**Society for Risk Analysis - Analysis Quality Test Battery, AQT Battery**

**Version:** Work in Progress March 18th 2019. Commented on by Terje Aven 3/19. Those comments responded to by John Lathrop 4/13/19. All of those changes incorporated in this version without marking.

**Introduction**

* This document presents a number of tests that can be used to evaluate the quality of risk analyses. We present these as a “battery” of tests, to stipulate that all of these tests should be applied, not just any selected subset. Sections A – O present general Analysis Quality Tests applicable in all domains. Section P presents domain specific tests. In the current version of the document, only one domain; terrorism risk assessment, is presented.
* Risk analysts are expected to answer each quality question, each AQT, with one of three responses:
  + Yes (then summarize the corresponding analysis quality feature)
  + No (then summarize the implications of that shortfall for risk management decision making)
  + DNA (Does Not Apply; realizing that any "DNA" could be questioned by any party,  
     so a DNA should be accompanied by a justification if it is not obvious).
* The goal here is “Full Disclosure,” not insistence on any ideal analysis quality. That is, in the real world of budgets, schedules, competing interests, and other decision factors, no analysis can (or perhaps even should) score a “Yes” or “DNA” on every AQT here. But risk management decision makers using risk analysis should be made aware of any shortfalls, and the implications of those shortfalls for their decision making.
* Related point: Any review of a risk analysis should consider improvements in the analysis. By design, and for clarity and focus, we leave considerations of analysis improvement outside the scope of the AQT Battery, but note that they should be part of any review.
* Many times here we refer to “risk management decision makers,” in particular associated with the phrases “should be made aware of,” “understandable to” and related phrases. In all such cases, we specifically mean decision makers who are NOT experts in risk analysis.
* By “analysis,” here we mean all of the analysis steps involved in supporting risk management decisions, that is: - setting context - risk communication **-** stakeholder involvement, - risk management decision making, and  
   - risk identification - risk governance.  
   - risk assessment
* This AQT battery may seem overly long and burdensome. We have three responses:  
  1) A conscientious review process should be able to complete this review  
   within a reasonable amount of time and effort.  
  2) For any particular analysis, a large number of these AQTs will probably have “DNA” responses.  
  3) These AQTs should all be addressed. It is indefensible to maintain that only some of these AQTs  
   should be addressed since to address all of them would be “too difficult.”
* An academic study of risk analysis could more the double the AQTs we list here. Our goal is not to be complete, but to identify the AQTs that most efficiently determine analysis quality in practice.  
  We selected these AQTs based on pitfalls and shortcomings we have observed in practice.
* It would be impossible to craft these AQTs in such a way that they would apply well at a detailed level to every analysis. So these AQTs are crafted very generally, and we depend on reviewers of each analysis to do a responsible job of applying each AQT to the analysis being reviewed.

**Contents (Ctrl Click on any line to jump to that Section or AQT)**

Section A. [Framing the Analysis and Its interface With Decision Making](#_Section_A._Framing)  
AQT 1 [Clarity of the goal](#Clarity_of_goal) of the analysis  
AQT 2 [Clarity of the decisions](#Clarity_of_decisions) to be supported  
AQT 3 Adequately [diverse set of perspectives](#Diverse_Perspectives) consulted in the naming and framing of the problem  
AQT 4 Appropriately [positioned in the organization chart](#Position_in_org_cht)  
AQT 5 [Embedding](#Embedding) in the decision process  
AQT 6 Decision maker [focus](#Focus)  
AQT 7 Analysis report [formats designed to be as helpful](#Formats_Helpful) as possible to decision makers  
AQT 8 Adequate [breadth, depth and detail](#Breadth_etc) to support the risk management decisions  
AQT 9 Societal and stakeholder [acceptability](#Acceptability)

Section B. [Capturing the Risk Generating Process (RGP)](#_Section_B._Capturing)  
AQT 10 [Comprehensiveness](#Comprehensiveness) of hazards/events, scenarios, scenarios “Not On the List,” implications  
AQT 11 [Complexity](#Complexity) of the RGP fully understood and taken into account  
AQT 12 Analysis methods [appropriate for the level of complexity](#Appropriate_for_complexity) of the RGP  
AQT 13 Process for [detecting early warnings](#Detecting_early_warnings)  
AQT 14 Consider [possibility of systems changes](#Possibility_changes)

