Editor's Note

Introduction to the Aims and Scope of the Journal

Bilal M. Ayyub, Ph.D., P.E., F.ASCE

Professor and Director, Center for Technology and Systems Management, Univ. of Maryland, College Park, MD 20742. E-mail: ba@umd.edu

DOI: 10.1061/AJRUA6.0000001

Motivation: Societal and Professional Needs

Our global society advances in many scientific and technological dimensions by expanding our knowledge through observation, discovery, information gathering, and logic. Access to information is becoming easier than ever as a result of computers and the Internet. We have entered an exciting era where electronic libraries, online databases, sensor-collected data, user information, social media data, and information on every aspect of our civilization—patents, engineering products, literature, mathematics, economics, physics, medicine, philosophy, and public opinions, to name a few—are only a mouse click or screen touch away. In this era, tools of big data and data analytics can generate even more information from the abundance of online resources. Moreover, people and things, such as sensors, computers, machines, actuators, communication nodes, switches, and controllers, are becoming interconnected through information flow and controls, creating what is termed the Internet of Things. Society can act or react based on this information at the speed of its generation, sometimes creating undesirable situations—for example, price or political volatilities.

People worldwide are increasingly aware of and sensitive to the harsh and discomforting reality that information abundance does not necessarily give us certainty. This observation holds not only in knowledge-based economies, but also in traditional industrial economies. Sometimes on the contrary, this abundance of information can lead to errors in decision making and undesirable outcomes due to either overwhelmingly confusing situations or a sense of overconfidence that leads to improper use of information. The former situation can be an outcome of both the limited capacity of the human mind to deal with complex information and information deficiency in many other cases, whereas the latter can be attributed in some cases to a higher order of knowledge deficiency, also called herein ignorance. This higher order of ignorance is termed the ignorance of self-ignorance.

It is important to assess uncertainties associated with information and to quantitatively evaluate our state of knowledge by measuring its deficiency (ignorance). The accuracy, quality, and incorrectness of such information, as well as knowledge deficiencies or inconsistency or incoherence, are being closely examined by philosophers, scientists, engineers, economists, technologists, decision and policy makers, regulators and lawmakers, and our society as a whole. As a result, uncertainty and ignorance analyses are receiving increased attention. We are moving from a state of emphasizing knowledge expansion and information creation to a state that includes knowledge and information deficiency assessment by critically evaluating them in terms of relevance, completeness, nondistortion, consistency, and other key measures. Ayyub and Klir (2006) provide an epistemological basis and a structured coverage of these areas.

Our society is less forgiving than ever and more demanding in regard to the knowledge base of agencies and institutions that provide risk governance. The processing of available information or acting on its results, even if its results might be inconclusive, are ultimately regarded as less excusable than a simple lack of knowledge or insufficient knowledge reliability. In 2000, the U.S. Congress and the Justice Department investigated Firestone and Ford Companies for allegedly knowing that perhaps defective tires were suspected in causing accidents claiming more than 88 lives worldwide without taking appropriate actions. The investigation and media coverage elevated the problem to a full-blown scandal as a result of inaction in light of the available information. Both Firestone and Ford argued that test results conducted after they knew about the potential problem were inconclusive. Such an approach can often be regarded by our demanding society as a deliberate cover-up, which might not be the case.

People have some control over the levels of technology-caused risks to which they are exposed and willing to undertake. Attempts to reduce risk by governments and corporations in response to the increasing demands by our society can entail reduction in benefits, thus posing a serious dilemma. The public and policy makers are required with increasing frequency to weigh benefits against risks and assess associated uncertainties when making decisions. Further, the lack of a systems or holistic approach leads to vulnerabilities when the reduction of one set of risks introduces offsetting or larger risks of other kinds. Risk and uncertainty in engineering thus have the *challenging characteristics* of being multidisciplinary, cross cutting, and system centric.

Purpose and Scope

The purpose and scope the *ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems* are to meet societal and professional needs and construct knowledge to inform decision and policy-making processes.

