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Open risk assessment: methods and expertise

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Abstract

Risk analysis and risk governance face a decline in social trust at both the scientific and policy levels. The involvement of society in the process has been proposed as an approach to increasing trust and engagement by making better use of available data and knowledge. In this session, EFSA explored the challenges in building trust and engagement and the latest thinking and methodologies for increasing openness that can help the organisation to move beyond traditional dialogue and towards a more sustainable stakeholder and society interaction. The discussion centred on the needs of EFSA and of target audiences throughout the process, from risk assessment initiation through societal decision-making and communication. The main focus of the session was on methodologies and approaches that would enable EFSA to increase its scientific rigour and build trust from additional inputs gained by opening up its risk assessments at the level of data gathering, data analysis, expertise and innovation. This will require an approach that moves beyond traditional risk assessment practices that rely on a long chain of static information and knowledge such as scientific articles, reviews, expert groups and committees.

Keywords: risk assessment, methodology, open science, engagement, cognitive analytics, crowdsourcing

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1. Aims of the session

The world of risk analysis and risk governance is facing a decline in trust by society at both the scientific and policy levels. To tackle this, the involvement of society in the process has been proposed as a way of increasing trust and engagement by making better use of available data and knowledge.

During this session, the European Food Safety Authority (EFSA) explored the challenges and the latest thinking and techniques on openness that can assist the organisation in moving beyond a traditional dialogue, towards a sustainable stakeholder and society interaction. The discussion covered the needs of EFSA and target audiences throughout the process, from risk assessment initiation through societal decision-making and communication. The focus of the session was on methodologies and approaches allowing EFSA to increase its scientific rigour and consequential trust gain from additional input gained by opening up its risk assessments at the level of data gathering, data analysis, expertise and innovation. This requires thinking beyond traditional risk assessment practices that rely on a long chain of static information and knowledge such as scientific articles, reviews, expert groups and committees.

2. Scientific background

The European food safety system has been created to establish an institutional separation between risk assessment and risk management. For the risk management, the European Commission, the European Parliament and competent authorities in the Member States are responsible for the preparation and enforcement of legislation on food safety, animal and plant health and animal welfare in the European Union (EU). EFSA's raison d'être is to support the risk managers in the decision-making process by providing them with risk assessments. The information resulting from the risk assessment thus needs to be of value to them (i.e. addressing the issue at hand in a manner that is relevant not only purely scientific but also useful as input for economical and societal impact analysis). In addition, EFSA's work and the risk management decisions based on it are only relevant if the risk assessments delivered by EFSA are trusted by society. To increase the trust by society, EFSA's 2020 strategy identified key objectives such as 'public engagement in the scientific assessment process', 'widening the evidence base', 'building scientific assessment capacity and knowledge community' and 'preparing for future risk assessment'.

To address those objectives, on its journey from truth to trust, EFSA has recently launched a number of activities to further contribute to the producing of more robust, transparent and open scientific assessments (Transparency and Engagement in Risk Assessment, TERA). Open scientific assessment can be defined as a decision support process where there is not only full transparency (showing what has been done and how it is done) but also an interaction with the outside world on the data, the methodologies used and the outcome. In line with the Authority's intention to further open up its activities to wider scrutiny and participation, EFSA has recently published a discussion paper on Transformation to an 'Open EFSA' (EFSA, 2014) and addresses 'Openness and transparency' (besides impartiality, methodological quality and responsiveness) directly as a key criterion in its PROMETHEUS project, which provides the principles and process for dealing with data and evidence since mid-2015.

The societal move to open science and open data, along with the increasing amount of evidence relevant for risk assessment published in the open literature, means that the amount of information available at hand grows every minute. The development and growth of global information technology (IT) networks has broken down the previous barriers to engagement (distance, knowledge, means of interaction), granting an ever rising number of users fast access to vast amounts of information on the Internet. As a result, a gradual but steady growth can be observed in users' interest, involvement and participation in projects beyond their traditional spheres of influence and direct professional networks. This technological development provided both opportunities and challenges for regulatory bodies possessing sizeable quantities of granular and aggregated data that are continuously fed into its scientific decision-making processes. As an example, we have witnessed the development of a EU initiative providing e-infrastructures (i.e. an entire digital environment or network, spanning countries and scientific disciplines, which allow locally controlled data systems to interoperate as seamlessly as possible). Using it, researchers can find, access, use and re-use data and results from other researchers, inside and outside their fields of competence and countries. Examples of open scientific e-Infrastructure are OpenAIRE (under which research institutions across Europe are experimenting with shared data and publication repositories), OpenMinTeD (fosters and facilitates the use of text and

data mining technologies in the scientific publications world) and ENGAGE (facilitating the publication and (re-)use of open distributed and diverse public sector information data, providing a single point of access to data, as well as relevant tools).

