



ONTOLOGY AND ETHICS OF RISK: UNCERTAINTY IN THE ERA OF CLIMATE CHANGE AND NEW TECHNOLOGIES

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ABSTRACT

As a world dominated by climate change, disruptive technologies, globalisation, and political instabilities comes in the spotlight, the concept of risk has become both pressing and evasive. This study examines the philosophical foundations of risk and reveals its definitional, epistemic, and normative aspects, while addressing the consequences of risk on a practical level for science, technology, and decision-making. The paper argues that risk is a contested concept that is influenced by probability, uncertainty, and vulnerability; that it is an epistemic construction mediated through models, knowledge systems, and institutional framings; and that it poses a moral challenge facing issues of responsibility, justice and inter-generational equity. Applying theoretical supports such as Beck's theory of risk society, Knight's risk versus uncertainty, and the ethics of responsibility. While Jonas presents risk in the broader contexts of resilience, governance, and legitimacy. From discussing climate governance, artificial intelligence, and systemic global risks, the case studies show that philosophical insight can help to inform decision-making in uncertainty and can influence institutional reactions. The key point is that risk should not be sent back to a technical or probabilistic calculation but understood as a multidimensional phenomenon at the intersection of knowledge, power, and ethics. By proposing a conceptual framework, which attempts to integrate ontology, epistemology, and ethics, this paper adds to current debates of the philosophy of risk and points to paths towards more resilient and responsible governance for addressing the global challenges of our time.

Keywords: Ontology, Epistemology, Risk, Climate Change, Technologies

INTRODUCTION

Risk has become one of the characteristic features of modern life. In an era of climate change, disruptive technology, globalisation and political instability, the struggle to cope with uncertainty goes beyond the traditional arena of finance and engineering into the daily lives of individuals and institutions. As Ulrich Beck contended in his book, *Risk Society* (1992) that modernisation creates manufactured risks, that are transboundary, systemic and that are also often beyond the control of individual actors. Risks are qualitatively different from the natural hazards of the past: they are the output of industrialisation, technological innovation and

international interdependence which are pervasive across social, political, and ethical spheres. Even though the concept of risk has been in the centre of public discourse and policy, it was only partially tapped in its complexity by the realm of philosophy. As Frank Knight made clear as far back as 1921, risk is probabilistic, meaning that outcomes and probabilities can be quantified, or it is uncertainty, meaning that the unknown is not quantifiable. This traditional differential still has strength, but it does not describe the full range of interpretations of risk across the disciplines today. In economics risk is often reduced to expected losses and rationalised through insurance models; in engineering risk is related to probabilities of failure and only in sociology is risk seen as socially constructed and presupposing institutional legitimacy. The debate has been furthered by the considerations of philosophers like Hans Jonas (1984) who have focused on the moral implications of technology: Technological actions entail moral obligations when there are long tenor and potentially irreversible results. These opposing understandings reflect the fruitfulness of the concept of risk as much as the failure to develop just one framework within which it can be conceptualised.

The definition amorphousness of risk has important consequences for decision-making. Bruce Schneier's observation in *Secrets and Lies* (2000) contend that many security practises in the corporate and political world serve as less serious protection than security theatre performed to reassure stakeholders is a good example of this point. All these views come down to the realisation that risk is not merely a technical or financial problem but a problem of governance, legitimacy, and institutional trust. From a philosophical point of view, the challenge is to reconcile the epistemic and normative nature of risk. On the one hand, risk is an epistemic construct; it is the output of models, probabilities and knowledge regimes that attempt to predict the probability of an ill-directed outcome. On the other hand, risk is a normative concept: it represents ethical judgements about what constitutes harm, who is responsible, and how this burden is spread through space and time; that is, which generations now and in the future will bear the burden. The ethics of responsibility as Jonas (1984) stresses of particular significance in the age of technological risks imposed on those who cannot give their consent: For example, think of the lack of consent by future generations. This epistemic uncertainty and normative obligation highlight the importance of philosophical study of the meaning and management of risk.