To meet that challenge, ASCE and ASME have created a jointly published *ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems*. This is the first joint journal for ASCE and ASME, driven by the multidisciplinary nature of the needs of the engineering community. The journal has the purpose and scope to address risk and uncertainty across both societies, cutting across their committees, councils, divisions, and institutes. A systems framework is necessary to address risk, disaster, and failure-related challenges due to many sources and types of uncertainty in planning, design, analysis, fabrication, production, operation, disposal, and life-cycle management of not only existing but also modern engineering systems. This journal helps to fulfill the ASCE and ASME visions, to broadly advance our engineering practices, and to prepare our practitioners by relaxing the domain boundaries traditionally followed because risks and failures do not recognize such boundaries.

The journal will (1) provide for dissemination of research findings, best practices, and concerns, and for discussion and debate on risk- and uncertainty-related issues; and (2) report on an encompassing range of risk and uncertainty analysis concepts and methods, including state-of-art and state-of-practice relating to civil engineering, mechanical engineering, and other related fields including but not limited to risk quantification based on hazard identification, scenario development and rate quantification, onsequence assessment, economic valuation, perception, communication, risk-informed

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decision making, tradeoff analysis, risk finance and management, resilience, and sustainability.

The scope of the journal includes, but is not limited to, the following:

- Concepts and methods: Risk methods, uncertainty analysis and quantification, reliability, safety, economic valuation, management, financial and insurance issues, computational methods, systems, resilience, and sustainability;
- Civil engineering applications: Civil infrastructure, buildings and other structures, underground systems, materials, construction, the environment, transportation, water resources, coastal engineering, construction engineering, project management, and lifecycle analysis and management;
- Mechanical engineering applications: Mechanical assets and infrastructure, materials and electromechanics, energy-related engineering including nuclear, gas and renewable sources, and manufacturing; and
- Related topics: Coastal and ocean systems, bioengineering, climate change adaptation, information storage and processing, finance, economics, robotics, automation, and control.

The journal has an editorial board, the members of which share this vision, including associate editors and members who were deliberately recruited to achieve intellectual and geographic diversity, and an advisory board to guide its development and efforts for meeting the needs of our engineering profession.

Approach

The approach of the journal will encompass several emerging themes of the field as provided in this section.

Theme 1: Complexity and Risks

For sake of comparison, ecological systems have a simple, but challenging, genetically encoded mission in life to survive and reproduce to preserve their kind and culture in hostile environments that are full of hazards, adversaries, and predators, and most importantly are dynamic in nature. Humans are not any different than other species; however, we have added aspirations of enhancing life quality, longevity, and happiness. Luckily, these risks faced by humans differ in occurrence rates (or odds), impacts, and in terms of our ability to recover from any impacts if they materialize. Fig. 1 shows the scope and impacts of these risks on ordinal scales from the perspective of humans (Ayyub 2014). The figure, inspired by the work of Bostrom (2002), does not show the important dimension of rates (or odds) for the various illustrative cases identified; rather it shows only the impact and scope with transgenerational and time dimensions and is intended to offer an illustrative basis for exhaustively scoping out risks for the purposes of this journal. The impact categories displayed are human centric, i.e., anthropocentric, starting from nuisance to human health with the components of bodily injuries, mental health, and death, to property and finally to the environment. The second scale of scope is also human centric that shows four categories from an individual to a group to a locality to worldwide, i.e., global. The examples provided in the figure cover many illustrative cases identified, from the mundane, tolerable risk of car damage due to a falling tree to the existential risk from an asteroid impacting Earth. Some of these risks are manageable, others are tolerable, some are inevitable, and a few could make us feel helpless.

