). Key findings of the report include the following¹:

“There is some research based evidence for scale aversion and some against. The greater weight of research demonstrates that, even where it is evident, scale aversion is not consistent and is dependent on numerous factors many of which are themselves subject to change and are subjective. Therefore, although scale aversion may exist in some situations, it is not a consistent phenomenon.” (HSE 2009)

“As there is little by way of consistent, ‘tidy’, predictable evidence for scale aversion both in research and public reaction to major accidents, it is neither practical nor sensible to attempt to measure it in mathematical terms.” (HSE 2009)

It was also noted that public reaction is very dependent on media coverage, which is an amplifier of people’s reactions. Earlier research by Slovic et al. (1984) found that the societal impact of an accident is determined to an important degree by what it signifies or portends, e.g. that a system is not as well understood as was previously thought. Other factors include the distinction between voluntarily accepted risks and involuntarily accepted risks, the level of personal control as well as ‘vulnerability’, e.g. children (Keeney 1980).

Recommendation: It is recommended that no generalised ‘scale aversion’ adjustments be made in risk assessments regarding the impact of multiple-fatality accidents at a societal level. As a starting point, N fatalities from a single event should be treated the same N single fatality events. Additionally, in certain situations it may be valuable to elaborate the consequences and subsequent flow-on effects of various events and attempt to assign some measure of their costs, potentially allowing specific ‘custom’ adjustments to be made in these cases, e.g. if certain events were seen to impact on the functioning or resilience of significant areas of society.

¹ The report is available online at: <http://www.hse.gov.uk/societalrisk/evidence-or-otherwise-of-scale-aversion.pdf>.

Further Reading

The following references are highly recommended for further reading, they each include a well-rounded review of related literature:

HSE, 2009. Evidence or Otherwise of Scale Aversion: Public Reactions to Major Disasters. , (June).

Slovic, P., Lichtenstein, S. & Fischhoff, B., 1984. Modeling the Societal Impact of Fatal Accidents. *Management Science*, 30(4), pp.464–474.

Other References

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Vrijling, J.K. & Ouwerkerk, S.J., 2005. Criteria for acceptable risk in the Netherlands. In *Infrastructure Risk Management Processes- Natural, Accidental and deliberate Hazards*. pp. 145–160.