

EPFL

2020

Annual Report

Overview of activities

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Foreword

It has been a long year since I last had the pleasure of addressing this report's readers. I am still working at home, albeit with an increasingly bright view of the light at the end of the tunnel. This has been an "interesting" year, one that most of us will long remember as a sharp demonstration both of the fragility of our daily routine and the resilience of people and institutions in general.

One of my biggest disappointments has been the ineffective and sometimes harmful responses of governments in most countries. Even countries that believe they have superior organisation and governance should be embarrassed by dysfunctional public health systems, lack of resources, inadequate communications between politicians and experts, ineffective messaging to the public, and a host of other failings. Many lives were lost and dreams shattered because governments failed at their basic task of maintaining order and safety.

IRGC has a vital role to play in preventing a similar failure in the future. The risk governance framework that IRGC has popularised for many years provides valuable insights for managing crises. It should be much more widely known and discussed. Moreover, IRGC needs to assume a more prominent role in these discussions, not just as the developer of a toolkit, but rather as a trustworthy source of technical expertise (from EPFL and elsewhere) informed by an understanding of political, economic, government and business factors. This is IRGC's challenge going forward.

James Larus
Academic Director

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Global risk governance in 2020

The year 2020 was dramatic and disruptive for everyone.¹ For individuals and organisations working in risk management, risk governance and crisis management, it was a stress test. For nearly twenty years, IRGC has been working with scientists and policymakers to help societies and organisations understand, evaluate and respond to the risks they face, focusing on those marked by high complexity, uncertainty and ambiguity. In 2020, there was abundant evidence of just how badly things can turn out in the absence of adequate preparation. It was not enough to say, “we knew and had told you that this could happen”. But the focus on crisis management should not divert attention from the underlying causes of the risk itself and the terrible costs of failing to deal with it in advance. It must now be a priority to prepare better for emerging risks and future crises. This does not only apply to pandemic risks. In February 2021, the devastating consequences of cold weather in Texas and neighbouring states also resulted from a lack of preparedness despite risk warnings. This was due not to poor risk analysis, but rather poor risk governance, ageing infrastructure and persistent perverse incentives that hinder the taking of well-known necessary actions.

Lessons from Covid-19

The pandemic reveals unpreparedness despite risk warnings

The first learnings from 2020 in terms of risk governance is thus “unpreparedness”. In many countries, no plans had been made to deal with the risk of a large-scale pandemic. This was despite repeated scientific warnings, and even though many of these countries had flagged pandemic risks in their national risk assessment exercises. The biggest exception to this pattern were countries, mostly in Asia, with recent experience of SARS and MERS outbreaks. Without that concrete experience, the problem seems to have been the familiar one of risks with a low probability of occurrence being neglected, despite knowledge of the massive losses and disruption they can cause. In other words, it is not enough to predict and warn about risks. For the future, there needs to be greater follow-through with the development of actionable policies and plans. Moreover, greater persuasion is needed to ensure that countries and organisations allocate the investment to prepare accordingly.

Obviously, it is impossible to prepare for every risk that could occur suddenly, so it is important to have a framework in place that decision-makers can use as

¹ This analysis of 2020 results to a large extent from conversations among members of IRGC’s advisory board in January 2021. IRGC is grateful to them for their support and advice.

soon as a major risk crystallises, rather than having to design one from scratch just as systems are put under huge stress, and to prepare in advance better policies, which can be implemented once a window of opportunity opens.

Science and policy must learn to work better together

The difficulty of establishing an efficient relationship between science and policy is the second learning from 2020 that IRGC wants to emphasise. The interaction between science and policy has rarely been as central to day-to-day decision-making around the world as during 2020. The Covid-19 pandemic has served as a global field test for how scientists and policymakers can work together, and numerous difficulties have arisen². At the bad-faith extreme, some politicians have wilfully ignored scientific advice. However, more frequently, problems have arisen in good faith due to tensions and misunderstandings relating to the two groups' very different priorities, constraints and working practices. It can be difficult for scientists to provide scientific advice that makes sense to governments. Likewise, it can be difficult for governments to know how to use the scientific advice they receive. Improving the science-policy nexus has always been at the heart of IRGC's risk governance model, and there should be cautious optimism on this point after 2020. The cauldron of Covid-19 is teaching scientists and policymakers a lot about each other, and this should improve the chances of successful cooperation in the future. These science-policy issues apply to a wide range of questions beyond the pandemic, including climate change.

We need to learn how to deal better with uncertainty

Throughout the pandemic, one of the central challenges faced by scientists and policymakers – both in working with each other and in communicating with the wider public – has been the issue of uncertainty. This is the third learning we would like to emphasise here. It is extremely difficult

for public authorities to take decisions affecting people's health based on uncertain evidence about an unprecedented and rapidly developing pandemic. The spread and transmission patterns of viruses can only be known conclusively after the outbreak ends. Until then, risk assessment remains tentative. Huge amounts of scientific and policy-related knowledge have been developed over the course of the pandemic, but scientists and governments still cannot avoid relying on uncertain assumptions about the future development of the virus and the consequences of risk management decisions, such as containment. In general, and particularly in a case like this one that affects people's health, it is a difficult and delicate task to communicate this kind of uncertainty to society. Transparency and trust are crucial to making sense of, accepting, and dealing with uncertainty and risk. We saw in 2020 that when individuals are hurt – whether in terms of their health or their economic situation – and they face uncertain futures, transparent and compassionate communication can serve to establish trustworthiness. This means being clear about what is known and what is not known. This kind of transparency is necessary to build acceptance of tough decisions, such as lockdowns. Similarly, when public authorities are trusted, it makes transparent communication easier, including with people who may be negatively affected by the developments.

Complexity and global interconnectedness are more obviously visible

The past year has also made everyone more aware of the complexity and interconnectedness of today's world, as well as the need to improve global collaboration. The 2008 crisis showed how easily and quickly financial risks can propagate around the world. Covid-19 has shown that "physical" risks can propagate just as easily and quickly, and with knock-on economic, financial and societal impacts that are still not clearly understood. 2020 has brought the issue of systemic risk to the forefront, not just in terms of the character of the crisis – Covid-19 clearly reveals the systemic nature of many risks³ – but also in terms of the difficulty of developing appropriate response strategies. Such responses

² This was not the first time. Crises such as those that resulted from Mad Cow Disease or the nuclear Fukushima accident also stressed the challenges of science-policy communication, and opened windows of opportunity for improvement afterwards.