Section C. [Communication](#_Section_C._Communication)  
AQT 15 [Communication integrated into the risk analysis](#Established_norms) following norms, e.g. ISO 31000, IRGC  
AQT 16 [Communication science](#AQT_16) used to scope the problem, inform the assessment methodology  
AQT 17 [Communication adequate](#AQT_17) between analysts, decision makers and stakeholders

Section D. [Stakeholder Involvement](#_Section_D._Stakeholder)  
AQT 18 [Stakeholder identification and assessment](#AQT_18)  
AQT 19 Stakeholders [consulted and engaged](#AQT_19)  
AQT 20 [Stakeholder communication integrated into the risk analysis](#AQT_20) following norms, e.g. IAP2  
AQT 21 Stakeholders’ [needs/interests/perspectives](#AQT_21) incorporated into naming-framing the problem  
AQT 22 Consideration of [stakeholders’ perceptions and concerns](#AQT_22)  
AQT 23 [Would all stakeholders agree](#AQT_23) that their perceptions and concerns were fully considered  
AQT 24 How much of stakeholder communication is [technical experts informing stakeholders](#AQT_24)  
AQT 25 [Stakeholders involved in the risk management decision process](#AQT_25)  
AQT 26 [Stakeholders involved in the risk management implementation process](#AQT_26)

Section E. [Assumptions and Scope Boundary Issues](#_Section_E._Assumptions)  
AQT 27 [All important assumptions and their implications listed](#AQT_27) in language clear to decision makers  
AQT 28 Risk variant of AQT 27: [Evaluation of the risk that an assumption deviates from the RGP](#AQT_28)  
AQT 29 All important [scope boundary issues and their implications](#AQT_29) listed in language clear to DMs

Section F. [Pro-Active Creation of Alternative Courses of Action](#_Section_F._Pro-Active)  
AQT 30 Process to create [alternative courses of action](#AQT_30) other than what originally considered

Section G. [Basis of Knowledge](#_Section_G._Basis)  
AQT 31 [Characterize the basis of each of the key sources of knowledge used](#AQT_31) in the analysis  
AQT 32 Characterize the [strength of knowledge in terms of its adequacy](#AQT_32) to support the decisions  
AQT 33 Clearly communicate to decision makers where [limitations of knowledge](#AQT_33)  
 call for risk management strategies that take those limitations into account  
AQT 34 Consider the role and importance of [surprises and unforeseen events](#AQT_34), Black Swans  
AQT 35 Consider [conflicting opinions](#AQT_35) between experts  
AQT 36 [Report all conflicting opinions](#AQT_36)  
AQT 37 [Consider unknown knowns](#AQT_37), i.e. knowledge of others, outside the analysis group  
AQT 38 Consider that some events may have been [disregarded as too unlikely](#AQT_38),  
 when that is based on assumptions

Section H. [Data Limitations](#_Section_H._Data), Availability, Collection, Verification, Validation, Management, Quality  
AQT 39 [Analyze data limitations](#AQT_39) and the implications of those limitations  
AQT 40 [Manage data](#AQT_40) with a system that logs all data and maintains data QA/QC, documented  
AQT 41 [Verify data](#AQT_41) for internal consistency  
AQT 42 [Validate data](#AQT_42) against external reference points

Section I. [Analysis Limitations](#_Section_I._Analysis)  
AQT 43 [Describe all analysis limitations](#AQT_43) as they apply to the risk management problem  
AQT 44 [Verify all calculations](#AQT_44), including with sensitivity analyses  
AQT 45 Check that [all metric levels in the results are supported](#AQT_45) by metrically valid operations

Section J. [Uncertainty](#_Section_J._Uncertainty:): Are All Sources Described  
 and The Implications for Risk Management Made Clear?  
AQT 46 [Characterize any aleatory uncertainty](#AQT_46) in terms that decision makers can understand  
AQT 47 Characterize the [propagation of that aleatory uncertainty into results](#AQT_47), in understandable terms  
AQT 48 [Characterize any epistemic uncertainty](#AQT_48) in terms that decision makers can understand  
AQT 49 Characterize the [propagation of that epistemic uncertainty into results](#AQT_49), in understandable terms  
AQT 50 [Characterize any model uncertainty](#AQT_50) in terms that decision makers can understand  
AQT 51 Characterize the [propagation of that model uncertainty into results](#AQT_51), in understandable terms  
AQT 52 Characterize the [combined uncertainty](#AQT_52), aleatory, epistemic, and model uncertainty,  
 in the results in terms that decision makers can understand  
AQT 53 Make the [implications of that combined uncertainty](#AQT_53) for decisions clear to decision makers

