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A systems approach to risk analysis validation for risk management

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ABSTRACT

This paper presents a logical structure to address the topic of this special issue: Risk Analysis Validation and Trust in Risk Management. We do that by presenting a systems approach that links all four of those concepts. The underlying logic: Validation should test how effectively a risk analysis supports actual, real-world implemented risk management. Our approach is based on a flowchart linking all of the elements from inputs through risk analysis, risk reporting and transparency, then how that reporting-transparency support the risk management decision making process and associated third party and stakeholder reviews (formal or informal), which in turn determine the trust and acceptance necessary for the real-world implementation of risk management actions. We take that flowchart and identify within it sixteen critical elements, then specify a validation test for each of those elements. Validation, then, consists of subjecting the risk analysis to those sixteen tests. Those tests, together, test the risk analysis for how effectively it supports implemented risk management. Another key feature: We divide the flowchart into Analysts' Domain, Users' Domain, and Analysis Community Domain. The Analysts' Domain is where the risk analysts work, then the Users' Domain stands between their work and implementation. The Analysis Community Domain is comprised of the communities of risk analysts and commissioners of risk analyses. Those two communities are where we would, as part of building our systems approach to risk analysis validation, build a "Culture of Analysis Quality," where the sixteen validation tests would be enforced by both of those communities.

1. Introduction

Risk Analysis shows up in our lives in several arenas. In many of those arenas, e.g. consumer product safety, medical treatment strategies, siting of hazmat facilities, routing of hazmat transport (rail, pipeline, truck), nuclear power and many more, risk analysis does not show up as a set of calculations, but shows up as support for arguments on one side or another (or both) of vigorous public debates over actions, regulations, laws and policies. In those cases the effectiveness of a risk analysis depends on a great deal more than what is typically covered in "Verification and Validation" (Goerlandt et al., 2016; Aven and Heide, 2009; Sargent, 2013; Petty, 2010; Department of Defense, 2008; United States Coast Guard, 2006). An analysis can be fully verified and validated in a purely analytic sense, yet still be ineffective because it is not accepted and trusted in the public debate it is to support. In particular, if one side of the debate can credibly cast doubt on the risk analysis, its role can be markedly limited. So what we have, there, are cases where the definition of "Validation" should be extended beyond a solely analytic test of the risk analysis, to concepts of validation covering the effectiveness of the risk analysis in the debate it is to support. That, in turn,

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calls upon us to adopt a systems approach to risk analysis validation – extending to tests of achieving trust and acceptance in the applicable public debate. This paper presents such a systems approach.

That systems approach has several implications. The most important one is that the duty of the risk analyst is not only to conduct all calculations in a valid and validly scoped way, but also to design his or her analysis specifically to most effectively couple with downstream elements standing between the risk analysis and its effectiveness in the real-world risk management process. What matters, at the end of the day, is the risk management that actually occurs, and that risk management is the result of a system of elements, only some of which are the analytic elements of risk analysis.

That reasoning is based on the definition of validation presented in ISO 15288: "Confirmation, through ... objective evidence, that the requirements for a specific intended use ... have been fulfilled" (International Organization for Standardization, 2015). While that definition is not specifically concerning risk analysis/management, it applies at the more general level of validation of systems approaches, which is the perspective taken in this paper. We add to that the obvious point that in the case of risk analysis for risk management, the specific intended use is to support the risk management involved, that is, the risk management decisions involved. That scope reflects the scope of this special issue, risk analysis in risk management. As Rae et al. (2014) point out, risk assessment "is used in many domains for many different purposes." That statement clearly applies more broadly to risk analysis as discussed here. We have written this paper specifically to apply to all uses of risk assessment in its many domains, focusing not on the substantive domains but on supporting the risk management decisions involved. Furthermore, as will become clear later in this paper, we describe validation tests in terms that apply equally well to supporting any risk management decisions in any risk domain.

To extend that point to a higher level: The scope of this paper extends to all risk analyses in support of risk management decisions. Sections of this paper discuss scenarios and adversary decisions, but those sections do not have the effect of limiting the scope of this paper to risk analyses based on explicit lists of scenarios, or risk analyses involving adversary decisions. As we discuss later, even risk analyses not based on explicit lists of scenarios should be examined with validation tests that ask, at a high conceptual level, whether or not all significant scenarios and/or scenario-like processes have been adequately considered in terms of initiation, unfolding and completeness.

Shortly we will present a graphic, Fig. 1, that presents all of the elements and relationships we have mentioned above. Then after explaining that graphic we will map each of the sixteen elements in the analysts'-domain part of Fig. 1 to a validity test, worded as a question. Those sixteen elements in the analysts' domain are so central to the logic of this paper, in Fig. 1 we have colored them a distinctive green color. Each test is presented paired with a discussion of the shortfalls associated with failures to pass that test. We note, in advance, that the list of tests is long – sixteen tests, one for each analysts'-domain element. We make no apologies for that. The fact of the matter is that those sixteen analysts'-domain elements operate as a system to support real-world risk management, in ways depicted in Fig. 1. So once we define validation as we have here, in terms of how effectively it supports risk management, we are forced to recognize that validation must involve many considerations, and so many tests.

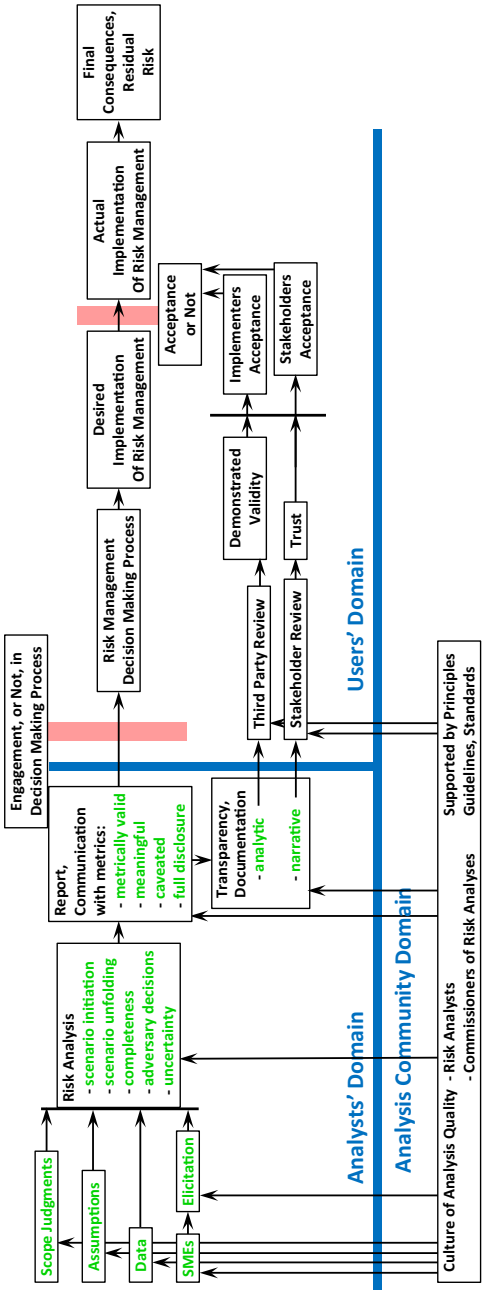

Fig. 1. Risk analysis validation – a systems perspective. Green font denotes the sixteen analysts'-domain elements that form the basis of the logic of the paper.

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