Theme 2: Cascading Impacts

Human-built systems are conceived and designed to achieve their respective objectives through appropriate decision making that entails coping with these risks through an effective and efficient use of resources. Humans in their aspiration for enhancing their life quality, longevity, and happiness take premeditated actions, undertake projects, alter environments, and consume resources that entail risks for the potential achievement of these aspirations as benefits. Trade-offs among resource consumption, environmental changes, benefits, and potential adverse impacts associated with risks are complex, and their analysis and quantification require quantifying and treating risks and uncertainties using risk frameworks.

Scope ▲ / Populations at Risk with Trans-generational Considerations	Nuisance	Human Health: Bodily	Human Health: Mental	Human Health: Life	Property*	Environment
Global (i.e., Worldwide)	Non-malicious, self-deleting, viral cyber attack	Nonfatal, infectious disease outbreak	Impacts of genocide	Asteroid or comet impacting Earth	Malicious, viral cyber attack	Global warming
Local (e.g., city, state, coastal area, etc.)	Closure of a coastal road for a few hours	Injuries from evacuating a city due to an emergency	Impacts of sniper shootings or attacks by UAVs	Defective pharma-ceutical product	Hurricane damage to a city	Oil spill from a deep well in a gulf
Group (e.g., family, workers, company, etc.)	Internet loss at home for an hour	Injuries from an explosion or fire	Accidental death or murder of a co-worker	Passenger & on-ground fatalities from an airplane crash	Fire in an electronic data center	Chemical spill from a pipe at an industrial plant
Individual (e.g., a person)	Minor delay in traffic due to congestion	Self injury from a home accident	Impact of the death of a close friend or family member	Fatal car crash	Car damage due to a falling tree	Oil spill from a can in a yard
► Impact	Impacts with Time and Exposure Considerations					

* includes financial markets and economies

Fig. 1. Anthropocentric risks

Adverse events, when they occur, or systems of interest to humans, when they interact with a hazard, could lead to impacts spanning multiple cases as partitioned in Fig. 1. For example, when a hurricane passes over a city, the impacts could cover the cases of individual, group, and local populations under nuisances, human health, property, and environment, and if it is of an extreme intensity, the impact might extend to a global level through interconnected world economies. The figure, therefore, is intended to illustrate various cases by examples with each listed under a particular case for convenience, while knowingly that the impacts could extend to other cases listed in the figure. Moreover, when events occur, or systems of interest interact with a hazard, adverse financial, monetary, and economic effects may result as footnoted in Fig. 1. These effects are included under property, although they exhibit some intangible characteristics that could make their analysis challenging, and quantification and economic valuation elusive.

Theme 3: Globalization and Interconnectedness

According to the United Nations Office for Disaster Risk Reduction (UNISDR) (2012), half of the world's inhabitants, expected by 2025 to increase by roughly two-thirds, and the vast majority of property and wealth are concentrated in urban centers situated in locations already prone to major disasters, such as earthquakes and severe droughts, and along flood-prone coastlines. It also reported that the 2011 natural disasters, including the earthquake and tsunami that struck Japan, resulted in $366 billion in direct damages and 29,782 fatalities worldwide. Storms and floods accounted for up to 70% of the 302 natural disasters worldwide in 2011, with earthquakes producing the greatest number of fatalities. It is anticipated that such disasters would occur in increasing trends of storm rates and disaster impacts due to a combined effect of changing climate and an increased coastal inventory of assets (Ayyub et al. 2012). These estimates do not account for the intangibles and their economic valuations, and other perspectives where third party liability could be a primary driver (Ayyub and Parker 2011).

Although population centers or geographic areas cannot be risk free from natural or human-caused hazards, communities should strive to manage risk and enhance resilience to the destructive forces or the impacts of resulting events that may claim lives and damage property. Risk perceptions of the risk landscape as assessed at the 2011 World Economic Forum place storms and climate change at high levels, as summarized in Fig. 2. Gilbert (2010) provided population-and-wealth-adjusted loss and fatality count trends from 1960 to 2009 to demonstrate that both are about flat without significant slopes; however, that study noted that the United States is becoming more vulnerable due to increased population concentration in areas prone to natural hazards (Burby 1998; Berke et al. 1993) and persisting inadequate condition of infrastructure (ASCE 2009 Report Card of Infrastructure).