Section K. [Consideration of Alternative Analysis Approaches](#_Section_K._Consideration)  
AQT 54 Consider [all plausible analysis approaches](#AQT_54), then logically select among them  
AQT 55 Make clear to decisions makers the [implications of choosing an alternative approach](#AQT_55)

Section L. [Robustness and Resilience of Action Strategies](#_Section_L._Robustness)  
AQT 56 Explicitly [examine the need for robustness and resilience](#AQT_56) of action strategies  
AQT 57 Test that the recommended risk management strategies  
 include [the robustness and resilience](#AQT_57) called for

Section M. [Model and Analysis Validation and Documentation](#_Section_M._Model)  
AQT 58 [Validate](#AQT_58) the model and analysis  
AQT 59 [Document](#AQT_59) that validation for third party review

Section N. [Reporting](#_Section_N._Reporting)  
AQT 60 [Define](#AQT_60) all key terms  
AQT 61 [Explain and motivate](#AQT_61) all results without using abstract terms  
AQT 62 If results are [not as expected, explain](#AQT_62)

Section O. [Budget and Schedule Adequacy](#_Section_O._Budget)  
AQT 63 Test that the [budget and schedule](#AQT_63) adequate for adequate analysis quality and defensibility

Section P. [Domain Specific AQTs](#_Section_P._Domain_1)

P1. [Adversary Modeling](#_P1.__Adversary)  
AQT P1.1 [Characterize and model adversaries](#P1_1) with the most appropriate adversary model  
AQT P1.2 Populate the adversary models with the [best available Subject Matter Experts & elicitation](#P1_2)  
AQT P1.3 Model [adversary reactions](#P1_3) to defensive courses of action  
AQT P1.4 Model adversary [acquisition of information and capabilities](#P1_4)  
AQT P1.5 Account for [“Deliberate Black Swans”](#P1_5)

# Section A. Framing the Analysis and Its interface With Decision Making

1. Clarity of the goal of the analysis.
   1. Is the goal of the analysis clear and clearly announced?  
      So that all parties can work toward that same goal without special communication.
   2. Is the risk/cost of falling short of that goal described?  
      So that all parties are appropriately motivated to achieve that goal.

Example goals: to assure a safe design, to develop a safe design, to select the best design, to demonstrate the level of safety to others, to evaluate insurance or risk management policies.

1. Are the decisions to be supported by this risk analysis clearly identified?  
   Example decisions: go/no-go on a project or action, or decide among actions, strategies or policies.
2. Are an adequately diverse set of perspectives (i.e., different risk management and stakeholder parties) effectively consulted in the naming and framing of the risk management problem, including scoping?

<<Back to [TOC](#TOC)>>

1. Is the risk analysis positioned appropriately in the organization chart of the client?  
   Points in the organization chart may range from tactical to strategic, from risk management to management to enterprise management, etc. For example, does the risk analysis deliver results to points in that chart (perhaps several points), such that for each point, it has the appropriate funding, timing and credibility?
2. Embedding in the Decision Process
   1. Is the risk analysis fully and effectively engaged with the risk management decision makers?
   2. Does the risk analysis timeline effectively support specific points in decision making?
3. Decision Maker Focus
   1. Does the risk analysis give risk management decision makers risk information customized to their perspectives?  
      That is, is the analysis shaped to each risk manager’s ability to address the risk?
   2. Does the risk analysis support risk management decision makers to:
      1. Understand the limitations of the analyses,  
          and the implications of those limitations for their decisions?
      2. Make tradeoffs against “Other Decision Factors”?
      3. Address sub-optimalities in the risk management processes?

<<Back to [TOC](#TOC)>>

1. Are the analysis report formats, numerical, graphical and text, explicitly and deliberately designed to be as helpful as possible to risk management decision makers, in combining the results of the analysis with the “Other Decision Factors” they may face in making their decisions?
2. Does the risk analysis have an adequate level of breadth, depth and detail to support the risk management decisions being supported?
3. Are societal and stakeholder acceptability systematically evaluated for:
   1. the risk management process?
   2. the recommended risk management actions?