³ See [IRGC guidelines for the governance of systemic risks](#).

must be science-based, well-communicated and coordinated with others, and each of these objectives is challenging in a situation of pervasive uncertainty. There will be a call to improve resilience in many systems after Covid-19, but resilience is not a panacea. For one thing, when the whole economic system is potentially at risk, resilience solutions are extremely costly, especially when they need to compensate for years of under-investment in risk management and the maintenance of critical infrastructure.

Looming now: the climate crisis

IRGC did not dramatically change its 2020 work programme in response to the Covid-19 crisis. We published two articles about the pandemic, one on insights from risk governance and one on contact-tracing technology.⁴ However, with so much work being done by so many on the pandemic, one of the lessons IRGC has taken to heart after 2020 is that Covid-19 should make everyone think more clearly about other risks for which the world is unprepared. Among them, there is perhaps no more important such risk than climate change. “Climate crisis deaths will be worse than Covid,” according to Mark Carney, the United Nations envoy for climate action and finance and the former head of the Bank of England.

Climate engineering

In 2020, IRGC restarted work on climate engineering⁵, with a review of techniques for carbon dioxide removal (CDR) and solar radiation management (SRM), focusing on the diversity of techniques and associated potentials and uncertainties in each category, their respective governance arrangements, the trade-offs involved, and the various possible policy options. The report we published sets the scene for future IRGC work that will go into more depth on some specific aspects of this topic. In particular, our climate engineering work in 2020 left us with some frustration at a number of obstacles that hamper the fight against climate change. One example is

the legacy of international legal conventions that can constrain how climate policies are framed. Typically, not all techniques for negative emissions technologies (NETs) are included in climate mitigation under the Paris agreement, which focuses on addressing climate change at source by reducing CO₂ emissions. However, reducing the concentration of CO₂ in the atmosphere has the same effect. There is wide agreement that, in addition to reducing CO₂ emissions, it will be necessary to remove CO₂ from the atmosphere with CDR techniques. More work is needed to understand these techniques, because at the moment, concerns about what the associated risks and costs might be are discouraging many from proceeding with important research and testing. Another example relates to SRM. Legitimate and scientifically grounded fears that SRM would create large risks elsewhere in the climate system (with cascading consequences in society and the environment) should not be a reason for inaction or a ban on research on SRM. Concerns about mitigation deterrence, moral hazard and organisational reputation are legitimate, but may be obstacles to a scientifically-informed dialogue in society. For more information, see page 8. Climate engineering is a topic IRGC will be building on in 2021.

Risks from transitions to a low-carbon economy and society

A second aspect of climate-related risks that IRGC focused on in 2020 was the transition risks associated with shifting to low-carbon technologies. We published a policy report arguing that in order to ensure the success of their climate strategies, policymakers should take these countervailing risks more seriously. Failure to do so could slow or derail important climate policies. Transition risks have already begun to crystallise. The gilets jaunes protests in France are one example. Another is Australia, which has moved slowly on preparations for the transition and now has to rush to respond to falling demand for its coal exports.

⁴ Covid-19: A risk governance perspective and Covid-19 contact tracing: efficacy and privacy.

⁵ In 2010, IRGC published Cooling the earth through solar radiation management. The need for research and an approach to its governance.

Looking ahead: sustainability matters

Across many domains, sustainability has become a central theme. The UN Sustainable Development Goals (SDGs) are a call for action and provide guiding principles, leaving every organisation to do what it can do to reach them.

A recurring question to us in the past few years has been: what does IRGC do for sustainability? Our response is in two parts. First, the risk governance approach can provide a compass because it consists of a set of neutral guidelines to support organisations in their efforts to reach their goals⁶. Second, as an organisation, when we recommend risk management response strategies for a 'desirable' outcome, we can decide that a 'good' or effective risk governance strategy will be one that maximises the goal of sustainability. In that sense, costs and benefits of a given activity should be evaluated, risks should be governed, and trade-offs between risks should be resolved in a way that maximises the goal of sustainability over other goals such as economic competitiveness, GDP or individual welfare.

Besides suggesting risk governance strategies that optimise sustainability, we can develop a set of criteria or necessary conditions for producing sustainable outcomes in applied research, technology and innovation projects. Technology and innovation often aim to mitigate or remedy existing risks, and this should be incentivised. By supporting those involved in such projects to understand better the context in which the outcome of their work will be implemented, we can help them identify emerging, consequential sustainability-related risks (and trade-offs) that would be caused by new technology. For example, digitalisation enhances economic opportunities for those who have access to it, but increasing electricity consumption for cloud computing and other supporting infrastructure, and inability to address the digital divide, may exacerbate intra- and inter-generational sustainability risks. Also, plastic food packaging can increase shelf life and reduce food waste, but if plastics end up in the ocean, microplastics cause lots of environmental harm. In broad terms, IRGC can work

to support the development and implementation of concrete actions towards sustainability, and suggest positive incentives for contributing to developing a sustainability mindset.

Responsible technology deployment

Sustainability is not the only important overarching goal for today's world. IRGC has a long-standing focus on developing risk governance guidelines for the rapidly evolving digital technology landscape, and last year highlighted continuing challenges in this area. In the digital domain, 2020 brought to light again the risk of misuse of artificial intelligence (AI) and machine learning. Calls for ethical, responsible or trustworthy AI have continued to multiply, and the debate has now moved on to the point that the introduction of various forms of AI regulation is being seriously debated in various jurisdictions. It remains far from clear what could or should be done, but the policy arena is changing: there is growing concern among many regulators and others that "something must be done" to prevent irreversible damage to fundamental rights, including greater control on certain applications of algorithmic decision-making. IRGC will continue its work on digital technologies in 2021, and the theme of governing risks from emerging and converging technologies remains at the core of what we do.

⁶ Risk governance is the process of assessing, managing and communicating risk in a comprehensive manner. This implies involving stakeholders and using multidisciplinary scientific evidence. The goal of an organisation that uses this process is decided by that organisation, not by the process itself, which is neutral.

