

Chapter 8

Conclusion

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Pretending to come to definite conclusions on uncertainty or uncertainties and how to live with it or them as safely as possible would have been pretentious. After all, uncertainty embodies to some extent the unknown. However, if the concept itself was only introduced as a central concept to risk management or safety in recent years, mankind has long lived and is still living with numerous uncertainties. The question is then whether it is doing so safely enough. Are there successful or satisfactory experiences of organizations dealing with uncertainty? In such cases, are they consciously and deliberately addressing uncertainty? Can their approaches be described, analyzed and extended to all hazardous activities?

8.1 Uncertainty: A Multi-faceted Notion

As aforementioned, uncertainty is increasingly frequently used as a concept to move forward in the risk or safety management domains (see ISO 31000, definition of risk management). Yet, trying to dig into what it really refers to is complex. Confronting perspectives on uncertainty make it obvious that the concept, as vague as it is today, requires some conceptual clarification and refinement. Indeed, it turns out that it may in reality refer to a variety of aspects. Furthermore, it is far from being an absolute notion.

When used by psychologists, uncertainty is likely to refer to the incomplete information that an operator has on the situation (s)he has to cope with.

For the residents of Edo back in the 17th century, it was the time at which a fire would occur as well as the wind direction which, to some extent (see Chap. 7), corresponds to their “operator’s” incomplete information on the situation.

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From a risk management point of view, uncertainty can be related either to the absence of information on the consequences of an event and their severity, or to the absence of numbers characterizing its likelihood. The CERN example is a striking illustration of the uncertainty of quantification (see Chap. 6).

From a broader perspective, uncertainty also covers unknown-unknowns, things that no one has ever anticipated or even imagined. Here again, it could be the combination or simultaneity of known individual phenomena or the phenomena themselves that no one has ever imagined, or an evolution at a time horizon that no one has ever considered. Human-induced climate change has only recently appeared on radar screens when anticipating the impact of technological and societal evolution.

While the word “uncertainty” has emerged as a new magic wand in the safety community, the concept itself has not been fully clarified in theory and its numerous interpretations, especially the dimensions considered, are most of the time left implicit.

8.2 Uncertainty: A Relative Notion

The multi-faceted nature of uncertainty is unfortunately (or maybe fortunately) not the only subtlety of the concept. Another one that seems often overlooked is its relativity. Indeed, anticipating hazards is a creative process more than a universal, well established approach. As such, it involves a number of aspects including experience, imagination and others. Some people or organizations may anticipate far more hazards and accident scenarios than others. How this kind of uncertainty can be accounted for is still an open question.

Ultimately, things may be a surprise for some, but not for others. Whistle blowers think they are certain of things that others deny. Likewise, a fire in a remote area could be completely unexpected by all, except the pyromaniac who lit it. In other words, we need to ask who is uncertain. When we commonly say after an event “no one could have imagined it”, what does this mean in reality? No one? No one we know of? No one who could have said or done something or who was in a position to say or do something?

In addition to varying from one person or organization to another, uncertainty also varies from one moment in time to another. As knowledge and experience grow, uncertainty evolves. It is not necessarily reduced though, conversely to what one could intuitively believe. Indeed, new knowledge may open up new areas of unknowns. When elementary particles were discovered, the whole area of quantum physics was unsuspected.

In other words, uncertainty turns out to be a relative more than an absolute notion. Relative to persons, relative to time... at least.

From a more philosophical point of view, uncertainty and risk share the same difficulty. They relate to the future, but we attempt to characterize and measure them with current knowledge. From an epistemological perspective, we can never accumulate

enough knowledge to achieve it (see Chap. 2). While the assessor's uncertainty can be reduced, the assessment itself will always be debatable.

The existence of debate and controversy is sometimes used to characterize uncertainty as the embodiment of the relativity of the notion. This may lead to considering that there is no uncertainty related to an idea/approach/action if everyone agrees, even if this idea/approach/action turns out to be erroneous or uncertain. Furthermore, such a characterization of uncertainty doesn't include unknown-unknowns in its scope.

Eventually, Uncertainty with a capital U becomes meaningless, making the need for some further conceptual work even more obvious. However, can we wait for additional conceptual development to be achieved (and what could be expected from it?) before starting to deal with uncertainty? Despite the current conceptual shortcomings, a number of approaches have been and are still being developed to live with uncertainty as safely as possible.

8.3 Reconciling Risk Management and Social Science Approaches to Uncertainty

If early risk management methods assumed that it was possible to reduce uncertainty to a point where it would no longer exist, recent reflections (and facts!) on uncertainty seem to converge at least on one aspect: we cannot and shouldn't only fight uncertainty.

Up to now, the approaches developed based on classical risk management methods and the ones derived from the social sciences used to be opposed to one another for their fundamental conceptual differences and also, if not more, for their difference in underlying disciplines.

Classical risk management methods, derived from engineering approaches, used to assume that uncertainty can, if not be reduced to zero, at least be described through a limited number of scenarios that can be anticipated and their likelihood calculated. With progress in computing capacity, the number of scenarios envisaged has increased over the years, further encouraging quantitative approaches of uncertainty and reinforcing the "illusion of control".

However, recent risk management method developments introduce an additional dimension or parameter to the likelihood and severity of consequences of risk, meant to reflect the uncertainties embedded in these dimensions without really characterizing them although trying to measure them (see Chap. 3). If uncertainty is getting closer to the world of the unknown, it is still expressed using equations.

Taking a closer look at it allows us to characterize the kind of uncertainty accounted for by these approaches. It seems to refer to the domain of the knowable or the known-unknowns, at least from the perspective of those performing the risk analysis at the time they are performing it.