<<Back to [TOC](#TOC)>>

# Section B. Capturing the Risk Generating Process (RGP)

1. Comprehensiveness
   1. Is there a structured taxonomy of hazards/events that is evidence of comprehensiveness?
   2. Is each scenario spelled out with agents and types of change?
   3. Are potential hazards/events/scenarios “Not On the List” (surprises, Black Swans) explicitly addressed?
   4. Are the implications of such hazards/events/scenarios for risk management explicitly described?
2. Is the complexity of the Risk Generating Process fully understood and taken into account? This can be tested by listing all the important (for the resulting risk) causal and associative links in the RGP, then demonstrating that each of those links is accounted for in the analysis. This needn’t be as burdensome as it may sound, if the causal and associative links are intelligently selected.
3. Are the analysis methods used appropriate for the level of complexity of the Risk Generating Process?

<<Back to [TOC](#TOC)>>

1. If the context calls for detecting early warnings, is there a process used for that detection?  
   Those early warnings include of potential surprising risk aspects, more broadly than concrete events.
2. Is the possibility of systems changes fully considered and recognized?  
   As part of that: Are adequate mechanisms in place to detect those changes?

# Section C. Communication

1. Is communication integrated into the risk analysis following established norms, e.g. using all aspects of:
   1. The ISO 31000 methodology: e.g., Establishing the context, Risk Assessment (Identification, Analysis, Evaluation), Risk Treatment?
   2. The International Risk Governance Council (IRGC) methodology: e.g., Pre-Assessment, Management, Appraisal, Characterization & Evaluation? Key: Categorizing the knowledge about the risk, and so related to Section G, Basis of Knowledge.
2. Has risk communication science been used to scope the problem and inform the assessment methodology?
3. Is communication adequate between: - analysts and decision makers?  
    - analysts and stakeholders?  
    - decision makers and stakeholders?  
   In all three cases, “adequate” means both parties agree the communication is adequate.

<<Back to [TOC](#TOC)>>

# Section D. Stakeholder Involvement

1. Has stakeholder identification and assessment been conducted?
2. Are all stakeholders effectively consulted and engaged?
3. Is stakeholder communication integrated into the risk analysis following established norms, e.g. using all aspects of:
   1. The International Association for Public Participation (IAP2) spectrum: inform, consult, collaborate, deliberate, empower?
   2. The Joint Fact Finding Methodology: problem identification, situation/stakeholder assessment, convene stakeholder process, scope methods of inquiry with stakeholder input, conducting the study with stakeholder participation, communicate results with stakeholders to generate interpretations and recommended actions.

<<Back to [TOC](#TOC)>>

1. Are stakeholders’ needs, interests, and perspectives effectively incorporated into the naming and framing of the risk management problem, including scoping? This is a version of AQT 3 as it applies to stakeholders.
2. Does the risk analysis fully consider stakeholders’ perceptions and concerns? How do you know that?
3. Would all stakeholders agree that their perceptions and concerns were fully considered?
4. To what degree is communication with stakeholders characterized by technical experts informing stakeholders, as opposed to two-way communication?
5. Are stakeholders appropriately involved in the risk management decision process?
6. Are stakeholders appropriately involved in the risk management implementation process?

<<Back to [TOC](#TOC)>>

# Section E. Assumptions and Scope Boundary Issues

1. Are all important assumptions, and the implications of each such assumption for risk management, listed systematically in language clear to risk management decision makers?  
   Example: A major model assumed that a critical resource constraint did not apply, as a way to avoid a large analysis burden. That assumption significantly distorted its risk ranking of alternative threats. That distortion was not made clear to decision makers.

The issue addressed in the above AQT has a risk variant. For clarity, we place that risk variant here in a separate AQT:

1. Each significant assumption may include a risk that that assumption deviates from the actual Risk Generation Process in such a way that the consequences and implications of that assumption are important. For each significant assumption, has that risk been evaluated and has that risk and its possible consequences and implications been made clear to the risk management decision makers?
2. Are all important scope boundary issues, and the implications of each scope boundary issue for risk management, been listed systematically in language clear to risk management decision makers? Some scope boundary issues may be best addressed in terms of associated assumptions. This AQT is included to highlight scope boundary issues as distinct from assumptions.  
   Example: A major model limited the scope of consequences considered, as a way to avoid a large analysis burden. That scope decision significantly distorted its risk ranking of alternative threats. That distortion was not made clear to decision makers.

