

## **A Global World of Risks. What is the Role of Technology Assessment?**

Isabel Abreu Santos (1); Lia Vasconcelos (2);

(1) MARE – FCT/UNL

(2) MARE – FCT/UNL

### **Introduction**

The present paper aims to discuss the role of technology assessment departing from a throughout reflection on the results of the recently published Global Risks 2015 10th edition report. The idea is to understand which role assumes the technological risk at the world wide scale to draw lessons to its role at the local level, understanding the interconnectedness among risks and levels.

### **Risk Conceptual Framework**

It is not possible to talk about risk without understanding the variety of concepts associate to its conceptualization. The evolution of the concept of risk followed human societies, from primitive society to agricultural, industrial, and currently towards the knowledge society. The sociologist Ulrich Beck (2008), states that currently we live in a "risk society". This risk society arises from several factors that have further complicated the approach of the environment, the habitat of the human being. Risk has taken over more and more of the Citizen daily space. As Beck states, "being at risk is the way of being and ruling in the world of modernity; being at global risk is the human condition at the beginning of the twenty-first century" (Beck, 2008).

From the scientific literature risk concepts are various and disciplines do not agree on a common definition. Palenchar (2007) states that "risk is a structured application of knowledge to the unknown", comprising various disciplines, each having a vision and approach to risk. "Anthropology views risk as a cultural phenomenon, sociology as a societal phenomenon, economics as a decisional phenomenon related to a means of securing wealth or avoiding loss, law as a fault of conduct and a judicable phenomenon, psychology as a behavioral and cognitive phenomenon, language as a concept, history as a story, art as an emotional phenomenon, religion as an act of faith and philosophy as a problematic phenomenon religion as an act of faith, and philosophy as a problematic phenomenon" (Althaus, 2005 in Palenchar, 2007).

Concepts and definitions of risk are also distinct whether it is defined by social sciences or natural sciences. Natural sciences focus is mainly in probability of occurrence and consequence analysis, while social sciences analyze perceptions, emotions and social context.

Peter Sandman, a risk communication expert, defines risk adding an emotional factor to the purely rational scientific equation, “risk is hazard plus outrage” (Sandman, 2013).

Additionally, according to specific areas of interest, risks may be environmental, financial, technologic, health related, safety, security and business, among others. Some authors distinguish risks in broad areas dividing into natural or man-made, being the latter also defined as anthropogenic or technological.

A common definition of risk proposed by Covello (1994) states that risk is “the probability of occurrence of an undesirable event. It is a function of the probability of occurrence and severity / magnitude of its consequences”. European and national legislation defines risk, associated with industrial and man-made activities as “the likelihood of a specific effect within a certain period or in specified circumstances” (Decree-Law 254/2007, Directive 2012/18/EU).

Recently, the International Standardization Organization, ISO, issued a norm, ISO 31000:2009, *Risk management – Principles and guidelines*, that can be used by any organization, activity or sector. ISO defines risk in a broad scope so it could be used in different areas of activity, as an “effect of uncertainty on objectives”, (being an effect a deviation from the expected — positive and/or negative(note1); objectives can have different aspects (such as financial, health and safety, and environmental goals) and can apply at different levels (such as strategic, organization-wide, project, product and process) (note 2); risk is often characterized by reference to potential events and consequences or a combination of these (note3); risk is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated likelihood of occurrence (note 4); and uncertainty is the state, even partial, of deficiency of information related to, understanding or knowledge of an event, its consequence, or likelihood (note 5)) (ISO 31000:2009).

The WEF (World Economic Forum) defines global risk as “an uncertain event or condition that if it occurs, can cause significant negative impact for several countries or industries within the next 10 years” (WEF, 2015, p. 12). A key characteristic of global risks is their potential systemic nature – they have the potential to affect an entire system, as opposed to individual parts and

components. WEF distinguishes five categories of risk: economic, environmental, geopolitical, technological, and societal. Each is defined as follows (WEF, 2014):

- *Economic Risks*: Risks in the economic category include fiscal and liquidity crises, failure of a major financial mechanism or institution, oil-price shocks, chronic unemployment and failure of physical infrastructure on which economic activity depends.
- *Environmental Risks*: Risks in the environmental category include both natural disasters, such as earthquakes and geomagnetic storms, and man-made risks such as collapsing ecosystems, freshwater shortages, nuclear accidents and failure to mitigate or adapt to climate change.
- *Geopolitical Risks*: The geopolitical category covers the areas of politics, diplomacy, conflict, crime and global governance. These risks range from terrorism, disputes over resources and war to governance being undermined by corruption, organized crime and illicit trade.
- *Societal Risks*: The societal category captures risks related to social stability – such as severe income disparities, food crises and dysfunctional cities – and public health, such as pandemics, antibiotic-resistant bacteria and the rising burden of chronic disease.
- *Technological Risk*: The technological category covers major risks related to the growing centrality of information and communication technologies to individuals, businesses and governments. These include cyber-attacks, infrastructure disruptions and data loss.