Moreover, the risks managed today cut across numerous areas of global interest. In climate governance, it is a common theme of debate whether precautionary measures should go over the adaptive resilience strategies. In technology, the accelerated pace of change in artificial intelligence and biotechnology has led to questions not only of safety and control but also of the birth of a new era of justice, bias, and the ability of human beings to exercise their own freedom of choice. Systemic risks in the global political economy, such as pandemic tendencies, cyber-attacks and financial crises show the fragility of the interdependency of systems and the inadequacy of national approaches to governance. These instances are illustrative that risk is not merely theoretical, but intensely practical and it affects how societies invest in the allocation of resources, organise institutions, and determine what they understand by ethics.

Against this backdrop, this paper attempt to look at the philosophical inquiry of risk, including the definition, epistemic, and ethical aspects, with its practical concerns in mind. The

main idea is that risk should not be taken as a probability calculation, or a technical failure to be avoided. Instead, risk should be understood as altering the concept of risk to one which is necessarily multidimensional and lies at the intersection between knowledge, power, and ethics. Based on conceptual foundations from Knight, Beck, Jonas and others, and contextualising these claims within current debates about climate change, technology and global governance, the study seeks to make a significant contribution towards developing a more integrated way of conceptualising and governing risk. This contribution is important for three reasons. First, it moves beyond the atomisation of risk research between philosophical inquiry on the one hand and empirical case studies on the other. Second, it is making the case for a conceptual framework that will bring ontology (what risk is), epistemology (how risk is known) and ethics (how we ought to act under risk) into a single intellectual debate. Third, it presents an enabling basis for conceptualising practical models of governance, indicating that proportionality, resilience, and legitimacy should be defining considerations for risk management in the twenty-first century. Integrating the study of theory with applications, the paper aims to add layers of richness to the philosophy of risk and to provide a guide to policy makers, technologists, and international institutions facing the realities of the uncertain world.

Conceptual Bases of Risk

Risk is a philosophically rooted concept that stretches all the way back to ancient roots of thinking about chance and fortune, as well as modern-day theories of uncertainty and governance. In Aristotle's *Nicomachean Ethics*, fortune (Tyche) remained as an external condition for the flourishing of human beings that is in permanent conflict with virtue and deliberation (Aristotle, 1999). Whereas Aristotle acknowledged the contingency of the living condition, and according to him there were reason and prudence that could orientate human action towards the good. With the dawn of the modern era of political philosophy, risk had started to attain a more systematic definition. In *Leviathan*, Hobbes depicted the state of nature as a state of endemic insecurity, in which individuals found themselves in a situation of permanent danger of violent death. In Hobbes's idea, the social contract was legitimate because it transferred this existential threat onto the sovereign and made him responsible for the security. Risk therefore became inherent in the logic of political order that legitimacy of power is structured by the capacity to collectively reduce the risk.

Nevertheless, Hume (2000) has a different view, and related risk to human epistemic limitations. In the *Treatise of Human Nature*, Hume focused on the fact that our judgments regarding probability are not based on objective certainty but on habitual expectations developed from successive experience. This epistemological account of uncertainty focused attention on understanding cognitive structures in which individuals and societies perceive and assess risk, rather than on threats from the outside world. Hence, risk is not just out there in the world, but also that it is constructed through human reasoning and imagination. In the twentieth century, risk was calculated, formalised in the language of economics. In addition, Frank Knight's (1921) put forward a critical distinction between quantifiable risks that are amenable to being dealt with in the probabilistic sense and genuine uncertainty that cannot be treated this way. This distinction is still important in economics, but it has also been relevant for debates

about decision making under incomplete knowledge in general. Knight's insight was that entrepreneurial profit comes from dealing with uncertainty rather than risk.

Later, theorists applied these insights to the social and political aspects of risk. Ulrich Beck proposed in his seminal work "Risk Society" (1992) that the development of industrial modernity produces new types of "manufactured risks," like nuclear accidents or climate change, which are global, unpredictable, and irreversible. Unlike conventional hazards, these risks are created by the institutions themselves, thus blurring the line between natural hazards and social decisions. Beck's analysis pointed out the inescapable link between risk and questions of governance, legitimacy, and reflexivity. Jonas (1984) further developed this view in his *Imperative of Responsibility* with emphasis being on the moral element of technological risk. According to Jonas, modern technology has given mankind an immense power that creates responsibilities for the future generation to carry the burden of the current generation's actions. The meaning of risk herein is not merely the issue of the likelihood as an element of danger, but a moral horizon that requires being cautious, humble, and answerable. These thinkers demonstrate the threshold complexity of the philosophical subject of risk. From Aristotle's ethics of decision-making to Hobbes's political security, Hume's epistemic scepticism, Knight's economic rationality, Beck's sociological denunciation, Jonas's ethical mandate, risk has never had a fixed definition. Instead, it has functioned as an onlooker that has altered questions of knowledge, power, and morality. This plurality still characterises contemporary discourses, which implies that any effort to build a philosophical framework on risk can no longer be achieved in ontological terms, but it represents ontological, epistemological, and normative examples.