<<Back to [TOC](#TOC)>>

# Section F. Pro-Active Creation of Alternative Courses of Action

1. Are alternative courses of action systematically generated through a process of pro-active, goal-focused creation? In some cases, an analysis to evaluate a course of action to address a situation focuses on only one “alternative” course of action, or a small set of alternatives that has been defined by some unexamined process or a process external to the analysis. A common wisdom in decision analysis is that often the best way to address a situation is to focus on creating alternatives other than the one or few considered. This AQT is designed to promote a process of examining the set of alternatives considered to see if one or more better alternatives can be developed. For example, if the response is “No,” then the analysts or decision makers can consider developing and evaluating other alternatives.

<<Back to [TOC](#TOC)>>

# Section G. Basis of Knowledge

1. Is the basis of knowledge characterized? For example: which inputs are empirically “objective”, which inputs are Subject Matter Expert (SME) elicitation, which inputs are based on testing, which inputs are based on modeling, which knowledge is based on argumentation and reasoning, which aspects are treated with assumptions, which analyses are broadly accepted, which analyses are one of two or more analyses that are considered acceptable, which analyses are novel and not widely accepted? This characterization of the basis of knowledge may seem impossibly involved in the general case, but for any particular analysis it is quite feasible and of course should be spelled out.
2. Is the strength of knowledge characterized in terms of its adequacy to support the risk management decisions to be supported? This AQT addresses the issue: Contexts with limited factual knowledge call for risk management recommendations that take those limitations into account.
3. In cases where limitations of knowledge call for risk management strategies that take those limitations into account, has that been communicated to risk management decision makers in language they can understand and apply?

<<Back to [TOC](#TOC)>>

1. Is the role and importance of potential surprises and the unforeseen (Black Swans) considered? Another description of those: events and scenarios “not on your list.” Some risk management contexts have inconsequential or extremely improbable Black Swans as the phenomena are well understood and the uncertainties are small. In other contexts, e.g. terrorism, Black Swans can be a driving consideration. This is a central concern and as such is also touched on in three other sections of this battery:  
   - Section B: … Completeness of the List of Hazards/Events;  
   - Section L: Robustness and Resilience of Action Strategies.  
   - Section P: Adversary Modeling.  
   While this four-section treatment may seem like overkill, in fact each section addresses the problem from an importantly different perspective.
2. Are conflicting opinions between experts considered?
3. Are all conflicting opinions reported?

<<Back to [TOC](#TOC)>>

1. Has there been explicit consideration of the possibility of unknown knowns (i.e. knowledge that others have, outside of the analysis group)? That is, have special measures been implemented to check for this type of event (for example, the use of an independent review of the analysis)?
2. Has there been explicit consideration of the possibility that some events have been disregarded because of very low probabilities, although these probabilities are based on critical assumptions? That is, have special measures been implemented to check for this type of event (for example, signals and warnings influencing the existing knowledge basis)?

<<Back to [TOC](#TOC)>>

# Section H. Data Limitations, Availability, Collection, Verification, Validation, Management, Quality

1. Are data limitations systematically analyzed, in particular the implications of those limitations for risk management, then any implications reported to risk managers in language they can understand and apply? Examples of those limitations: availability and aspects of data collection.
2. Are the data managed with an adequate data management system that assures each piece of data is accurately logged, and that appropriate levels of QA/QC are maintained, including the ability to demonstrate that adequate level of QA/QC to a third party?
3. Are the data verified for internal consistency?
4. Where possible, are the data validated against external points of reference? That is, are external points of reference sought, then are the data checked for consistency with those external points?

<<Back to [TOC](#TOC)>>

# Section I. Analysis Limitations

1. Are all analysis limitations, as they apply to the risk management problem, clearly described?

That is, are the limitations of the set of calculations of the analysis, including modeling, explicitly examined, in particular as they apply to the overall risk management situation at hand? This is as opposed to other limitations covered in two other sections of this battery:  
- Section G: Basis of Knowledge  
- Section H: Data Limitations

Notice the overall theme spanning Sections G, H and I: Any risk analysis is subject to limitations in knowledge, data and calculations/modeling. Even in the best of cases, those limitations are typically unavoidable. What is important here is that those limitations, and the implications of those limitations, be examined and clearly explained to the risk management decision makers.