Renn's (2012) definition of technological risk refers to technology or its products, man-made related, and states as being "the likelihood of physical, social, and/or financial harm/detriment/loss as a consequence of a technology aggregated over its entire lifecycle. Technological hazard refers to the threat potential of a technology or its products, i.e. the potential to harm people, nature, capital, or human-made facilities". Having these definitions of technological risk as background the authors look into the overall global situation of risk as stated in the 2015 WEF report

### **A Global World of Risk**

The World Economic Forum (WEF) recently published "The Global Risks Report 2015" presents the results of 10 years of the most significant long-term risks worldwide questioning more than 900 perspectives of experts and global decision-makers.

The World Economic Forum is an international institution, established in 1971, with its headquarters located in Switzerland. It is a nonprofit Foundation “committed to improving the state of the world through public-private cooperation (...) by engaging business, political, academic, and other leaders of society to shape global, regional, and industry agendas” (<http://www.weforum.org/world-economic-forum>, retrieved 16-2-2015).

The WEF is famous for its annual meeting in Davos, where about 2500 important people from around the world and different fields of activities, (e.g., business, political, journalists, academia, etc.) meet together to discuss the more challenge issues facing the world and to shape the global, regional and industry agendas for the year ahead” (<http://www.weforum.org/world-economic-forum>, retrieved 16-2-2015). The Forum contributes to global governance in the informal spaces at the base of the formal multilateral legal frameworks and institutions, such as the International Monetary Fund, the United Nations and the World Trade Organization.

The world economic forum defines risk as “an uncertain event or condition that, if it occurs, can cause significant negative impact for several countries or industries within the next 10 years” (WEF, 2015, p. 8). It defines trends as a “long term pattern that is currently taking place and that could amplify global risks and/or alter the relationship between them” (WEF, 2015, p. 8). The relationship between risks and trends is the characteristics of a trend as having the capability of altering the future evolution of risks, since they are long-term ongoing processes (WEF, 2015, p.12).

The Global Risks 2015 10th edition report offers us a great opportunity to explore the perception of risk at a wider range. The risks considered are known and unknown, and include uncertainties and other factors that are not exhaustive. This document is essential to support society and decision makers in a world of growing complexity and uncertainty due to the widening of global interconnectedness and the increasing speed of change. Mostly the Global Risk report has been widely used , namely (a) to build scenarios, (b) prepare crisis exercises, (c) assess vulnerabilities and their potential for cascade effects, (d) inform “sense making” exercises in crisis situations, (e) train top decision makers, (f) model risks external to the direct business environment (WEF, 2015).

Responsible for the diffusion of highlighting the most significant long-term global risks, it has evolved from risk identification towards risk interconnection and possible cascading effects. This year, the report introduces a new component aiming to reveal potential causes as well as solutions to the risks, informing on examples of risk mitigation and resilience practices (WEF, 2015).

This report is the result of a collaborative effort that started in 2006, it makes the most out of the expertise of the WEF, its diverse communities and its knowledge networks, expressing the results of discussions, consultations and workshops that reflect the views of the leaders involved. Support by the annual Global Risks Perception Survey that gather the perception of about 900 members of the World Economic Forum (WEF)'s global multi-stakeholder community, this year collected between July and September 2014, it reflects on how they think about global risks, how to mitigate them and how to strengthen resilience(WEF, 2015), (table 1 and 2).

This year the report identifies 28 global risks (table 3) structured in five categories – economic, environmental, societal, geopolitical and technological – and 13 drivers (table 4) related to these risks, and supplies, for the first time, insights of complex risk environment at the regional level. More specifically the report identifies concern with the acceleration of the effects of climate change and the changes of the global geopolitical contexts and the impacts it can have on the international collaboration (WEF, 2015).

In technological terms the report points to the fact that differs strongly from the past, “with rising of technological risks, notably cyber-attacks and new economic realities, which remind us that geopolitical tensions present themselves in a very different world from before. Information flows instantly around the globe and emerging technologies have boosted the influence of new players and new types of warfare” (WEF, 2015).