Theme 4: Uncertainty Dichotomies

Risk studies rely on the development and use of predictive models that in turn require knowledge and information and sometimes subjective opinions of experts. Ayyub and Klir (2006) provide working definitions for knowledge, information, and opinions. The reliability of the results from such predictive models is greatly dependent on the level of deficiency in the underlying knowledge, information, and opinions. As we develop knowledge from information that comes from data collected, we need to recognize and study the deficiencies in data, information, and knowledge. Information deficiency, including data deficiency, can be termed uncertainty; whereas knowledge deficiency, including opinion deficiency, can be termed as ignorance. It should be noted that the former, i.e., uncertainty, is a subset of the latter, i.e., ignorance. Such an examination should recognize the evolutionary nature of epistemology and the roles of cognition and languages. Fig. 3 provides a hierarchical breakdown of ignorance as an inclusive term of all deficiency

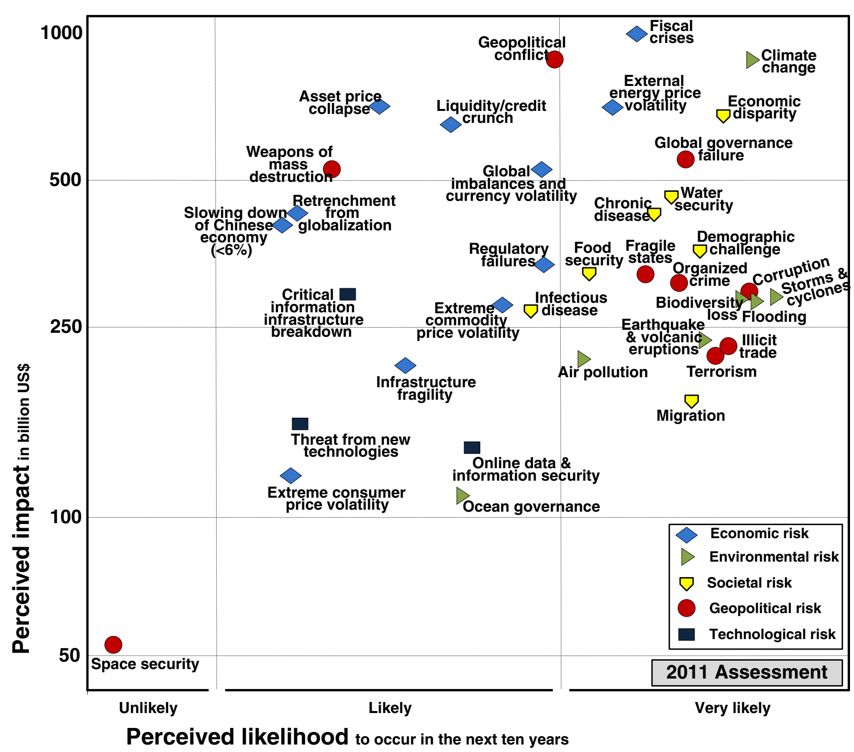

Fig. 2. Perceived risks in 2011

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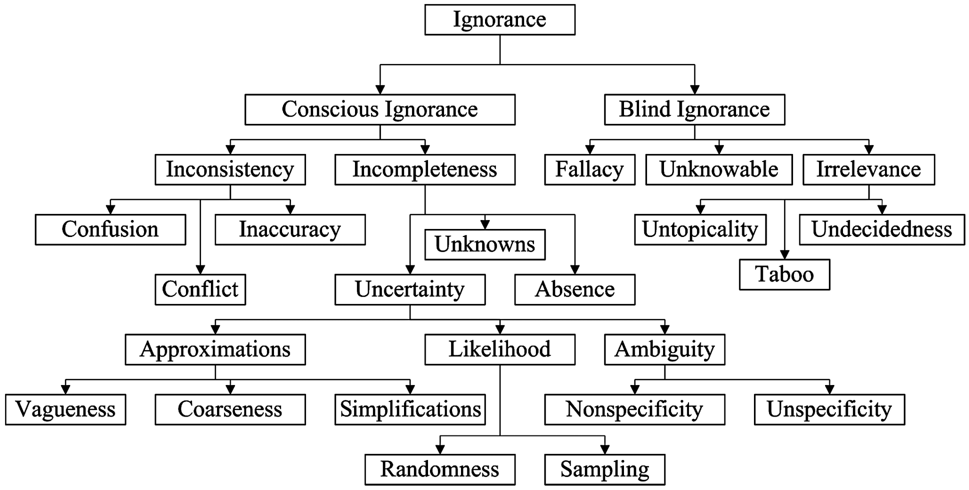

Fig. 3. Ignorance hierarchy

components including uncertainty. It is within the scope of this journal to report on any of these components, their interactions and aggregations, and uses in risk and decision analysis. The terms in Fig. 3 are defined and mathematical theories for their examination are also offered by Ayyub and Klir (2006).

Theme 5: Systems Analysis and Systems Engineering

A generalized system formulation allows scientists and engineers to develop a comprehensive understanding of the nature of a problem and the underlying physics, processes, and activities. Applications of risk and uncertainty analysis in systems engineering have had considerable interest in recent years (e.g., Thekdi and Lambert 2014; Xu et al. 2014; Hamilton et al. 2013; Lambert et al. 2013a, b; Karvetski and Lambert 2012; Ayyub et al. 2012). In a system-level formulation, an image or a model of an object that emphasizes some important and critical properties is defined. System definition is an important first step in an overall methodology formulated for achieving a set of objectives. This definition can be based on observations at different system abstraction levels that are established based on these objectives. The observations can be about the different elements (or components) of the system, interactions among these elements, and the expected behavior