1. Have all calculations in the analysis been verified? That may include extensive sensitivity analyses.

<<Back to [TOC](#TOC)>>

1. Are all metric levels in results (i.e., nominal, ordinal, interval, ratio) supported by metrically valid operations beginning with the data? For example, if the results include bar charts or other formats that present ratio-scale data (whether or not the analysts intended a ratio-scale presentation), are those results ratio-scale invariant to metric-allowed variations of the source data? For a specific example from experience: A major model elicited ordinal judgments of probability, then multiplied pairs of those judgments and summed those products into results numbers, presented in scatterplots and bar charts. An analysis with alternative transformations of the original data, shifted by transforms allowable for ordinal metrics, resulted in rank reversals in the bar charts. So in that case the results were not even valid as ordinal metrics.

<<Back to [TOC](#TOC)>>

# Section J. Uncertainty: Are All Sources Described| & The Implications for Risk Management Made Clear?

Uncertainty is of course central to any risk analysis, and touches on fundamental issues. As such we organize this section differently than the other sections. We start with a “Checklist of Uncertainty Sources,” then for each one we ask two questions, i.e., two AQTs. Several different taxonomies of uncertainty sources could be considered. We find this taxonomy to be most useful:

Checklist of Uncertainty Sources:

Native to Data: The part of the uncertainty that is inherent in the set of collectable data, such that, independent of data sampling, there is unavoidable uncertainty in the sampled data. This is sometimes referred to as “aleatory uncertainty.”

1. Is that aleatory uncertainty characterized in terms that risk management decision makers can understand?
2. Is the propagation of that aleatory uncertainty into results uncertainty characterized in terms that risk management decision makers can understand? That propagation should often be analyzed with extensive sensitivity analysis.

<<Back to [TOC](#TOC)>>

Data Collection: The part of the uncertainty that is due to the practical limitations of data collection. That is, practical considerations of time and budget typically limit data collection to less than the ideal amount. This is sometimes referred to as “epistemic uncertainty.”

1. Is that epistemic uncertainty characterized in terms that risk management decision makers can understand?
2. Is the propagation of that epistemic uncertainty into results uncertainty characterized in terms that risk management decision makers can understand? That propagation should often be analyzed with extensive sensitivity analysis.

Model Uncertainty: The part of the uncertainty that is due to the fact that the model used as a basis for the analysis may not fully capture the actual risk generating process.

1. Is that model uncertainty characterized in terms that risk management decision makers can understand?
2. Are the implications of that model uncertainty for uncertainty in the results characterized in terms that risk management decision makers can understand? Those implications should often be analyzed with extensive sensitivity analysis.

<<Back to [TOC](#TOC)>>

The above AQTs cover the three basic sources of uncertainty in risk analysis: Aleatory, epistemic and model uncertainty. But what matters for risk management is the combined results of those three sources for the combined uncertainty in the results. Which leads to the next AQTs:

1. Are the three sources of uncertainty just discussed (aleatory, epistemic and model) combined into a representation of the combined uncertainty in the results, in terms understandable to risk management decision makers? That representation should often be developed with extensive sensitivity analysis.
2. Are the implications of that combined uncertainty for risk management decisions made clear to the risk management decision makers, in terms they can understand and apply in their decisions?

Side Note: The orientation of this AQT Battery is, as mentioned, full disclosure, as opposed to how to improve the risk analysis. But in this Section I we address uncertainty, an issue so central to risk analysis that we here insert the following discussion:

One result of these Section-J AQTs is that the risk management decision makers could decide to address these uncertainty-based shortfalls by calling for improvements in the analysis, which can take two forms:

Epistemic Uncertainty may be reduced by further data collection effort.

Model Uncertainty may be reduced one or both of two ways:  
- Commission other versions of the risk analysis using alternative models.  
- Commission further research to improve the model used.

We leave these considerations of analysis improvement outside the scope of the AQT Battery, by design, but note that any such considerations should be part of any review of any risk analysis.

<<Back to [TOC](#TOC)>>

# Section K. Consideration of Alternative Analysis Approaches

1. In some cases more than one analysis approach could be applied. Are all plausible alternative analysis approaches considered? Then was the adopted analysis approach selected in a logical process?
2. Are the implications for risk management of choosing an alternative analysis made clear to risk management decision makers?