Approaches deriving from social sciences have never attempted to describe or characterize uncertainty as such. Yet, the approaches deriving from these disciplines tackle it in different ways.

Some approaches such as organizational learning try to extend the world of the known to the whole organization rather to leave it only to those who experienced a situation. The experience accumulated, be it directly or indirectly through discussions with peers or other practices, allows for pushing back the frontiers of some kind of uncertainty, the knowns to some—unknowns to others at a given point in time.

The resilience school of thought suggests that it is more about how to live with unknowns to the organization when faced with them. However, they are not pretending to reduce the world of the unknown-unknowns.

Eventually, pushing the discussion further between risk management and social sciences representatives leads to a much more optimistic conclusion than the initial somehow sterile monologues. Indeed, while both are referring to uncertainty, their scopes are different but interestingly enough complementary.

The theoretical scope of risk management is limited to the world of the known and knowable to the risk managers and the experts they are relying on at the time when they perform the risk analysis. Therefore, if unknown-unknowns to anyone at the time considered are not satisfactorily addressed by risk management approaches, it is essentially because they are outside of their theoretical scope.

However, unknown-unknowns do exist and organizations have to be prepared to cope with them. Unlike the turkey that gets used to be comfortably fed for 364 days and is caught by surprise on Thanksgiving day [2], resilience engineering approaches aim at making organizations resilient to these unexpected or even unexpectable situations (see Chap. 4).

Everyone then agrees that it cannot be done by means of an improved risk analysis method.

In summary, both risk analysis and social sciences based approaches such as resilience, pragmatist theory or collective mindfulness, or to refer to another dichotomy of approaches, Safety 1 and Safety 2, are doing the job they are meant to do with respect to uncertainty. Of course they can be improved in their own field. But the mismatches lie in the kind of uncertainty they are respectively contemplating. Any refinement, as sophisticated as it might be, won't change the scope of reference. What could be improved is their use through better characterizing what to use them for and what can be expected from them. In this perspective, risk analysis becomes a reasonable argument more than an objective representation of the truth, useful for dialectical debate on safety.

8.4 Should We Fear Uncertainty?

Whatever the approach to uncertainty, thus whatever the type of uncertainty, the very fact of associating it with the concept of risk has induced a certain fear of uncertainty. Yet, strangely enough, humans are used to living with uncertainty, at least some kind

of uncertainty. It is the case for example of the incomplete information we have in situations we are dealing with. Most people make their way safely through life despite a number of major uncertainties and unexpected situations. A way forward could be to build on this existing ability at a broader scale.

Why are we so afraid of uncertainty? Has it always been the case? The residents of Edo chose to stay there and live there. They didn't flee from the city and its repeated fires. Closer to us, there is no major reluctance from the general public to use mobile phones despite today's uncertainty on the electromagnetic hazards of these devices. There are numerous examples of known-unknowns that we all live with, sometimes willingly. Why is it so?

It seems that for the accepted risks or uncertainty the associated benefits are clearly perceived as such. How many people feel lost when they forget their mobile phones or when the network is down? Who would envisage spending a week on a boat to cross the Atlantic one way (except for cruise addicts)? However, is this risk/benefit balance sufficient to make a risk or uncertainty widely accepted? In fact, the alchemy seems to be more subtle. Even when uncertainty is not perceived only negatively, there appears to be some conditions to make it possible to live with it. Even though most people are not ready to significantly reduce their electrical power consumption in countries where nuclear power is used, there are strong opponents to the nuclear industry. What else is then needed beyond perceived benefits to make uncertainty more acceptable to most people?

The Edo case described in Chap. 7 highlights at least two complementary major conditions:

- giving people some control over their fates;
- the hierarchy of values is respected in the way risk is managed.

If we consider how the general public is currently involved in risk management or can feel in control, it is mainly through intermediaries, be they Regulators or other more or less formal organized bodies. Feeling in control and involved thus necessarily relies on a key element: Trust.

More generally, at all levels the question of trust appears as a central one when it comes to living with uncertainty, especially when the magnitude of potential consequences is high. Trust in experts, trust in decision-makers, trust in Authorities and all the ones who may have different interests and/or a different perimeter of uncertainty.

8.5 Living with Uncertainty: Beyond Organizations and Regulators...

If innovative hazardous activities tend to learn from classical ones such as nuclear, aviation..., they can also help us further reflect on what is needed to build trust and ultimately live with uncertainty in other hazardous industries. The example of gene therapy research, acknowledged as being a hazardous activity with a high level of

uncertainty, brings a new perspective on this question. More precisely, it broadens the scope of the question to its societal and ethical dimensions.

Indeed, it seems today that most research on new risk management approaches based on uncertainty focuses largely on organizations themselves (e.g. resilience) or tackle regulation regimes. However, hazardous industries operate in a much broader framework. Modern society models have created a pathological relation to risk, the illusion of control. They changed mankind's relation to risk.

Acknowledging that risk/uncertainty management is embedded in a political context/process—exerting a significant influence—led gene therapy research to getting back to fundamental questions: the questions of moral responsibility and societal benefits. Eventually, it also led to evolving towards a morally responsible approach to risk/uncertainty management [1].

If the questions of moral responsibility and societal benefits were certainly raised at the advent of now well-established hazardous technologies, acknowledging uncertainty as part of hazardous industries' operations may require revisiting these questions and integrating them into a broad dynamic societal risk management framework.

References

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2. Taleb NN (2007) *The black swan: the impact of the highly improbable.* Random House, New York

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