Key projects

In 2020, we produced specific risk governance recommendations in a number of different areas. At the request of the Swiss Government Federal Office for the Environment, we organised an expert workshop and produced a report on governance issues in climate engineering. We also convened an expert workshop on the governance of low-carbon transition risks, and continued our involvement in EU research projects about governing risks from engineered nanomaterials and the changing relationship between digital technology and global governance. Building on our many years of work looking at risks stemming from digitalisation, we organised a conference with expert speakers discussing topics such as AI and policy, Covid-19 tracing apps and deepfakes.

We maintained our focus on developing methods that others can use to improve their risk governance, for example, by publishing a revised guide on the role of stakeholder involvement. We also began our new “Spotlight on risk” article series, which we used to address current events such as assessing early months of the Covid-19 pandemic from a risk governance perspective.

Activities at a glance

Events

January – IRGC annual strategy meeting

April – Expert workshop: International governance issues on climate engineering

September – Expert workshop: Risk governance and the low-carbon transition

November – Conference: Governance of and by digital technology

Publications

April – Spotlight on risk. **Covid-19: A risk governance perspective**

May – Spotlight on risk. **Covid-19 contact tracing: Efficacy and privacy**

May – Review of current governance regimes and EU initiatives concerning AI (working paper)

June – International governance issues on climate engineering (report)

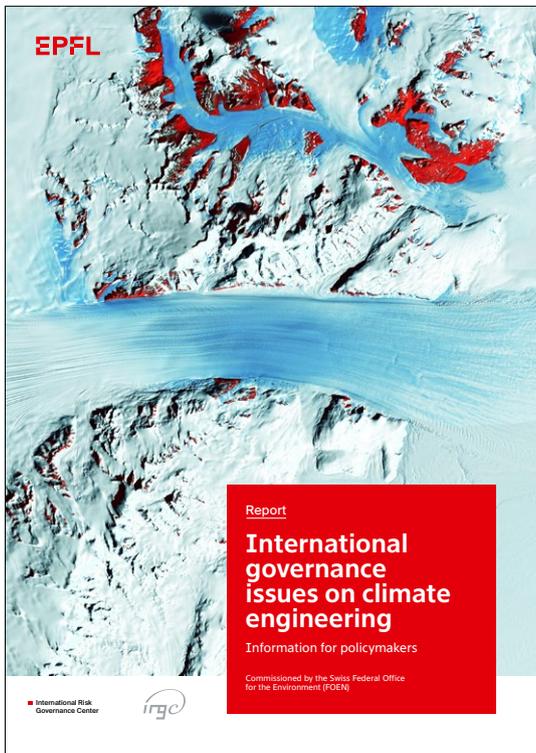
August – Spotlight on risk. **Low-carbon transition risk**

November – Involving stakeholders in the risk governance process (guidelines)

December – Governance of and by digital technology (conference proceedings)

All IRGC publications can be found at www.epfl.ch/research/domains/irgc/publications

International governance of climate engineering



To reach the global warming goals set out by the Paris Agreement (keep warming well under 2°C above pre-industrial levels), the world needs to reach global net-zero CO₂ emissions in the second half of this century. Carbon dioxide removal (CDR) encompasses a range of techniques to remove CO₂ from the atmosphere. Some of these techniques could be part of international climate policy, but steps need to be taken to lay a foundation for a decision-making process regarding research, policy, regulation and possible use. Another approach, solar radiation management (SRM), involves the use of technologies that could artificially cool the planet.

IRGC carried out work in 2020 to provide policymakers with an overview of the governance issues raised by climate engineering technologies. A workshop in April contributed to developing the knowledge base regarding various issues related to CDR and SRM technologies and governance arrangements. This was followed in June by an in-depth report entitled “[International governance issues on climate engineering](#)”. Its four chapters,

authored by experts in the field (Matthias Honegger, Anna-Maria Hubert, Jesse Reynolds and Paul Rouse), draw together information and recommendations relevant to technology assessment and international policymaking in this area of growing importance for mitigating the causes and effects of climate change.

This study suggests a series of governance recommendations:

- Distinguish between CDR and SRM, as well as among the diverse CDR techniques.
- Accelerate authoritative, comprehensive and international scientific assessment.
- Encourage the research, development and responsible use of some CDR techniques.
- Help build capacity for evaluating CDR and SRM in some of the countries that lack the resources to do so.
- Facilitate the elaboration and implementation of non-state governance.
- Explore potential further governance of SRM while remaining agnostic concerning its ultimate use.

IRGC's climate engineering report was launched by Marie-Valentine Florin along with two co-authors, Jesse Reynolds and Paul Rouse, on 18 June 2020 at a session of the [Geneva Environment Dialogues](#), which discuss current and pressing topics on the global environmental agenda.

This project was undertaken thanks to support from the Swiss Government's Federal Office for the Environment.

Risk governance and the low-carbon transition



2020 was one of the three hottest years on record, and yet, if temperatures continue to rise as they have been, it could end up being one of the coolest of the 21st century. In order to avoid the worst effects of global warming, a growing number of countries have committed to ambitious climate goals that will require them to transition to a low-carbon economy and society. However, ensuring that climate strategies are successful means preparing for any unintended adverse consequences that might arise, such as job losses in declining energy sectors or possible environmental impacts of scaling up renewables.

In order to investigate and address these transition risks, IRGC organised an expert workshop with the Institute for Advanced Sustainability Studies (IASS) and hosted by the Swiss Re Institute. This workshop brought together a multidisciplinary group of experts to discuss potential adverse countervailing risks that could be caused by the low-carbon transition, as well as the governance principles and priorities that should guide responses to them. It is imperative that transition risks are identified, assessed and managed in order to ensure a successful low-carbon transition, which is necessary for meeting global climate goals.

Workshop participants included experts from the OECD, the European Commission, Imperial College London, the World Economic Forum, the CICERO Center for International Climate Research, the Swiss Federal Institute of Aquatic Science and Technology and ETH Zurich, among others. The presentations and discussions that took place at this workshop led to the production of a [policy brief](#), which was published in early 2021.

Some governments and organisations are already focusing on the issue of transition risk, but it needs more widespread attention.