The Epistemology of Risk

Risk epistemology is concerned with the set of ways that societies have acquired, codified, and operationalised knowledge about the unknown futures. From the time of Aristotle and indeed much earlier, it has been understood that risk was not an objective fact, but an emergent property of epistemic practices and especially the epistemic boundaries of human knowing. David Hume in his *Treatise of Human Nature* emphasised that probabilistic inferences are based not on objective certainties, but on habitual anticipations. For Hume, uncertainty is a structural aspect of cognition and not an accidental gap of information. This scepticism anticipated modern accounts that do not consider risk as a natural phenomenon, but rather as a place created by human agencies, as well as social structures. However, Frank Knight's seminal contribution in *Risk, Uncertainty and Profit* (1921) created a distinction between measurable risk and real uncertainty. Knight also emphasized radical uncertainty, to which many twenty-first-century accounts of systemic crises have returned, finding the traditional models of probability incomprehensible, despite their complex indeterminacies. This Knight understanding is still supporting modern economic, entrepreneurial and governance theories and reminding scholars of the complete failure of statistical tools to domesticate the unknown. A more recent re-organisation of knowledge about risk can be seen in the development of modern risk analysis, based on the theory of probability and statistical modelling. Betz (2009) presents such a scenario based climatological modelling, although indispensable, is epistemically vulnerable. Van Asselt and Rotmans (2002) agree that uncertainty in integrated

models for assessment has ontological foundations in systemic complexity and epistemological foundations from incomplete knowledge. Consequently, risk knowledges are always imbued with assumptions, simplifications, and blind spots.

These epistemic tensions are clearly revealed in debates on global governance. Beckert (1996) shows how actors, faced by incomplete information and doubt towards the future, conduct risk bearing decisions. Contemporary scholarship has elaborated this narrative by bringing forward the politics of uncertainty. Scoones and Stirling (2020) argued that communities invent different ontologies of uncertainty, which can be anything from statistical calculation to precautionary discourse with corresponding implications for governance. In all together, these perspectives suggest that the epistemology of risk cannot amount to probabilistic formalism only. The discipline calls for an examination of the social and institutional factors that bring claims of credibility about risk. Whether in the form of statistical modelling, scenario planning, or precautionary discourses, knowledge of risk is always carved out by epistemic limits and cognitive habits and politicised contexts. It is the philosophical challenge, then, to devise a way of articulating a responsibly navigable uncertainty since no prediction or level of control is ever completed.

The Ethics of Risk

The ethical dimension of risk has become increasingly salient in modern philosophy especially as advances in technology and consequences of environmental crises have broadened the purview of human responsibility. In contrast to epistemic treatments which see risk as situated in areas of knowledge and probability, ethical analyses bring forward accountability, watchfulness, and justice amid uncertainty. Jonas (1984) *The Imperative of Responsibility*, is still a voice in this debate. He argued that current technology, which has the capacity to alter the character of ecosystems, amend the genetic composition of organisms, and endanger the human species, requires a new macro-ethic of precaution. Because the consequences are now felt across generations, Jonas proposed the heuristics of fear in which decisional should prioritise avoiding tragic harm even when the probabilities are not significant. Justice considerations make the ethics of risk even more difficult. Farah and Lo Giudice (2024) stress that an expansion of the principles of responsibility developed by Jonas needs to include the concept of intergenerational equity and the susceptibility of populations in the global south to the impacts of climate change. The distributive aspects of risk therefore highlight the necessity that ethical responses focus not just on the issue of prevention but also of justice. Jonas's thinking has also infiltrated the debates about biotechnology and genetic engineering. Ballet & Bazin (2017) suggest that environmental ethics and environmental justice have become distinct from one another and the analytical chasm that separates them bears no less a gap. Whereas environmental ethics examines how people interact with nature, environmental justice examines how people interact with people through nature. However, Jonas's work provides the conduit that closes this conceptual difference: he stresses the precarious link between the identity of humans and of responsibility, which cannot be separated from nature.