Evolving risks from 2007 to 2015 in terms of Impact and Likelihood, are shown in table 1, and it is obvious that geopolitical risks are presently the main concern, though environmental and economic risks also maintain an important position. Highly likely events that reflect recent events and human action influence respondents' perceptions, such as interstate conflict (conflict over Crimea) failure of national governance and state collapse (rise of Islamic state) and extreme weather events. Economic risks were a main concern from 2007 to 2014, but in 2015 it's at the bottom of top five. Highly potential impactful risks shows a shift from economic risks in general to risks related to water crises, on top concern, followed by rapid and massive spread of infectious diseases, reflecting concerns due to the recent spread of Ebola.

Table 1 – Evolving Risks in terms of Likelihood from 2007 to 2015

	2007	2008	2009	2010	2011	2012	2013	2014	2015
1 <sup>st</sup>	Breakdown of critical information infrastructure	Asset price collapse	Asset price collapse	Asset price collapse	Storms and cyclones	Severe income disparity	Severe income disparity	Income disparity	Interstate conflict w/ regional consequences
2 <sup>nd</sup>	Chronic disease in developed countries	Middle East instability	Slowing Chinese economy (<6%)	Slowing Chinese economy (<6%)	Flooding	Chronic fiscal imbalances	Chronic fiscal imbalances	Extreme weather events	Extreme weather events
3 <sup>rd</sup>	Oil price shock	Failed and failing states	Chronic disease	Chronic disease	Corruption	Rising greenhouse gas emissions	Rising greenhouse gas emissions	Unemployment & underemployment	Failure of national governance
4 <sup>th</sup>	China economic hard landing	Oil and gas price spike	Global governance gaps	Fiscal crises	Biodiversity loss	Cyber attacks	Water supply crises	Climate change	State collapse or crisis
5 <sup>th</sup>	Asset price collapse	Chronic disease in developed countries	Retrenchment from globalization (emerging)	Global governance gaps	Climate change	Water supply crises	Management of population ageing	Cyber attacks	High structural unemployment & underemployment

Source: adaptado de WEF, 2015, p.14

Table 2 – Evolving Risks in terms of Impact from 2007 to 2015

	2007	2008	2009	2010	2011	2012	2013	2014	2015
1 <sup>st</sup>	Asset price collapse	Asset price collapse	Asset price collapse	Asset price collapse	Fiscal crises	Major systemic financial failure	Major systemic financial failure	Fiscal crises	Water crises
2 <sup>nd</sup>	Retrenchment from globalization	Retrenchment from globalization (developed)	Retrenchment from globalization (emerging)	Retrenchment from globalization (emerging)	Climate change	Water supply crises	Water supply crises	Climate change	Rapid & massive spread of infectious diseases
3 <sup>rd</sup>	Interstate & civil wars	Slowing Chinese economy (<6%)	Oil and gas price spike	Oil price spike	Geopolitical conflict	Food shortage crises	Chronic fiscal imbalances	Water crises	Weapons of mass destruction
4 <sup>th</sup>	Pandemics	Oil and gas price spike	Chronic disease	Chronic disease	Asset price collapse	Chronic fiscal imbalances	Diffusion of weapons of mass destruction	Unemployment & underemployment	Interstate conflict w/ regional consequences
5 <sup>th</sup>	Oil price shock	Pandemics	Fiscal crises	Fiscal crises	Extreme energy price volatility	Extreme volatility in energy & agricultural prices	Failure climate change adaptation	Critical information infrastructure breakdown	Failure climate change adaptation

Economic
  Environmental
  Geopolitical
  Societal
  Technological

Source: adaptado de WEF, 2015, p.14

In a more specific approach (table 3) the different types of risks are identified in a more detailed way. The classification of global risks in categories varies over the years. The nature of risks is increasingly global, systemic, and uncertain. For example, one could argue that water crises should be more an environmental risk than a societal risk, but consequences of an event of such nature could be societal, environmental, economic and/ or geopolitical.