Governance of nanotechnology-related risks: Nanorigo



Nanorigo (Nanotechnology Risk Governance) is a European Union project that has as its goal the development of a Risk Governance Framework and a related Nanotechnology Risk Governance Council for manufactured nanomaterials and nano-enabled products. IRGC is one of 28 partners in this project and it is our role to provide core principles for the development of the Framework, as well as leading work on establishing the Council. We are currently halfway through the project.

In 2020, we continued our work developing multidisciplinary and multistakeholder collaboration in the assessment and management of nanotechnology risks related to future nano-based products or systems. Most of these could result from converging technologies and could raise environmental sustainability challenges.

We also worked last year on defining the mandate, composition and structure of the new Council. This was based on extensive consultations with Nanorigo partners, an analysis of the landscape of existing European institutions concerned with safety and security related to engineered nanomaterials, and the presentation of possible models in other sectors.

Digital technology and global governance: Trigger



The Trigger (Trends in Global Governance and Europe's Role) project studies the role of the European Union in an evolving global governance landscape. While its overall objective is to provide EU institutions with the knowledge and tools to enhance their effectiveness and influence, IRGC's role focuses in particular on the interrelations between global governance and digital technologies.



In 2020, we produced a working paper on the governance implications of artificial intelligence and machine learning (AI/ML). Machine learning models can be used to automate decisions in an ever-widening range of contexts and this automated decision-making can be deployed in ways that have a material impact on people's lives, from shaping the content of a social media newsfeed to determining whether or not someone should be incarcerated. The

report provides a global survey of AI/ML governance initiatives before analysing three domain-specific applications of these technologies: autonomous vehicles, aspects of public administration and healthcare. It concludes by suggesting that the EU may be best placed to influence global governance of AI/ML in those domains where normative principles are particularly prominent.

Another pillar of our work for Trigger is one of four extended case studies that assess the EU's ability to shape global governance in a number of key areas. IRGC's case study focuses on data protection. This work applies a model of "actorness" that has been developed by our partners on the Trigger project and that provides seven dimensions against which influence can be assessed (authority, autonomy, cohesion, recognition, attractiveness, credibility and opportunity/necessity to act).

Public conference: Governance of and by digital technology

Building on our work with the Trigger project, in November, we organised the "Governance of and by digital technology" conference. This public

event brought together leading policymakers, researchers and practitioners to discuss the implications of digital technologies, with a particular focus on the governance and regulation of AI/ML.

The event also included discussion of governance by (or with) digital technology, and the danger that decision-making algorithms, without human supervision or control, will reduce or remove the ability of institutions and people to make decisions. What kinds of rules and regulations are necessary to prevent new technologies from causing harm? Speakers included Stuart J. Russell from UC Berkeley, Joanna Bryson from the Hertie School, Karen Yeung from Birmingham Law and Bryan Ford from EPFL.

This conference hosted nearly 150 attendees from multiple countries. Video recordings from the event are available to the public. Following the conference, IRGC published its conference proceedings, which provide an in-depth analysis of the discussions and debates that took place at the event.



Involving stakeholders in the risk governance process



Stakeholder involvement is a cross-cutting aspect of the risk governance process. As part of our ongoing work on core concepts, we published the guide “[Involving stakeholders in the risk governance process](#)”. This was an update of an earlier publication that was produced with Institute for Advanced Sustainability Studies (IASS) in 2013.

Stakeholder involvement is a key component of the IRGC risk governance framework. Involving stakeholders is helpful for assessing risk perception, concerns and opinions, for evaluating factors that influence decision-making, and for effectively managing risks.

This document provides advice to risk managers and policymakers on why and how to plan and conduct stakeholder involvement processes to achieve better risk governance outcomes at each stage of the risk governance framework. It outlines the objectives that can be achieved through stakeholder involvement, and specific outcomes that can be expected.

Communication	Consultation/ feedback	Deliberation/ co-determination
<ul style="list-style-type: none"> • Literacy • Behavioural change 	<ul style="list-style-type: none"> • Representation of public preferences • Informed consent 	<ul style="list-style-type: none"> • Self-commitment • Co-regulation/management

Objectives and expected outcomes of stakeholder involvement.

Using real-world examples from climate engineering, wildfire management and Covid-19, risk managers are also given tangible ways of involving stakeholders in risk management. The guide concludes with the benefits and challenges of involving stakeholders, and offers advice for overcoming common pitfalls.

Spotlight on risk series



In 2020, IRGC began its Spotlight on risk series. This series of shorter articles looks at current events and trends through the lens of risk governance. IRGC will continue this series in 2021.

Covid-19: A risk governance perspective

The early months of the Covid-19 crisis required policymakers to make high-stakes decisions under conditions of uncertainty and compressed timescales. This piece used the IRGC risk governance framework to outline the key stages of the evolution of the crisis, and to ask what lessons might be learned for the immediate future. This article was also translated into Japanese.

Covid-19 contact tracing: Efficacy and privacy

This article assesses the risk-risk trade-off between privacy and efficacy that the use of contact tracing apps entails. It argues for the use of privacy-preserving apps, but highlights potential weaknesses and cautions against allowing digital tracing to detract from other pillars in the pandemic response.

Low-carbon transition risk

This article outlines some of the countervailing risks associated with the transition to a low-carbon economy and society. The low-carbon transition is becoming increasingly urgent as evidence of climate change mounts, but ensuring a smooth transition calls for more work to assess, evaluate and mitigate various risks that are likely to arise.

IRGC & the EPFL community

One of IRGC's main roles is to provide a bridge between the world-class research and innovation that takes place at EPFL and the wider world of public policy outside. The importance of fostering such links between science, technology and policy has been starkly confirmed by the events of 2020, and IRGC looks forward to continued collaboration with researchers across EPFL on finding science-based solutions to policy problems.

The concept of risk is central to what IRGC does. Our role at EPFL allows us to highlight some of the potential risks associated with various fields of science and technology. But just as importantly, it also allows us to highlight for policymakers how advances in science and technology can mitigate existing risks, or contribute to deeper transitions (such as decarbonisation) with the potential to transform societies' risk landscapes.

Education forms a small but growing part of IRGC's activities. Each year, Marie-Valentine Florin teaches an undergraduate course on risk governance within the EPFL Social Sciences and Humanities (SHS) programme. This provides students with insights about risk governance and a framework to analyse and make sense of risk issues, especially those related to emerging technologies.