<<Back to [TOC](#TOC)>>

# Section L. Robustness and Resilience of Action Strategies

1. Is the need for robustness and resilience of action strategies explicitly examined? This AQT is crucial, and directly relates to Sections B (… Scenarios Not On the List), F (Pro-Active Creation of Alternative Courses of Action), and I (Analysis Limitations). At base, here, is the recognition that in many areas, a risk analysis cannot confidently take into consideration all scenarios that could happen. From that it follows that, unless the need for robustness and resilience is explicitly examined, the results of the analysis can fall importantly short of adequately supporting risk management decisions.
2. Do the recommended risk management strategies that follow from the risk analysis include the robustness and resilience called for by the situation? This AQT follows naturally from the one before, and is based on the analysis-limitation logic presented there.

<<Back to [TOC](#TOC)>>

# Section M. Model and Analysis Validation and Documentation

1. Is the model and analysis fully validated, by normal standards of validation in the domain of practice that applies?
2. Is the model, analysis, and validation fully documented, so that a third party review can determine the validity of the model?

<<Back to [TOC](#TOC)>>

# Section N. Reporting

1. Are key terms defined?
2. Are the results explained and motivated without using abstract terms?
3. Are the results as expected? If not, is it explained why?

<<Back to [TOC](#TOC)>>

# Section O. Budget and Schedule Adequacy

1. Is the budget and schedule adequate to support the risk analysis at an appropriate level of quality and defensibility? Typically a case can be made for an improved analysis with a larger budget and longer schedule. In the real world there is always a tradeoff between analysis quality (as defined by these AQTs), budget and schedule. But this AQT is targeted to situations where a convincing case can be made that the analysis is too restricted by budget and/or schedule to do an adequate job of supporting the risk management decisions at hand.

<<Back to [TOC](#TOC)>>

# Section P. Domain Specific AQTs

## P1. Adversary Modeling

P1.1 Are adversaries **characterized and modeled** with the most appropriate available adversary model?

Adversary modeling in most cases is extremely challenging. Four considerations are typically called for:

1) Limit estimations of adversary behavior to only those behaviors of interest to the risk management actions being considered. Examples: Choice of weapons, choice of tactics, choice of targets, choice of routes.

2) Make the analysis results conditional on factors that are most difficult to model: Example: It is typically essentially impossible to model adversary initiation of an attack campaign. So in those cases if possible make the results conditional on that initiation. In some cases that won’t support certain budget allocation decisions, but that support may call for judgments not well analytically based, and that situation should be clearly identified and communicated to decision makers.

3) Make it a deliberate part of the data collection, including SME elicitation, to estimate the lack of predictability of adversary behavior, then build the results of that collection-elicitation into the model. For example, if it is determined that the model can only reliably estimate adversary behavior as a slight adjustment to random behavior, then that finding must be built into the results.

4) Sensitivity analysis is often called for in risk analysis. That is especially the case in adversary modeling since the uncertainties can be extremely large.

<<Back to [TOC](#TOC)>>

P1.2 Are those adversary models **populated** using the best available Subject Matter Experts (SMEs) and SME elicitation techniques?

One expression we use is that “SMEs and SME elicitation are the smallest lenses on our optical bench.” We have found cases where model development involved millions of dollars of PRA programming but not much budget for SME elicitation. When such cases are examined from a “Value of Information” point of view, arguments could be made for large reallocations of effort toward SMEs and SME elicitation. As one example, it is often called for to have multiple rounds of elicitation, varying between one-on-one and group elicitations, but again, budget allocations can be such that those extensive elicitations are not considered.

P1.3 Do those models include adversary **reactions** to defensive courses of action?

P1.4 Do those models include adversary **acquisition** of information and capabilities?

P1.5 Does the analysis account for **“Deliberate Black Swans”** developed by adversaries?

That is, while Black Swans are of special concern, as discussed in Sections B (… Scenarios Not On the List) and F (Basis of Knowledge), they are even more so in adversary modeling, since we can assume that, for some adversaries, it is a natural part of their game strategy to deliberately seek to develop scenarios (attack weapons, tactics, routes and targets) ‘Not On the Defender’s List.”

<<Back to [TOC](#TOC)>>