Table 3 - Global risks 2015

Geopolitical Risks	Environmental Risks	Economic Risks	Societal Risks	Technological Risks
Failure of national governance	Extreme weather events	Asset bubble in a major economy	Failure of urban planning	Breakdown of critical information infrastructure and networks
Interstate conflict with regional consequences	Failure of climate-change adaptation	Deflation in a major economy	Food crises	Large-scale cyber attacks
Large scale terrorist attacks	Major biodiversity loss and ecosystem collapse	Energy price shock to the global economy	Large-scale involuntary migration	Massive incident of data fraud/theft
State collapse or crisis	Major natural catastrophes (e.g., earthquake, tsunami, etc.)	Failure of financial mechanism or institution	Profound social instability	Massive and widespread misuse of technologies (e.g. 3D printing, artificial intelligence, geo-engineering, synthetic biology, etc.)
Weapons of mass destruction	Man-made environmental catastrophes (e.g., oil spill; radioactive contamination)	Failure/shortfall of critical infrastructure	Rapid and massive spread of infectious diseases	
		Fiscal crises in key economies	Water crises	
		High structural unemployment or underemployment		
		Unmanageable inflation		

Source: adapted from WEF, 2015, p.53-54

Drivers of those risks are considered in the form of 13 trends (table 4). During the survey respondents were asked to select between three and six trends and to identify for each the risk they believe is most interconnected (WEF, 2015, p. 5). The distinction between risks and trends allows a “better understanding of the underlying drivers of global risks” (WEF, 2015, p. 12). Trends occur with certainty and are long-term ongoing processes that can alter the future evolution or the interrelations of and among risks, without becoming necessarily risks themselves (WEF, 2015, p. 12).

Table 4 – Trends considered in the WEF Report 2015

Ageing population
Climate change
Environmental degradation
Growing middle class in emerging economies
Increasing national sentiment
Increasing polarization of societies
Rise of chronic diseases
Rise of hyper-connectivity
Rising geographic mobility
Rising income disparity
Shifts in power
Urbanization
Weakening of international governance

Source: adapted from WEF, 2015, p.55

A comparison of the most perceived risks in terms of likelihood and impact is presents in table 5, with the 10 top concerns. Comparing with past surveys, there is a rise on technological risks, under cyber attacks, reflecting the importance on information flows and emerging technologies.

Table 5 – The 10 global risks in terms of likelihood and in terms of impact. (895 respondents)

In terms of Likelihood		In terms of Impact	
1	Interstate conflict	1	Water crises
2	Extreme weather events	2	Spread of infectious diseases
3	Failure of national governance	3	Weapons of mass destruction
4	State collapse or crisis	4	Interstate conflict
5	Unemployment or underemployment	5	Failure of climate-change adaptation
6	Natural catastrophes	6	Energy price shock
7	Failure of climate-change adaptation	7	Critical information infrastructure breakdown
8	Water crises	8	Fiscal crises
9	Data fraud or theft	9	Unemployment or underemployment
10	Cyber attacks	10	Biodiversity loss and ecosystem collapse

Source: adapted from WEF, 2015, p.9; results from the Global Risks Perception survey 2014, WEF in WEF, 2015, p.9

Results reflect difference in expert risk perceptions over the years, presenting as the main survey respondent's **perceptions** (table 1 and 5):

-**Economic impacts** are dominant from 2007 to 2014, but in 2015, **geopolitical** risks are in the top concern; may be due to the rise of Islamic state and the dispute over Crimea, both in 2014 (WEF, 2015, p. 14)

For 2015 **Environmental risks** assume a major concern referring climate change and water crises as the top issues. It also highlights the interplay between geopolitics and economics, rapid urbanization in developing countries, and emerging technologies (WEF, 2015, p. 11); In particular, growing social polarization, isolationism and nationalism are referred as having the potential to trigger geopolitical conflicts (WEF, 2015, p. 24) Emphasis is given to the rising socio-economic inequality, weak economic growth, food price volatility and food insecurity, unemployment, large-scale migration and the growing heterogeneity and interdependence of societies are among the key drivers of social fragility.

Above average are **technological risks**, under large-scale cyber attacks, concerning internet security, storage of relevant data (health, finances) in the cloud, dependency of infrastructures communication, among others (WEF, 2015, p.22).

- In the overall, effective governance at all levels, from industry codes of conduct to national regulations and global cooperation, are viewed as critical of how well risks from emerging technologies are foreseen and minimized (...) making the mechanisms of global governance more effective in resolving tensions among nation states (WEF, 2015, p. 41).