Knowledge available in society that can be beneficial to EFSA's risk assessment or to drive innovation has, at this point, only been explored by calls for data, public consultations to the stakeholder community or by classic procurement or grant-based procedures, hence leaving untapped the knowledge scattered over the enormous public not reached by those approaches. Over the next few years, EFSA wants to explore how this vast amount of knowledge and information 'out there' can be used in its risk assessments in a transparent and traceable way. In this sense, recent developments and experiences using crowdsourcing and cognitive analytics are being explored.

This approach will assist the organisation in moving beyond dialogue to sustainable societal interaction while at the same time strengthening trust.

3. Summary of presentations

Openness in science is not new, but society is demanding that science opens up more. Public bodies, consumers and other stakeholders want a voice in risk governance as a whole, from the start onwards, and not just at the end, or, similar to most cases, after the decisions have been taken. Escalating volumes of data requires new ways of approaching assessment and analysis in order to ensure that the risk assessments are considering all of the available evidence while expertise and knowledge are mined through online communities. The session brought together some of the latest open assessment models and tools that are emerging.

Keynote speaker Gerard De Vries from the University of Amsterdam provided the ideal conceptual springboard to start the session, outlining the assets that society can add to the scientific process, where to look among the public and experts, and the skills and tools that they can bring, starting from the three requestors for public involvement in risk governance being the market, science and politics. 'We need to rethink what is science, what is society and what is the place of research in public life'. He illustrated the importance of the involvement of as many actors as possible in each step of the process from risk identification over risk assessment to risk governance. Every actor can participate in their own way, bringing a piece of the puzzle to the table. This approach is classically perceived as burdensome and complex but gains are to be found later in the process with more effective decisions, increased trust among the actors and a much smoother buy-in of risk governance measures.

Involving society in science by involving diverse types of expertise into the assessments (e.g. from both the natural sciences and social sciences) is already a reality in some areas, as presented by the European Chemicals Agency's Tomas Öberg, who described how such an interdisciplinary approach is used to carry out impact assessment for chemicals covered by the EU's REACH Regulation. This approach adds value to the risk assessment and enlarges the knowledge framework of the risk manager.

Moving beyond the scientific comitology concept and using the power of the crowd can bring diversity and speed when looking for new ideas, concepts, specific information, techniques and solutions to specific problems. The crowd can help overcome problems, whether this is about looking for a new concept, seeking global insights and studies, trying to overcome a sticky problem, exploring disruptive landscapes or analysing big data. Crowdsourcing is not really new, according to Miia Kosonen of Mikkeli University in Finland, because crowd wisdom is as old as human society. What is new is our ability to connect and engage in knowledge-based interactions by use of the Internet. Citizen science and crowdsourcing are not intended to replace scientific expertise but rather to complement it by adding an extra viewing angle or filling existing gaps in research topics and knowledge. Kosonen outlines three models for crowdsourcing that are motivated by degrees and combinations of competition and collaboration. Interestingly, the key motivators for knowledge-sharing are social integrative benefits and learning benefits. The nature of these drivers partially rules out bad intentions or mediocre contributions, which are often cited as the main risks of crowdsourcing and a reason not to use it as a tool.

As an example of competition-driven crowdsourcing, InnoCentive's Steven Drew described his company's open innovation tool whereby some 100,000 registered 'solvers' take part in 'challenges' designed to solve scientific problems. Prize money and opportunities for further collaboration are the main drivers in their crowdsourcing model. He demonstrated some impressive challenge outcomes and provided examples of the diversity of goals for which crowdsourcing can be used. Linked to risk assessment in particular, the crowd can be used to conduct studies to feed into risk assessments, to

identify models that can be applied to safety assessments, to visualise acquired data sets for diverse or alternative observations, or to derive algorithms to better analyse data.

For over a decade, Jouni Tuomisto of Finland's National Institute for Health and Welfare has been developing practical, more collaboration-driven open assessment tools using web-based platforms. Those so named 'knowledge crystals' are set up to answer a specific research question and make available, in a fixed location on the Internet, the best currently known answers, as well as all available data and information and discussion needed to convince a critical reader. The crystals are updated as new data appear and are open to anyone's participation under specific rules. Such a model is more complex than just an online calculator or a piece of text written with online tools, states Tuomisto; rather, it is a scientific community on a specific topic but, in contrast to classical communities, it is open to everyone, no matter what background you have or contribution you could make. It can be used as a discussion forum aiming to resolve disputes or to present hypotheses and attempt to reject them based on data. The knowledge crystal is a database for up-to-date quantitative estimates about important variables and a modelling environment optimising decision options based on the variables. Also, it is a resource centre for re-using existing information in similar new cases and, finally, it is a forum for discussions about values and objectives that should be used to choose or reject decision options.

In order to ensure that all available evidence is integrated into a risk assessment, the need for exploring automated approaches is becoming more and more obvious. The volume, variety and velocity of data are not only creating an unprecedented opportunity but also new challenges because individuals cannot hope to critically evaluate all of these data on their own. Cognitive analytics such as machine learning and natural language processing can visualise relationships in information from millions of texts, books, online articles and more. Such an amount of information would take risk assessors decades to digest.