In 2020, Marie-Valentine started offering a new course in EPFL's doctoral school. The course aims to provide PhD candidates with transferable skills relating to IRGC's policy-focused activities. It involves participation in an IRGC expert workshop, and in the subsequent research and analysis process, students

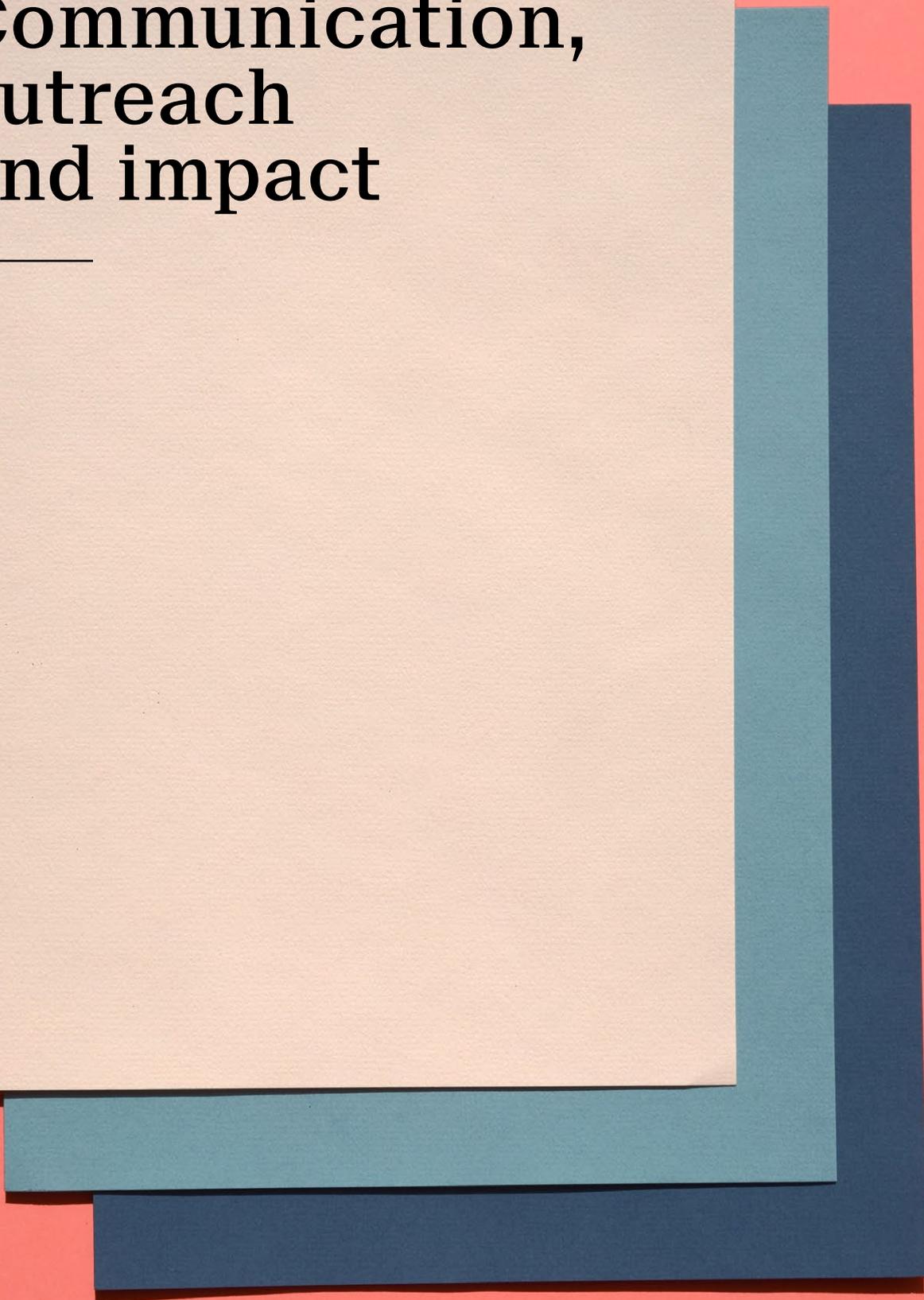
are confronted with the challenge of providing scientific information that is relevant to policymakers. As part of this course, three PhD students participated in our September expert workshop on low-carbon transition risks.

Our collaborations with EPFL last year included our public conference on "Governance of and by digital technologies", where faculty members from the School of Computer and Communication Sciences were among the moderators and panellists. When EPFL was leading work on the digital Covid-tracing protocol that was subsequently adopted by Google and Apple, we produced a "Spotlight on risk" article assessing potential contact-tracing conflicts between privacy and efficacy. We also presented our work at events run by our colleagues, such as presentations by Marie-Valentine at the Swiss Data Science Center's SDSC-connect conference on digital forgery/deepfakes as the dark side of machine learning, along with participating in an executive training on risk management to present a risk governance perspective on data governance and machine learning.

In the year ahead, we hope to continue and deepen our work with the rest of the EPFL community. Two specific areas of collaboration will be space debris and climate engineering. More broadly, we envisage IRGC being a prominent participant in efforts to make sustainability a guiding principle for all activities across the university.



Communication, outreach and impact



IRGC's impact

IRGC's work is dedicated to expanding knowledge and understanding about the increasingly complex, uncertain and ambiguous risks that affect society. We act as a neutral platform for multi-stakeholder dialogue on these risks and opportunities, and aim to provide scientifically grounded policy recommendations for risk governance. As an interdisciplinary research centre, IRGC's work has a wide reach, and is used in policymaking, industry, academia and society at large. We highlight some examples from 2020 below.

— Policymakers



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

The Swiss Federal Office for the Environment (FOEN) commissioned IRGC to produce a report on [climate engineering governance issues](#), and subsequently used it as one of the supporting documents in an analysis of the potential role of negative emissions technologies (NETs) in Switzerland's climate goals for 2050.



OECD repeatedly drew on IRGC's work on [systemic risks](#) across a range of publications:

- [Systemic thinking for policy making: The potential of systems analysis for addressing global policy challenges in the 21st century](#). In this publication, global experts from OECD and the International Institute for Applied Systems Analysis (IIASA) pooled their expertise and experience to propose new approaches to analysing the interconnected trends and issues shaping the world.
- [A systemic resilience approach to dealing with Covid-19 and future shocks](#). This publication outlines the response of OECD's New Approaches to Economic Challenges (NAEC)

group to Covid-19. It proposes a systems-thinking approach and highlights the role of resilience in preparing socioeconomic systems for future shocks.

