



A Note on Risk Communication Failures Between Safety Engineers and Non-Specialist Stakeholders

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Abstract

Risk and safety science for engineers has developed increasingly sophisticated quantitative methods for hazard analysis, including fault tree analysis, bow-tie modeling, and probabilistic risk assessment frameworks capable of producing precise numerical estimates of failure likelihood and consequence severity. In our experience reviewing safety case documentation across several infrastructure and industrial projects, we have observed a recurring communication gap between the engineers producing these quantitative risk assessments and the non-specialist stakeholder's regulators, community boards, and executive decision-makers who must ultimately act on them. This short communication documents that gap and suggest it warrants more direct attention within engineering risk communication training.

Keywords: Safety Engineers; User Interface Design; Risk Communication Failures; User Experience

Introduction

In reviewing safety case submissions and observing associated stakeholder meetings across several projects, we noted a consistent pattern: quantitative risk figures, once presented, tended to anchor discussion in ways that displaced qualitative context that the original analysts considered important [1]. A probability estimate expressed as, for example, a specific annual failure frequency, was frequently treated by non-specialist stakeholders as a precise and directly comparable figure across different hazard scenarios, even when the underlying analysts intended the figure primarily as an order-of-magnitude estimate subject to substantial modeling uncertainty. We observed this particularly in comparative contexts, where stakeholders were asked to weigh one proposed design against another and gravitated toward the numerically smaller risk figure without engaging with the confidence intervals or assumption sets underlying each estimate, sets which in

several cases differed enough between the two analyses that direct comparison was of doubtful validity.

Discussion

This pattern is consistent with a broader risk communication literature outside engineering specifically, which has long documented the tendency for single point estimates to be over-trusted relative to the ranges and assumptions that produced them, particularly among audiences without training in probabilistic reasoning. What we would add, from an engineering risk science perspective specifically, is that safety case documentation conventions may inadvertently reinforce this tendency by foregrounding a single headline risk figure in executive summaries while relegating assumption sets, sensitivity analysis, and confidence bounds to technical appendices that non-specialist stakeholders reviewing time-constrained submissions are unlikely to read in full [2].

We would suggest that engineering risk communication practice, and potentially training curricula for engineers producing safety cases, place more explicit emphasis on presenting uncertainty ranges and key assumptions alongside headline risk figures in the same summary-level documentation that decision-makers actually engage with, rather than treating uncertainty disclosure as a secondary technical matter appropriate only for specialist appendices. Presenting a range with explicit assumption caveats directly alongside the headline estimate, even at some cost to the apparent precision and persuasive cleanliness of the summary, would likely produce more appropriately calibrated stakeholder decisions than the current convention of headline figure plus buried caveat [3].

Conclusion

This communication reflects a pattern observed across a limited set of project reviews rather than a systematic study, and we would welcome more rigorous survey or experimental work testing whether altered summary-level

presentation formats measurably change stakeholder risk calibration in practice. Given the decision-relevance of safety case documentation in infrastructure and industrial contexts, we consider this a worthwhile area for further empirical attention within risk and safety science for engineers.

References

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