

Proceedings of the 35th European Safety and Reliability & the 33rd Society for Risk Analysis Europe Conference
 Edited by Eirik Bjorheim Abrahamsen, Terje Aven, Frederic Boudier, Roger Flage, Marja Ylönen
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 doi: 10.3850/978-981-94-3281-3_ESREL-SRA-E2025-P7742-cd

Towards practical definitions of quality of maritime risk analyses during procurement processes

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In the maritime context, national authorities and other actors regularly procure risk analyses from external providers. In the public sector this requires the drafting, publishing and evaluating the outcomes of formal calls for tenders. In such procurement processes, the *quality* of the received proposals is typically highlighted as a key criterion to be used when deciding on the winning bid, alongside other features such as price and the availability of sufficient personnel/other resources. This implies estimating the quality of a risk analysis, before it is carried out. As this is naturally a challenging task, the quality criteria of risk analyses are commonly simplified one way or another, often involving the perceived quality of previously produced studies or simply relying on the provider's overall reputation. This might be convenient in practical situations where a provider must be selected under time pressure. However, it may present a missed opportunity to ensure best value for money and, in the bigger picture, raise the standard of commissioned risk studies and the field at large. Our contribution builds on the SRA Risk Analysis Quality Test with a specific focus on which tests could be relevant for the risk analysis tendering stage. Based on an initial review by the authors, we propose two lists of key criteria for this purpose: one for drafting calls for proposals and another for evaluating them. Aimed primarily to initiate a focus on this aspect of risk management, the initial lists will be further developed during interviews and workshops with potential end-users in future work.

Keywords: Risk Analysis, Procurement, Quality, Evaluation, Maritime Authorities, Navigation, Waterway risk, Goal-based regulation.

1. Introduction

In the maritime application domain and other contexts, national authorities and other actors regularly draft, issue and evaluate the outcomes of invitations to tender for risk analyses (SRA 2018). The purpose of these procurement processes is to select an external consultant to deliver an analysis which is needed to support risk management decisions. In the maritime context, examples include the need of authorities to assess the navigational safety impacts of new developments (e.g. offshore wind farms or routing measures), or that of industry actors to provide evidence that their design or process fulfils Goal-Based

Standards (GBS) of the International Maritime Organization (IMO).

In procurement, the *quality* of the received proposals is typically highlighted as a key criterion for deciding on the winning bid, along with other features such as price and the availability of sufficient personnel and other resources. This implies estimating the quality of a risk analysis, before it is carried out. As this is naturally challenging, the quality element is commonly simplified through proxy criteria such as the overall reputation of the provider or the perceived quality of previously delivered and available studies. This might be convenient in practical situations where a provider must be

selected under time pressure. However, it can also be a missed opportunity to ensure best value for money and, in the bigger picture, raise the standard of commissioned risk studies and risk analysis quality in the wider application domain, especially given the absence of a current lack of widely applied risk analysis quality criteria in the maritime domain.

In this paper, we explore and build on the content and underlying ideas of the Risk Analysis Quality Test (RAQT), published by the Society for Risk Analysis (SRA) (Lathrop et al. 2020, Lathrop et al. 2024) to increase the focus on quality in procurement processes of maritime risk studies. We do this by proposing two initial sets of quality criteria derived from SRA's RAQT: one for the purpose of drafting calls for risk analysis proposals, and another for evaluating them. The lists have been created by mapping a selection of RAQT tests to the steps of the IMO Formal Safety Assessment (FSA) framework (IMO 2018). We consider this necessary as IMO FSA is, since the 1990s, a *de facto* standard for maritime risk studies. Risk management standards have an important role in harmonising practices (Parviainen et al. 2021), however they might also limit the advancement of risk and safety (Aven and Ylönen 2019). We also extend our scope beyond the FSA framework, to capture all the steps in currently most widely used standard for risk management across industrial domains, i.e. the ISO 31000 standard (ISO 2018). Our initial proposals are intended as a potential RAQT complement for the specific context of fast paced public procurement processes.

2. Context and Methods

2.1 Outline of procurement processes

Procurement, the structured purchasing of goods or services (such as the delivery of risk analyses) from suppliers, is a core activity of both public and private organizations. Two primary purchasing arrangements can be identified: partnership sourcing and adversarial competition (Parker and Hartley, 1997). This paper focuses mainly on public procurement of the latter type, where two or more vendors compete for a contract through a tendering process.