- [Anticipatory innovation governance: Shaping the future through proactive policy making](#). This OECD working paper on governance in the public sector introduces the key concepts and features of anticipatory innovation governance, promoting it alongside other types of public sector innovation as a means of guiding policy in conditions of complexity and uncertainty.
- [Shaping the Covid-19 recovery: Ideas from OECD's generation Y and Z](#). This publication is the result of a call launched by OECD for its staff, consultants and interns to produce proposals on how countries can emerge from the Covid-19 crisis with a more resilient and inclusive system.



National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

The Dutch National Institute for Public Health and the Environment (RIVM) uses IRGC's [risk governance framework](#):

- The framework is listed as an element of [RIVM's toolkit](#).
- It is also used in the document ["Balancing advantages and disadvantages of protective measures in nuclear accidents"](#).



The World Health Organization used the IRGC [risk governance framework](#) in the publication ["Guidance framework for testing the sterile insect technique as a vector control tool against Aedes-Borne diseases"](#).

In its report “[Science & tech spotlight: Deepfakes](#)”, the US Government Accountability Office (GAO) referenced IRGC’s [policy brief on the governance of deepfake risks](#).

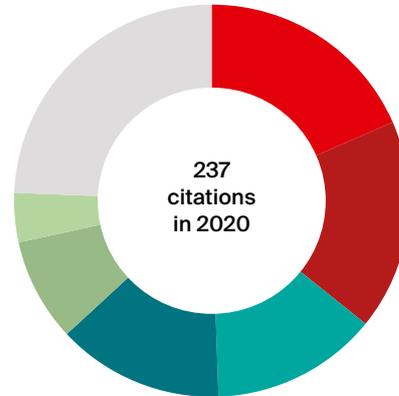


The European Food Safety Authority (EFSA) uses IRGC’s [risk governance framework](#) and guidance on [stakeholder involvement](#) in its report, “[Technical assistance in the field of risk communication](#)”.

Scientific community

According to Google Scholar, IRGC’s reports were cited in 237 academic publications in 2020, an increase from 214 in 2019. The core frameworks and guidelines continue to garner particular interest. The risk governance framework was cited 97 times and the emerging risk framework and systemic risk framework were each cited roughly 25 times. There was a marked increase last year in citations of our resource guides on resilience. These were published in 2016 and 2018, highlighting a lag between our publication of new work on risk governance concepts and its subsequent application in the wider scientific literature. The remaining citations in 2020 relate to our work on specific risk domains, including primarily reports on algorithmic decision-making, precision medicine and energy policy.

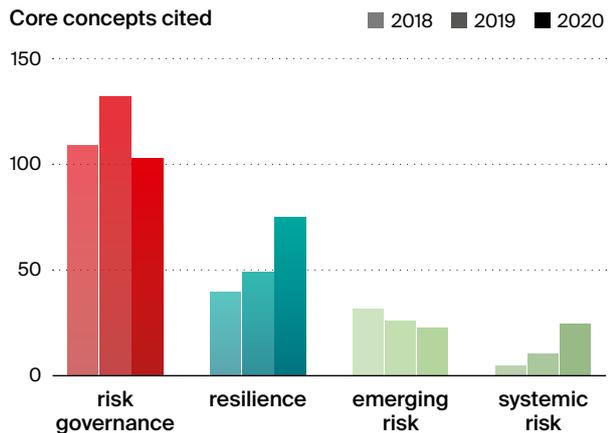
Research citations



- 18% IRGC (2017) Introduction to the IRGC risk governance framework
- 17% IRGC (2005) Risk governance: Towards an integrative approach
- 14% IRGC (2016) Resource guide on resilience, volume 1
- 14% IRGC (2018) Resource guide on resilience, volume 2
- 9% IRGC (2018) Guidelines for the governance of systemic risks
- 4% IRGC (2015) Guidelines for emerging risk governance
- 24% Others

Source: Google Scholar

Core concepts cited



Source: Google Scholar

Selection of citations

“Work on systemic risk – such as for problems that are complex, uncertain and/or ambiguous – acknowledges that conventional approaches for risk assessment and management are not sufficient. Broader frameworks are required, such as the IRGC framework.”

Aven, T., & Renn, O. (2020). Some foundational issues related to risk governance and different types of risks. *Journal of Risk Research*, 23(9), 1121–1134. doi.org/10.1080/13669877.2019.1569099

“Taking the IRGC, the CWA 16649:2013 and, especially, the EU-OSHA as reference, Brocal et al., have developed a theoretical framework inspired by meta-learning lessons, which allows the modelling and qualitative characterisation of emerging risk.”

Brocal, F., Paltrinieri, N., González-Gaya, C., Sebastián, M. A., & Reniers, G. (2020). Approach to the selection of strategies for emerging risk management considering uncertainty as the main decision variable in occupational contexts. *Safety Science*, 134, 105041. doi.org/10.1016/j.ssci.2020.105041

“In order to help decision-makers prepare for systemic risks, the IRGC published ‘Guidelines for the governance of systemic risks’, which provides an innovative governance cycle to trigger and facilitate the transition from the previous system to a regime better equipped to cope with systemic risks.”

Chao, C.-W., & Chao, K.-T. (2020). 8: Governing the climate-driven systemic risk in Taiwan – Challenges and perspectives. In *Climate Change Governance in Asia*. ISBN 9780367227005

“In this chapter, an exploratory application of key elements of the IRGC risk governance framework is presented, focusing on selected risks associated with shipping in the Canadian Arctic.”

Chircop, A., Goerlandt, F., Aporta, C., & Pelot, R. (Eds.). (2020). *Governance of Arctic Shipping: Rethinking Risk, Human Impacts and Regulation*. Springer International Publishing. doi.org/10.1007/978-3-030-44975-9

“IRGC believed that risk governance plays a major role in the reduction in cybercrimes in today’s contemporary risk environment. Therefore, it is imperative to examine the link between risk governance and cybercrime in today’s financial landscape.”