Eventually, ethics of risk reveals three important insights. First, risks are not simply calculable hazards but moral challenges in which we must take responsibility to both present and future stakeholders. Second, precaution is not an academic instruction based on technical

and technological factors, but a principle of justice where harms are equivalently distributed. Third, technological risk requires humility: the recognition, in Jonas's words, that human power must be checked by moral insight. As Khedidja (2025) argues, Jonas's ethic indicates a "new perspective on environmental responsibility" which overlaps issues of sustainability, justice, and risk in a common philosophical shared space.

Risk in Society: Governance & Legitimacy

The risk society thesis, articulated by Ulrich Beck, has been a basis for developing the idea of the transformation of the mode of governance of the late modern age. Beck (1992) argued that the obsession of the industrial society with wealth distribution has been succeeded by the control of manufactured risks, from nuclear accidents to climate change. It is in this context of developing technology assessments that the risk is not a technical issue; rather, it is a political phenomenon that is also intricately linked to questions concerning legitimacy and trust in governing institutions (Ekberg, 2007). Goldin strengthened this view focusing on the reflexivity of contemporary institutions that constantly monitor and re-evaluate risks as a normal element of their activities. For Goldin, and Vogel, (2010) reflexivity means that risk is not something that connotes externality to governance but that is constitutive of governance: states, corporations and international organisations justify action based on risk assessments, but those assessments are in turn influenced by social and political expectations. Equally, Rosa, Renn and McCright (2014) observe that risk society is an epoch, in which governance itself is inextricably linked with risk communication and credibility of expertise. The nexus between risk and legitimacy is because stakeholders are more in high-stakes technology areas. Alario and Freudenburg (2006) describe how debates over energy policy in the United States had at times turned on public trust in expert knowledge, highlighting that legitimacy simply could not be won on technical solutions. Instead, there is a need for governance frameworks to pay attention to the social processes through which risks are perceived, contested, and accepted. Renn (2017) has formalised this insight in a theory of risk governance, in which technical assessment is combined with participatory deliberation to produce legitimacy between stakeholder groups.

Risk governance is also of a global nature. Beck (1992) developed his thesis into a theory of risk society arguing that the globalisation of the world is increasing the scale of and the potential of governing the risks. Rosa, Renn and McCright (2014) similarly argue that legitimacy in risk governance demands a balance of rational expertise and democratic inclusion since it is unlikely that level-headed, technical responses will get trust from the public. Governance debates also heighten the inequalities in exposing to risk. In this respect, the concept of risk governance is never neutral, but rather a negotiation of legitimacy between competing claims of knowledge, institutional interests, and social demands. Renn (2017) has synthesised these debates into a comprehensive model of risk governance, emphasising the importance of ensuring that legitimacy is not only based on technical accuracy, but also on transparency, accountability, and inclusiveness. More than risk assessment is needed for an effective governance, says his framework, and building shared meanings and trust amongst risk bearers and decision-makers is one way to do it.

Bringing together, these viewpoints tend to deem the governance of risk in contemporary society as much a process of legitimacy as it represents control. Risk governance involves a paradox: Risks are increasingly global, public, complex and uncertain, yet control can only be won locally over affected publics through a governance process that considers their values, expectations, vulnerabilities, etc. As Beck and Giddens foresaw, risk is no longer just a problem to be solved, it is the medium in which modern societies do things to their future.

Case Discussions: Weather Modification, Climate Change, and Corporate Privatisation

Climate change is the archetypal risk in two aspects: as an ontological and as a governance problem. It is not just an environmental danger but a systemic disruptor of economies, infrastructures, and social systems too. Scholars are increasingly viewing climate change as a systemic financial risk given its potential to instability in the credit markets, disrupting the supply chains and worsen inequalities (Choudhury, 2021). The vulnerabilities were reinforced by the pandemic of the coronavirus, showing how shocks occur across systems affecting the existing vulnerabilities in unexpected ways, and amplifying existing fragile (Schweizer & Juhola, 2024; Mitra & Shaw, 2023). The responses in governance have focused on incorporating the risk of climate under financial regulation, especially the stress test and disclosure systems. Goldin and Vogel (2010) state that systemic risks like climate change require global institutional responses. The promise of AI in climate risk modelling with more granular simulations of longer time scales of environmental impacts is highlighted by more recent studies (Ukatu et al., 2025; Akomea-Frimpong et al., 2025). These changes support the idea of climatic change not being a threat but posing a challenge even to human regimes and investment, The philosophical lesson is two-fold. First, climate change shows the ontological hybridity of risk: physical processes, human vulnerabilities and institutional responses are not separated. Second, it emphasises the ethical aspect of intergenerational justice, because the largest burdens for current and future generations will be borne by vulnerable populations today and generations in the future (Mitra & Shaw, 2023). Thus, climate risk is an example for ensuring that governance is precautionary, globally integrated, and based on legitimacy.