An important difference between private and public settings is that while private organizations are freer to select a provider, and thus commonly rely on partnership sourcing, the

commissioning of services (such as risk studies) by public entities need to follow more specific rules to ensure good use of public funds. This includes procurement laws, transparency requirements, and evaluation criteria (Moe et al., 2017; Ystmark et al., 2019). Within the EU, this process is regulated by directives such as the EU Public Procurement Directive (Directive 2014/24/EU), which establishes uniform rules to enhance competition and transparency across member states.

Any successful tendering process requires a systematic and well-structured approach to ensure high-quality outcomes while upholding principles of transparency, fairness, and cost-effectiveness. The tendering process begins with a needs assessment and project definition, where the scope of services is identified and detailed project specifications, and in some cases limitations, are defined. Then the process moves to tendering, i.e., public advertisement, where tenders are openly advertised to ensure transparency and foster competition. Evaluation criteria are listed at this stage to guide submissions and ensure fair assessment. In EU member states, Tenders Electronic Daily (TED) (EU 2025) serves as an online portal for publishing public procurement notices which exceed specified budgetary threshold values.

Then, the bid submission and evaluation phase take place where suppliers submit their proposals. Authorities evaluate these bids based on the published criteria, typically including cost and quality. Typical proxy measures for bid quality include previous references, (perceived) technical and methodological competence, and compliance with relevant standards. After this evaluation, the contract negotiation stage ensues, in which the winning bidder is selected, and the contract terms are finalized.

Once the contract is awarded, the focus shifts to contract management and performance monitoring. Maritime authorities closely oversee the execution of the contract to ensure that the work aligns with the agreed-upon terms and schedules. Finally, the process concludes with post-project evaluation, where authorities assess the project's outcomes, and review the contractor's performance.

2.2 Defining Quality of Risk Analyses in procurement processes

While quality (in addition to price) is typically highlighted as a key award criterion in procurement processes of risk analyses, it is less straightforward to define what it means in more specific terms. As a result, quality aspects might be down prioritized in procurement processes, or attributed quality may be based on the general reputation, brand, or perceived expertise of the provider, and less the actual merits of the received proposals.

General guidelines in the field of risk management, e.g. the ISO 31000 standard (ISO 2018), or for the maritime domain, e.g. IMO Guidelines for Formal Safety Assessments (IMO 2018), do point at general characteristics of good risk assessments or analyses, but do not specify quality in detail. This gap in establishing criteria for risk analysis quality has been recently filled through the *Risk Analysis Quality Test (RAQT)* (Lathrop et al. 2020). The report, published under the umbrella of the Society for Risk Analysis, includes a battery of 76 questions/tests, divided to 15 categories, to comprehensively evaluate/define the quality of risk analyses supporting risk management decisions (Lathrop et al. 2024).

While we acknowledge the merits of RAQT in defining quality of risk analyses also for procurement purposes, we interpret (perhaps wrongly) that in its current, extensive, form it requires some adjustments for procurement purposes. We also observe that its structure differs from that of the IMO FSA framework. As IMO FSA is a widely used standard for maritime risk analyses, some sort of bridge between it and the RAQT would likely be needed to facilitate uptake of the latter in maritime circles.

2.3 IMO FSA as a de facto maritime risk analysis standard & its limitations

The IMO Formal Safety Assessment (IMO 2018) framework, developed during the 1990s and first formally adopted in 2002, introduced risk management culture to the work of the IMO, and with it, within the wider maritime domain. While it has its limitations (Rosqvist and Tuominen 2004, Psarafitis 2012), it remains a cornerstone of risk analyses in the maritime domain (Montewka, Goerlandt and Kujala 2014). IMO FSA is structured around five steps (IMO 2025):

1. identification of hazards (a list of all relevant accident scenarios with potential causes and outcomes);
2. assessment of risks (evaluation of risk factors);
3. risk control options (devising regulatory measures to control and reduce the identified risks);
4. cost benefit assessment (determining cost effectiveness of each risk control option); and
5. recommendations for decision-making (information about the hazards, their associated risks and the cost effectiveness of alternative risk control options is provided).

It should be noted that the five FSA steps do not cover the whole continuum of modern risk management thinking (e.g. SRA 2018, ISO 2018), which also emphasise the importance of additional elements such as ensuring proper orientation in the context, scope, risk communication and stakeholder consultation as well as monitoring and review.