Erin, O. A., Kolawole, A. D., & Noah, A. O. (2020). Risk governance and cybercrime: The hierarchical regression approach. *Future Business Journal*, 6(1), 12. doi.org/10.1186/s43093-020-00020-1

“The overall aim of this article is to contextualize and analyse MASS in a risk governance context, utilizing key concepts of the IRGC risk governance framework.”

Goerlandt, F. (2020). Maritime Autonomous Surface Ships from a risk governance perspective: Interpretation and implications. *Safety Science*, 128, 104758. doi.org/10.1016/j.ssci.2020.104758

“In the influential risk governance framework by the IRGC, risk communication aims to ensure consideration of a plurality of values and interests in order to enable acceptance and social license of risk management strategies by societal actors. The IRGC’s framework has been applied in contexts such as food health and safety, drinking water quality, offshore oil, and autonomous vessels.”

Goerlandt, F., Li, J., & Reniers, G. (2020). The Landscape of Risk Communication Research: A Scientometric Analysis. *International Journal of Environmental Research and Public Health*, 17(9), 3255. doi.org/10.3390/ijerph17093255

“The purpose of IRGC’s exercise is not to generate a deterministic model that applies to any and all systems – this is neither possible nor helpful. Instead, it is designed to produce more introspective, collaborative, and multi-system viewpoints regarding the threats that may be lingering along the peripheries of our systems, as well as where our system’s critical functions or resilience challenges should be improved within future strategic management opportunities.”

Hynes, W., Trump, B., Love, P., & Linkov, I. (2020). Bouncing forward: A resilience approach to dealing with Covid-19 and future systemic shocks. *Environment Systems & Decisions*, 1–11. doi.org/10.1007/s10669-020-09776-x

“The IRGC was first to address the risk governance of emerging and systemic risks, as a response to policy challenges, and developed a generic framework for risk governance, which has been considered broadly applicable for nanotechnology as an emerging technology.”

Isigonis, P., Afantitis, A., Antunes, et al. (2020). Risk Governance of Emerging Technologies Demonstrated in Terms of its Applicability to Nanomaterials. *Small*, 16(36), 2003303. doi.org/10.1002/sml.202003303

“By using the IRGC risk governance framework as an analytic tool we aimed to answer the question: What aspects of risk scientists are [sic] uncertain about when they refer to uncertain risks? To put the findings in context, we also answered the question what cases of uncertain risks are discussed in the literature and from what scientific research perspective these cases are addressed.”

Jansen, T., Claassen, L., Poll, R. van, Kamp, I. van, & Timmermans, D. R. M. (2018). Breaking Down Uncertain Risks for Risk Communication: A Conceptual Review of the Environmental Health Literature. *Risk, Hazards & Crisis in Public Policy*, 9(1), 4–38. doi.org/10.1002/rhc3.12128

“We use the IRGC risk governance framework to briefly describe our preliminary assessment of the status of ‘understanding’ AMR risks, which led to the design and execution of the present literature review.”

Spruijt, P., & Petersen, A. C. (2020). Multilevel governance of antimicrobial resistance risks: A literature review. *Journal of Risk Research*, 1–14. doi.org/10.1080/13669877.2020.1779784

“A risk governance framework refers to the actors and processes used to identify, assess, manage, and communicate those risks. It is especially relevant to situations where there are multiple agencies determining actions with uncertain consequences, as in the case of collaborations seeking to address resilience, climate change, sustainability or other complex social issues. For more on this topic see International Risk Governance Council.”

Resetar, S., Ecola, L., Liang, R., Adamson, D., Forinash, C., Shoup, L., Leopold, B., & Zabel, Z. (2020). *Guidebook for Multi-Agency Collaboration for Sustainability and Resilience*. RAND Corporation. onlinepubs.trb.org/Onlinepubs/nchrp/docs/NCHRP08-36Task142.pdf

“There could be regulatory conflicts among/ between federal agencies and those of states or provinces. But as the IRGC pointed out, there could be overlaps among synthetic biology and other technologies, such as nanotechnology and biotechnology, particularly where there is convergence.”

Srinivas, K. R. (2020). Governance of Emerging Technologies / Applications in the Bio / Life Sciences: Genome Editing and Synthetic Biology. In A. Chaurasia, D. L. Hawksworth, & M. Pessoa de Miranda (Eds.), *GMOs: Implications for Biodiversity Conservation and Ecological Processes* (pp. 441–462). Springer International Publishing. doi.org/10.1007/978-3-030-53183-6_20

“In this article, we adopt a new risk categorisation system brought forward by Renn in a framework of IRGC to classify climate change risks, which may be instrumental in a better governance of climate risks.”

Zhang, Y., Wu, S., Liu, D., & Dai, E. (2010). Categorising risks from climate change under IRGC’s risk governance framework. *Risk Management*, 153–170

Examples of IRGC references in research

Kraft, T., Roth, P., & Wiemer, S. (2020). *Good Practice Guide for Managing Induced Seismicity in Deep Geothermal Energy Projects in Switzerland: Version 2 [Report]*. ETH Zurich. www.research-collection.ethz.ch/handle/20.500.11850/453228

Lim, W.-K. (2020). *Designing Emergency Management: China's Post-SARS Experience, 2003–2012*. Routledge.

Malakar, Y., & Lacey, J. (2020). *Risk Governance of Nanotechnology in Australia: Developing Responsible Science and Technology*. doi.org/10.25919/5f21c738ae2ca

Mechler, R., Stevance, A.-S., Deubelli, T., Linnerooth-Bayer, J., Scolobig, A., Irshaid, J., Handmer, J., Hochrainer-Stigler, S., & Schinko, T. (2020). *Bouncing Forward Sustainably: Pathways to a post-COVID World. Governance for Sustainability*. IIASA-ISC. covid19.iiasa.ac.at/isc/

Mezzanotte, F. E. (2020). An Examination into the Inventory Protection Properties of Robo-advisory Services in Switzerland. *Capital Markets Law Journal*, 15(4), 489–508. doi.org/10.1093/cmlj/kmaa024

Miettinen, M. (2020). “By Design” and Risk Regulation: Insights from Nanotechnologies. *European Journal of Risk Regulation*, 1–17. doi.org/10.1017/err.2020.58