The main conclusions of the report is to defend the importance of risk management and “the need to build resilience”; mentioning that decision makers recognize that “risk are not isolated but dynamic in nature and crossing many spheres of influence” (WEF, 2015, p.50). Furthermore, the report assumes that “multi-stakeholder collaboration and global governance are key to building resilience and mitigating risks” concluding that “the year 2015 presents an unprecedented range of opportunities to take collective action to address global risks” (WEF, 2015, p.51)

### **Technological Risk Role Debated**

Technological risks have different definitions and perceptions. In the overall the literature refers to this typology of risks as opposed to natural risks. They are man-made and created by human beings, consequently hard to accept; citizens’ perception of technological risks is higher than natural risks. Unlike natural risks, they are imposed, related to power and decision-making, from the risk holders to the risk takers.

Additionally they are strongly related to memories of past events. A series of hazardous accidents (Bhopal, Seveso, Chernobyl, Fukushima) have increased public awareness of

technological risks and pressured governments and regulators to reduce or control risks (Renn, 2012). This leads us to state that all the causes of technological risks are somehow related to human failure.

Risk definition commonly utilized in risk assessment, mainly in technological risks, as being a function of the probability of occurrence and severity of consequences, is no longer able to respond to current characteristics of risk that are “complex, uncertain and ambiguous” (IRGC, 2007) and as Beck states cannot be “limited spatially, temporarily or socially” (Yates, 2001). A balance between information and judgment putting risk communication as a major lider seems to be an important tool in order to empower one to make thoughtful decisions about their own future.

Technological risks in globally in our present world play a major role and should be taken into consideration, however what the WEF 2015 report identifies as relevant technological global risks focus mostly in emerging technologies such as synthetic biology, gene drives and artificial intelligence. When we talk about technological risks of the common citizen perception, these follow more Renn (2012) concept and therefore it encompasses risks ~~such~~ as “the processing of physical signals and/or information about a potentially harmful impact of using technology and the formation of a judgment about seriousness, likelihood, and acceptability of the respective technology”. It is therefore obvious that any technologic assessment has to consider the different layers of the contexts of operation. It is as important the global level for certain risks as the local level, being the local level risks perception the ones that will be better understood and challenged by the common citizen.

This seems to call for more transparency on information related to risk, to avoid the explosion of strong risk perception when it is not justified and/or lack of interest when there is a real risk in technical terms. But risk is often not put upfront assuming entities an inactive position, either because people do not understand it or because it is highly complex. Both situations call attention to the difficulties posed to risk communication. Neither case are good for healthy and resilient societies, therefore an additional responsibility should be place on the role of technological assessment.

For this, “multi-stakeholder collaboration and global governance are key to building resilience and mitigating risks” and “the year 2015 presents an unprecedented range of opportunities to take collective action to address global risks” (WEF, 2015, p.51). This could be inspirational for

technological assessment, allowing for greater involvement of the technology stakeholders within the evaluation processes.

### **Final Considerations**

At present time citizens are faced with global, uncertain and complex risks in all dimensions of life. The pace of technological change is faster than ever. Disciplines such as nanotechnology, genetics, synthetic biology and artificial intelligence are creating new fundamental capabilities, which offer tremendous potential for solving the world's most pressing problems. At the same time, they present hard-to-foresee risks and are perceived as high risks by non-experts. (WEF, 2015; Renn, 2012). They can be hard to accept even if science calls attention to its importance as positive outcomes.

Pidgeon (2014) refers to risks as being “never purely environmental or technological – they always involve people, communities, their organizations and sometimes (as at Fukushima Daiichi in Japan) the cultures of whole nations. Few would disagree that we are in a more globalized world, and one which holds fundamental implications for many aspects of both risk governance and the organization of everyday life” (Pidgeon, 2014).

The field of research on the issue of risk in the overall and technological risk in particular, presents a severe case of problems of fragmentation. Each area of study focus in his particular field of research, but there is little learning and share of scientific communication inter disciplines lacking the necessary multi-disciplinarity that is needed to overcome the growing global non-linear systemic and complex that involve the issue of the risk society where we all live.

Even though we live in a global world of risks in which technological risks are increasingly an important share, it is also evident that its acceptance relies on risk communication and governance, relies on trust and confidence, in order to allow for an increasing of “people's ability to cope with their environments and control their own destinies” (Aldoory, 2010). Trust and confidence can only be built at a local level. This calls for the reinforcement of the intercommunication top-down, bottom-up and transversal.

Therefore, the understanding of perceived global risks is essential, but for effective and efficient policies for addressing the risk society, local focus and an expanding involvement of the citizen is a must, this puts an emphasis on the role of technology assessment as a vital tool to build up resilient societies.

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