2.4 Method

As a prototyping exercise, we combined the RAQT, FSA and ISO 31000 frameworks to explore new ways to promote quality in the procurement of maritime risk analyses. Through initial discussions, we drafted a table with rows representing a set of risk analysis steps, consisting of a synthesis of the five FSA steps and additional steps from the ISO 31000 framework. Subsequently, each of the five authors used their expert judgement to select key RAQT tests corresponding to the identified steps. The results were then combined to a joint table through an iterative discussion process, with key RAQT derived tests for each step. Finally, two columns of quality criteria were derived from this material: one for the purpose of drafting calls for proposals and another for evaluating them.

3. Results: Initial template for quality of maritime risk analyses in procurement processes

The result of our analysis is presented in Table 1 (c.f. following pages).

Table 1: Proposed Draft Key Risk Study Quality Criteria for: A) Drafting Tender / Request for Quote & B) Quote Preparation/Evaluation.

| ISO 31000 Steps | FSA Steps (3.1.1.1, p.5) | Main SRA Quality Tool categories | A) Key Quality Criteria for Tender / Request for Quote Drafting | B) Key Quality Criteria for Quote Preparation/Evaluation |
|---|------------------------------|---|--|--|
| Scope, Context, Criteria | Not covered explicitly | Category A. Framing the Analysis and Its Interface With Decision Making c.f. RAQT A1, A2, A3, A5, A6, and A7. | Clearly describing aims/the decision-making process to be supported with study, including the risks or costs of failure. Specifying evaluation criteria of tendering, especially quality aspects. Describing decision-making needs, statutory authority, legal requirements and other relevant decision-maker perspectives. | Demonstrate understanding of aims/the decision-making process to be supported, including the risks or costs of failure. Demonstrate understanding of decision-making needs, statutory authority, legal requirements, and other relevant decision-maker perspectives. |
| Communication & Consultation (Stakeholder engagement) | Not covered explicitly | Category C. Risk Communication; Category D. Stakeholder Involvement; Category A c.f. RAQT A4, C1, C2, D1 | Needs for a stakeholder identification/engagement process (as desired). Needs for stakeholder engagement measures to set the scope, participate in expert judgment exercises, comment on hazard and risk analyses and their results. Needs to integrate communication into the risk analysis (as desired). | Provision of a provisional list of relevant stakeholders (at some level). Propose appropriate stakeholder engagement measures to set the scope, participate in expert judgment exercises, comment on hazard and risk analyses and their results Propose communication measures (including with decision makers). |
| Risk identification | 1 identification of hazards; | Category B. Capturing the Risk Generating Process (RGP); Category J. Uncertainty: Sources, Characterization, Implications for Risk Management; Category A c.f. RAQT B1, B5, J10, J12 | Highlighting pre-identified (key) risk categories to be focused on, based on ultimate aims of study. Needs to include a systemic, comprehensive identification of hazards and events, including both risks and opportunities. Needs to cover unforeseen hazards or events (e.g., Black Swan events). | Appropriate focus on pre-identified (key) risk categories, based on ultimate aims of study. Plans to carry out a systemic, comprehensive identification of hazards and events, including both risks and opportunities. Plans on how to consider unforeseen hazards or events (e.g., Black Swan events) and how will the implications of these scenarios be integrated into the overall risk management strategy. Select and describe methods for the above topics. |
| Risk Analysis | 2 risk analysis; | Category B; Category E. Assumptions and Scope Boundary Issues; Category G. Basis of Knowledge; Category H. Data Limitations, Availability, Collection, Management, Verification, Validation; Category K. Consideration of Alternative Analysis Approaches; Category I. Analysis Limitations; Category J. Uncertainty: Sources, | Need to consider data limitations, & uncertainties (including possibilities of systemic changes). Need to propose alternative analysis approaches, then logically select among them? Need to apply the findings of the risk identification step (Risk Generating Process) in analysis, including possible systemic changes. Need to validate/review the selected model and analysis results | Identification of available data sources. Commitment to (or a plan for) accounting for data limitations, & uncertainties (including possibilities of systemic changes). Demonstrating knowledge of plausible analysis approaches/methods, then logically select among them? Clearly describing and argue for the selected analysis method. Identifying aspects of relevant risk which the selected analysis methods will likely be unable to cover in a satisfactory way Commitment to apply the findings of the risk identification step (Risk Generating Process) in analysis, including possible systemic changes. |