Risk Management Tool

Artificial intelligence is a maker of new risks, as well as a solution to how to manage them. As Spitz and Desbiey (2025) point out, AI increases the unpredictability of systemic disruptions by increasing the level of automation, concentration of decision-making, and opacity of the financial and governance systems. At the same time, risk governance is an area where AI tools are increasingly being deployed, especially in the financial markets, climate stress testing, and supply chain management (Oluwaferanmi, 2025; Metha et al., 2025). The dual role is amply demonstrated around finance. AI-driven models have been used in stress testing financial systems, simulating scenarios of economic disorder, pandemics, and climate shocks (Metha et al., 2025; Dugbartey, 2025). Although these innovations may result in increased predictive power, academics are concerned with epistemic overconfidence: AI systems are confined by both the quality of the data and biases in which the training settings are developed (Schweizer & Juhola, 2024). Philosophically, AI raises questions as to the delegate of responsibility in risk governance. If the decision-making process increasingly

becomes automated, then accountability may become diffused or obscure. Jonas's ethic of responsibility comes into play as urgent in this case: Precaution must apply not only to what risks are managed, but with whom - or with what - they are trusted. AI in this sense is therefore a paradigmatic example of where epistemology and ethics intersect, involving not only humility about the ability to make any claims about its predictive capacity, but also seriousness in terms of maintaining human oversight.

Global Systemic Risks

Systemic risks are those that go beyond the borders of climate change and artificial intelligence to include risks like pandemics, geopolitical, and surging risks in the critical infrastructure space. The recent COVID-19 pandemic has provided a hugely vivid example, highlighting the response failures, exacerbating social inequalities, and producing major economic shocks (Pescaroli et al. 2023; Lopez and Alcaide, 2020). Pandemics and climate change are characterised by the same structural features, as shown by Schweizer and Juhola (2024) they are transboundary, non-linear and cannot be necessarily present in classical risk management techniques. Financial crises are another good example. Goldin and Vogel (2010) cite the 2008 financial crisis as an illustration of global systemic risk, where shocks within one system propagate through interdependencies to a worldwide meltdown. Indeed, more recent research demonstrates how geopolitical, cyber, and climate risks are now converging to create multidimensional systemic risks that cannot be adequately addressed under traditional siloed governance models (Dugbartey, 2025; Maskrey, Jain & Lavell, 2023). These are all examples of the need for resilience and adaptability. As explained by Mitra and Shaw (2023), systemic risks are a stronger generalisation of standard probabilistic models which also account for the unknown, which are emergent properties of complex systems which remain unavoidably unattainable thus far. This philosophical insight reinforces Knight's theory of uncertainty or Beck's theory of manufactured risk, that risk becomes in late modernity the primary product in and of the very economic institutions that are there to alleviate risk.

Integrative Lessons

From climate change to artificial intelligence and systemic crises, there are some common themes that continue to arise. First, all three examples show the conjoining of risk with governance legitimacy: trust in institutions is the determinant factor of whether responses are effective or not. Second, they show how technology is a double-edged sword, as the source of new risks, as well as the tool for risk management. Third: they point out that there are moral asymmetries in risk: a disproportionate share of the burden of such risks either falls on future generations that will face the consequences of climate instability or the marginalised that will face the consequences of pandemics and economic upheavals. Such teachings have re-emphasised the importance of a philosophic model of risk. Ontologically, they confirm that risk is systemically relational. Epistemologically, modelling and simulators, as indispensable as they may be, are shown to be fallible. In their underlying implications, they emphasise again the need for caution, equity, and inter-generation responsibilities. By framing these case situations in bigger philosophical architecture, risk does not manifest itself as an exception, rather it has become the main horizon within which societies are bargaining their futures.