Cognitive technologies, which are products of the field of artificial intelligence research, provide computerised tools performing tasks that only humans used to be able to do. As a first step in exploring its potential role in risk assessment, we need to better understand cognitive computing and how it enhances, scales and accelerates human expertise. New tools can help as presented by Cameron Brooks from IBM Watson who reported numbers about the potential of cognitive computing for extracting evidence from unstructured big data. Watson can read 200 million pages of data in 3 s. It is claimed that not only does it understand but also it can generate and evaluate evidence-based hypotheses, and adapt and learn over time.

While the engagement of society in a transparent risk assessment process creates trust, the outcome of a risk assessment should be accessible and understandable for that same society. To convey scientific assessments in a clear and concise manner, visualisation tools may be used to clarify the relationship between probability and the extent of damage using colour gradations. Germany's Federal Institute for Risk Assessment, explained Mark Lohmann, has developed a graphical tool that illustrates the magnitude of substantial risk assessment parameters. The tool is used for risk communication to increase knowledge about risks and understanding of scientific findings, and to promote dialogue with the public and stakeholder groups that helps to determine misunderstandings and avoid conflicts. The tool is structured as a table containing the five characteristics: affected groups of persons; probability of impaired health in the event of exposure; severity of impaired health; validity of the available data; and possibilities for consumers to control the risk through such measures as avoidance or caution. Currently, it is in the process of being updated, taking into account evaluations by different stakeholders, especially focusing on the usability of different verbal expressions defining the term 'probability'.

Robert Doubleday of Cambridge University's Centre for Science and Policy summed up the session and concluded that rigour is needed because no single form of expertise can encompass every requirement for complex scientific questions while the process of selecting expertise needs to be open. Efficiency is needed too because data and demands may be growing exponentially, whereas public resources are not growing at the same rate.

4. Conclusions and recommendations

Questions related to food safety are becoming more complex and require faster responses to help risk managers and the EU's 500 million consumers. EFSA plays an increasing role in providing data analysis and scientific advice to help risk managers respond to urgent food safety-related questions. Greater complexity, where the analysis of big data is becoming a fundamental feature of scientific

research, and increasing urgency imply considerable resource investments, both in financial and human capital terms, in order to provide scientific advice. These challenges have to be faced against the backdrop of the current financial crisis. Collective intelligence available globally via the Internet has shown that it is capable of elaborating and digesting enormous quantities of data.

Enhancing collaborative approaches and openness to interested parties and external knowledge communities will help address the challenge of more complex food safety-related questions and will enhance scientific scrutiny; the openness of the process will improve outputs and engender trust. On the other hand, greater involvement and participation could also hide potential risks, such as the disproportionate influence of a limited number of actors or a loss of control by EFSA over the content of an output.

Following the Massachusetts Institute of Technology definition, crowdsourcing is a problem-solving model because it enables an organisation confronted with a problem and desiring a goal state to scale up the task environment dramatically and enlarge the solver base by opening up the problem to an online community through the Internet. When seen through a research and development lens, problem-solving might well be synonymous with innovation. In that sense, existing IT options need to be explored or developed in order to facilitate the exchange of data and ideas for the use in crowdsourcing, whereas the success of such exercises can only be guaranteed by demonstrating the benefit to the crowd involved and society at large. To do this, the assessment of impacts through socio-economic analysis requires further development.

Thanks to recent developments in the field of artificial intelligence, cognitive technologies extend the power of computers to tasks that were originally performed by humans. In that sense, the link between using crowdsourcing and cognitive analytics in risk assessment is a no brainer. Cognitive analytics such as machine learning and natural language processing can discover patterns and relationships in information from millions of texts, books, online articles and other sources (e.g. social media), comprising information that could take researchers (humans) decades to discover, retrieve and digest.

As a first step in exploring its potential role in risk assessment, we need to better understand and pilot cognitive computing and its role in enhancing, scaling and accelerating human expertise. All this should be achieved without losing the human factor in the loop because validation is needed and specific domain expertise is indispensable in order to act on the insights that might be gleaned by cognitive analytics-driven analysis.

Open data and open models change the way we think about evidence-based decision-making: it is collaborative, dynamic information collection work that produces a quantitative description of the topic in the form of an online collaborative model. This may imply that, in the future, in order to have up-to-date and relevant risk assessments, a more dynamic approach would need to be adopted. The implications for risk management and risk communication should be carefully considered underpinned by an in-depth analysis of possible legal and regulatory issues (information quality, data security, privacy and information policy, etc.), vulnerability to lobbying and ethical implication (digital exclusion due to social and economic barriers, etc.) and possible issues related to scientific reliability and reproducibility of results.

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Abbreviations

IT information technology
TERA Transparency and Engagement in Risk Assessment