| | | | | |
|---|--|---|--|---|
| | | Characterization, Implications for Risk Management; Category M. Model and Analysis Validation and Documentation c.f. RAQTs of the categories E, G, H, K, I, J & M, as appropriate | | Consider need, and methods for, validating/reviewing the selected model and analysis results. |
| Risk Evaluation & Risk Treatment (6.5.2) | 3 risk control options; 4 cost-benefit assessment; | Category F. Proactive Creation of Alternative Courses of Action c.f. RAQT F1 | The need to propose alternative courses of action, then logically/methodologically select among them a shortlist for decision? | Aims of, and methods for, deriving alternative courses of action. Aims of providing, and methods for logically/transparantly creating a shortlist for decision makers? |
| Risk Treatment (6.5.3 Preparing) | 5 recommendations for decision-making. | Category A, Category L Robustness and Resilience of Action Strategies. c.f. RAQT A2, A3, L1 | The need to propose recommended courses of action, and their robustness. | Delivery of clear recommended courses of action, including argumentation for the recommendation. Acknowledging limitations and robustness of the recommended courses of action Alignment with the client's decision-making needs, addressing statutory authority, legal requirements, and decision-maker perspectives, while identifying limitations, supporting tradeoffs, and addressing risk management flaws |
| Risk Treatment (6.5.3 implementing) | (Not covered explicitly) | (Not covered explicitly) | (Not relevant for studies) | (Not relevant for studies) |
| 6.6 Monitoring and review | (Not covered explicitly) | Category M Model and Analysis Validation and Documentation c.f. RAQT M2 | Needs to transparently document methods and models to allow external reruns/review. | Acknowledge, and plan for, documenting methods and models used, to allow external reruns/review. Disclosure of any proprietary tools/models to be used but which will not be available for review. |
| 6.7 Recording and Reporting | (10. Presentation of FSA results) | Category A; Category C; Category J; Category M; Category L; Category N Reporting c.f. RAQT A8, J17 (also J1, J16, A7 & A9?) | Needs around communicating the results clearly to decision-makers, including the provision of a summary of uncertainties and assumptions with their implications. Request to disclose any potential conflicts of interest. | Understanding the need to, and propose methods/tools for, communicating the results, including summary of uncertainties and assumptions with their implications, clearly to decision-makers? Disclosure of potential conflicts of interest. |
| Budget | - | Category O. Budget and Schedule Adequacy | The cost range (if appropriate) Any cost breakdown requirements | The cost of the proposed study, including that of any optional additional elements and breakdowns. |
| Timeframe | - | Category O. Budget and Schedule Adequacy | Deadlines/milestones/timeline requirements. | Delivery schedule (milestones) of the proposed study |
| Human Resources | - | (Not covered explicitly) | Requirements for staff availability and backup arrangements | Staff availability and backup arrangements |
| Qualifications/References | - | (Not covered explicitly) | Requirements for references/qualification documentation | References/qualifications |

4. Discussion and conclusions

The quality of risk analyses needs more focus, especially in the context of procurement processes. The initial quality criteria presented in Table 1 are provided to initiate an academic and professional focus on this theme, which has not received much attention to date. An underlying motivation is to explore ways to leverage the extensive knowledge underlying the SRA Risk Analysis Quality Test (Lathrop et al. 2020) with the practices of maritime risk analyses, which are commonly based on the framework of the IMO Formal Safety Assessments (IMO 2018).

As an initial proposal, future work is needed to further elaborate, modify or affirm the presented list. This can for instance be done via a Delphi study (Laine et al. 2024) or through workshops with potential end-users. This can lead to a more structured set of quality criteria for procurement processes, perhaps similar to a maturity model, which would have wider acceptance among maritime industry and authority professionals working with risk analysis.

Acknowledgements

This research was co-funded by OpenRisk II (Tools for shared & dynamic maritime traffic risk picture of the Baltic Sea region; project no. C041) project, co-funded by the Interreg Baltic Sea Region Programme 2021-2027, to support the transition toward a greener and more resilient Baltic Sea region. The contributions by the 5th author have been supported by the Natural Sciences and Engineering Research Council of Canada (NSERC), through the Discovery Grant Program (award number RGPIN-2019-05945) and the Canada Research Chairs Program (award number CRC-2023-00059).

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