Risk, Technology and its Future.

The ethical and epistemic issues of risk are most severe around emerging technologies. Artificial intelligence to biotechnology and climate engineering are changing the boundaries of humanity and at the same time create new levels of uncertainty never seen before. As Beck (1992) understood in his thesis on risk society, modern risks are increasingly manufactured: they are not natural hazards to be avoided but the result of the institution and technology that were intended to protect us from them. Biotechnology has equally profound ethical issues for the ability to meddle with genetic inheritance or ecological systems, Jonas (1984) cautioned against the responsibilities that accompany a power to do things for the future that future generations are unable to agree to present decisions. This imperative is, however, forcefully resonating in the debates on gene editing, synthetic biology, and the emergent bioeconomy. As Schoop (2022) argues, an ethical bioeconomy cannot be possible unless it is based on both technological viability and ethical responsibility and intergenerational justice. The dangers of biotechnology are not limited to unanticipated side effects but are pervasive in the social and moral structures in which such technologies are used. Climate change is the paradigmatic example of future-oriented risk. Its global movement and intergenerational nature are the structural expression of Jonas's appeal for a heuristic of fear: a moral duty to avoid disastrous consequences despite the uncertainty. What they have in common is an acknowledgement that technological risks cannot be brought down to calculable probabilities. They are systemic, crossing geographical, temporal, and governmental boundaries. As Jonas anticipated, the development of technology is increasing the scale of human action to the point where they overwhelm traditional beliefs. As the threats of AI, biotechnology, and climate change raise questions for how to construct responsibility, they require us to move away from short-term, individualistic choices to long-term, collective action.

At the same time, government structures will need to be flexed in keeping up with the evolving nature of risk. Rosa, Renn & McCright (2014) note that since public trust is a necessary component in decisions with irreversible consequences, legitimacy in risk governance is grounded not only on expert standing but also on participatory inclusiveness. Modern technologies increase this need because their danger is simultaneously new and disputed. Absent transparent processes and ethical accountability, there is the risk that governance will devolve into what Schneier (2000) calls the security theatre where the responses are visible and not effective but fail to address the vulnerabilities that prevail. Hence, the future of risk is inextricably linked with the development of emerging technologies. The philosophical challenge is not merely to conceptualise what risk means in this context but also to formulate principles of responsibility, justice and legitimacy that can provide the basis for organising collective action.

Towards a Philosophical Understanding of Risk

Based on the above discussion, we can understand that risk cannot be interpreted using a single perspective. Ontologically it is based on the idea of plurality; epistemologically it is based on the idea of the limits of prediction and knowledge and ethically it is based on the idea of responsibility and justice. This collectively present insights pointing towards the need for a

multidimensional approach that brings together ontology, epistemology, and ethics as a coherent philosophical approach to risk.

Ontologically, risk should not be look at as a stable quality of the world but as a category of relation. It arises from the intersection between hazards and vulnerabilities and how humans perceive them. Classical theorists like Aristotle (Aristotle, 1999) viewed uncertainty as an inevitable component of human life, Hobbes grounded risk to the base of political order and Hume as a function of epistemological habit. Modern theory by people such as Knight, Beck, and Jonas, by an extension of this ontological spectrum, they separate between calculable risks, manufactured uncertainties, and moral responsibilities. The point is that risk cannot be considered either objectively through probability or subjectively through perception but possesses a hybrid reality of material and social conditions.

Epistemologically, risk is suggestive of human ignorance. Probability theory and modelling are immensely powerful tools for making predictions, but they still have their limits as Knight, and his interpreters have reminded us: Radical uncertainty is hard to quantify. Beckert and Scoones demonstrate that uncertainty is no longer a transient interlude but intrinsic to social coordinating practises, whereas Betz and Van Asselt and Rotmans illustrate that with the modelling of sciences we inevitably deal with reduction of complexity. At the same time, risk knowledge is entangled with legitimacy and trust because, as Rosa, Renn, and McCright suggest, both epistemic credibility and institutional authority are needed to convince individuals to approve of risk assessments. Thus, any philosophical framework must recognise that: Risk is always imperfectly known, socially contested, and politically framed.