of the system. Each level of abstraction is considered as a knowledge layer. They are obtained about a problem or a project of interest and define a system to represent the problem or the project. As additional layers of knowledge are added to previous layers, higher epistemological levels of system definition and description are attained which, taken together, form a hierarchy of system descriptions. A constructivism view in systems analysis, as described by Klir (1969), could offer an appropriate basis for uncertainty and risk analysis. According to constructivism, all systems are artificial abstractions. They are not made by nature and presented to us to be discovered, but we construct them by our perceptual and mental capabilities within the domain of our experiences. According to this formulation, constructivism does not deal with ontological questions regarding the real world. It is intended as a theory of knowing, not a theory of being. It does not require analysts to deny ontological reality. Moreover, the constructed systems are not arbitrary, i.e., they must not collide with the constraints of the experiential domain. The aim of constructing systems is to organize our experiences in useful ways. A system is useful if it helps us to achieve some aims, for example, to predict, retrodict, control, or make proper decisions.

Conclusion

The *ASCE-ASME Journal of Risk and Uncertainty in Engineering Systems* hereby invites manuscript submissions and proposals for special issues.

A website has been created for this journal at http://www.asce-asme-riskjournal.org/. The journal will be produced in two parts, which are Part A: Civil Engineering and Part B: Mechanical Engineering, that require submitting the papers to the respective ASCE and ASME manuscript management systems. The separation in two parts offers a grouping convenient for users and production processes and the opportunity for expansion to other parts if deemed appropriate and needed by ASCE and ASME. Depending on the topic covered in a paper, it should submitted to one of these parts according to the following links:

- Part A: Civil Engineering (ASCE), http://jrnrueng.edmgr.com/
- Part B: Mechanical Engineering (ASME), http://bit.ly/1fjTQCc

In case of questions or additional information, ASCE can be contacted at Journal-submissions4@asce.org, and ASME at journals@asme.org. The editorial board, including the editor (Fig. 4), the associate editors, members, and advisors, is available at http://www.asce-asme-riskjournal.org/.

Fig. 4. Bilal M. Ayyub

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