Ethically, risk requires an extended scope of responsibility. The moral imperative of not to go down catastrophic futures, even in uncertainty is encapsulated in the heuristics of fear by Jonas, whereas the precautionary principle makes this moral ethic relevant in environmental policy. Climate and environmental justice scholars urge that risks are risk pathway unevenly distributed and disproportionately disadvantaged in the global South and to future generations. Indeed, in technology ethics, similar issues come up in AI and biotechnology where irreversible interventions into human systems need humility and fore thought. These perspectives converge on the understanding that ethics of risk cannot be limited to cost benefit analysis but needs to consider responsibility, precaution, and justice. Recognising these views together, the proposed framework views risk as the three-dimensional function:

This integrated framework makes two major contributions. First, it overcomes the fragmentation of current approaches through coordination of these approaches within a shared philosophical framework. Taking its point of departure from this ambiguity, it acknowledges risk as essentially multiple but organised. Second, it offers practical guidance for governance by pointing to three criteria (proportionality, resilience, and legitimacy) that may be useful to guide decision-making in contexts of uncertainty. Proportionality is the principle of response being fair to the scale of exposure, resilience is the principle of adaptive capacity and legitimacy provides the basis for a legitimate legacy in inclusive processes of trust building. In this way the philosophy of risk can contribute to our understandings not only in the academic realm, but also to practical accounts of how to address twenty-first century dilemmas such as climate change, artificial intelligence, and biotechnology. By putting together ontological, epistemological, and ethical aspects, the framework presented here aims to transcend

disciplinary silos and provide a consistent explanation of how risk should be conceptualized, researched, and regulated.

CONCLUSION

Risk is one of the defining categories of late modernity, spanning science, technology, governance and philosophy. Far from being a unified or technical concept, risk is multidimensional: at the same time an ontological phenomenon of the world, an epistemic construction of knowledge and an ethical challenge for societies facing uncertainty. This plurality is, far from being a weakness, a strength, for it represents the way in which risk functions as a mediator in our relations with the future. From Aristotle's reflections on fortune, through Hobbes's logic of insecurity, to Hume's scepticism, Knight's distinction between risk and uncertainty, and Beck's "manufactured risks" and Jonas's imperative of responsibility, philosophy has known that risk is more than probability - that it is a category which determines power, morality and knowledge. Recent discussions have highlighted the fact that risk is never known or agreed upon but is socially produced, contested and institutionalized.

The epistemological lens emphasises the limits of prediction and modelling, even with probability and statistics, as radical uncertainty (as Knight argued) stays at the centre of, for example, climate change and systemic crises. Ethical perspectives remind us of that responsibility, precaution and justice must be the guide during the decision-making process before harm is irreversible. In a risk society (Beck, Giddens), governance will have to move beyond technocratic control and engage participation, transparency, and legitimacy, especially when it comes to systemic and intergenerational risks, such as artificial intelligence, biotechnology, and climate change. The threefold synthesis proposed here - of ontology, epistemology and ethics - presents an integrated framework and can be used to guide governance through proportionality, resilience and legitimacy.

Finally, risk is not an issue that ought to be eradicated but a horizon where societies are negotiating how to establish their connection with the future. It is possible to take a step into ethically responsible and socially legitimate governance strategies by acknowledging its multidimensional nature and integrating it into philosophical thought. The work of philosophy is therefore not just to define risk but to help man live wisely in the light of risk.

RECOMMENDATIONS

1. **Integrate Epistemologies:** Future governance of risk needs to combine scientific, local and experiential knowledge systems. This diversity would provide greater resilience through the inclusion of different perspectives as part of risk assessment and management.
2. **Embed Ethical Responsibility:** Risk governance must institutionalise principles of responsibility, precaution and justice as underlying principles. These are not discretionary values but are crucial to safeguarding intergenerational equity.
3. **Foster Participatory Governance:** Public trust and legitimacy in dealing with systemic risks rely on inclusive decision-making processes with transparency, accountability and shared ownership.

4. **Promote Adaptive Mechanisms:** In the face of acceleration of technological change, governance will need to incorporate adaptive mechanisms that can develop with emerging risks, especially in cyber-bioethics, and climate science.
5. **Strengthen Interdisciplinary Research:** Philosophy, science, policy, and ethics are needed to work together to address the complexity of modern risks, to develop models that are conceptually clear, normatively robust, and practically useful.

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