Perrez, F. X. (2020). The Role of the United Nations Environment Assembly in Emerging Issues of International Environmental Law. *Sustainability*, 12(14), 5680. doi.org/10.3390/su12145680

Sornette, D., Cauwels, P., Mearns, E., & Wu, K. (2020). *Human-Environment-Health and Reinforcement of Individual Resilience* (SSRN Scholarly Paper ID 3580740). Social Science Research Network. doi.org/10.2139/ssrn.3580740

Tiwari, A., & Marella, T. K. (2020). Algal Biomass: Potential Renewable Feedstock for Biofuel Production. In N. Srivastava, M. Srivastava, P. K. Mishra, & V. K. Gupta (Eds.), *Substrate Analysis for Effective Biofuels Production* (pp. 1–32). Springer. link.springer.com/chapter/10.1007%2F978-981-32-9607-7_1

Tulonen, T., Šimić, Z., Marsden, E., Verschueren, F., Paul, S., & Arellano, A. L. V. (2020). The Role of Safety Authorities in Providing Foresight. In *Enhancing Safety: The Challenge of Foresight*. European Safety, Reliability & Data Association. doi.org/10.2760/814452

Zevenbergen, C., Gersonius, B., & Radhakrishnan, M. (2020). Flood resilience. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 378(2168), 20190212. doi.org/10.1098/rsta.2019.0212

World Health Organization. (2020). *Global literature on coronavirus disease*. pesquisa.bvsalud.org/global-literature-on-novel-coronavirus-2019-ncov/resource/en/covidwho-361401

Papers and presentation

Papers co-authored by IRGC staff

Collins, A., Florin, M.-V., Renn, O., Journal of Risk Research, March, [Covid-19 risk governance: drivers, responses and lessons to be learned](#)

Trump, B.D., Galaitsi, S. E., Florin, M.-V. et al., Molecular Systems Biology, July, [Building biosecurity for synthetic biology](#)

Viscusi, G., Collins, A., Florin, M.-V., ICEGOV 2020 conference, September, [Governments' strategic stance toward artificial intelligence: An interpretive display on Europe](#)

Viscusi, G., Rusu, A.; Florin, M.-V., IEEE Computer Society, October, [Public strategies for artificial intelligence: Which value drivers?](#)

External events at which IRGC contributed its research outcome

In 2020, IRGC was invited to present its work at academic conferences and for private companies:

Presentation – “Social impact and risk governance of machine learning in the context of infectious diseases”, Digitalization and Infectious Diseases: Improving patient outcome in the age of big data and machine learning, Digital ID2020, (January), M.-V. Florin

Workshop – “Future of regulatory systems”, expert workshop, EPFL (February), M.-V. Florin

Contribution – “Science and business: Working together for sustainability”, Global Sustainability Strategy Forum, IASS (March & October), M.-V. Florin

Dialogue – “International governance issues on climate engineering”, GENeva Environment Dialogues (June), M.-V. Florin

Presentation – “Dealing with the challenge of evidence-based decision-making in situations of uncertainty and emergency”, Healthy Urban Systems Online Workshop, UNIL (September), in preparation of a MOOC, M.-V. Florin

Presentation – “Will digital forgery become the dark side of machine learning? How can we prevent this from happening?” SDSC-Connect, EPFL (October), M.-V. Florin

Presentation – “Resilience and SD: Lessons still being learned from Covid-19”, Annual Conference of the European Sustainable Development Network (ESDN) (October), M.-V. Florin

Presentation – “Forged authenticity: the case of deepfakes”, Deepfakes: Is your business equipped against digital deception and devaluation of truth?, Webinar, Swiss Re Corporate Solutions (October), A. Collins

Presentation – “Gouvernance des risques systémiques dans les transitions au sein de systèmes complexes et adaptatifs”, Congrès Lambda Mu 19 de maîtrise des risques et sûreté de fonctionnement, Institut pour la maîtrise des risques (IMdR) (October), M.-V. Florin

Presentation – “Covid-19 and the global risk landscape”, National Briefing on Global Risks, Governance Institute of Australia (November), A. Collins

Presentation – “A risk governance perspective on data governance and machine learning”, CAS in Data Science & Management, EPFL/UNIL, (November), M.-V. Florin

Presentation – “Governance of systemic risk – focus on Covid-19”, SRA Annual Meeting: Risk Science for Sustainability, Society for Risk Analysis (December), M.-V. Florin.

Media

IRGC's projects and frameworks are increasingly covered by Swiss and international media.



Interview – Les mots de l’Epoque: résilience (“Words of our time: Resilience”), about [IRGC’s resource guide on resilience \(vol. 1 & vol. 2\)](#)



Article – How Swiss scientists are trying to spot deepfakes, about [Forged authenticity: Governing deepfake risks](#)

“The fabrication of deepfake videos has become ‘exponentially quicker, easier and cheaper’ thanks to the distribution of user-friendly software tools and paid-for services online, according to the IRGC at EPFL. ‘Precisely because it is moving so fast, we need to map where this could go – what sectors, groups and countries might be affected,’ says its deputy director, Aengus Collins.”



HEIDI.NEWS

Article – L’EPFL plaide pour une meilleure gouvernance de l’ingénierie climatique (“EPFL calls for better governance of climate engineering”), about [international governance issues on climate engineering](#)

“Better knowledge of risks and the establishment of international governance are two essential prerequisites for climate geoengineering, according to a report written by EPFL under the mandate of the Federal Office for the Environment (FOEN), published on June 19. But given the ethical issues involved in this approach, such a governance structure is unlikely to emerge immediately. Why this is important: Climate geoengineering involves modifying the climate, locally or globally, in the hope of combating global warming.”

Bilan

Article – Eviter la sortie de route des véhicules autonomes (“Preventing self-driving cars from going off road”), about: [Risk and opportunity governance of autonomous cars](#)

[translation] “For the IRGC, the development of self-driving cars must be carried out with a certain spirit of cooperation. ‘The effective collaboration between industry, regulators and other actors affected by mobility rules will determine the speed at which the technology is implemented,’ the council said.”



TheNewsLens [關鍵評論](#)

Article – Taiwan’s response to Covid-19 is a lesson in managing risk, about [IRGC risk governance framework](#)

“How did Taiwan keep the coronavirus at bay? Using the risk governance framework developed by the IRGC helps us understand the strategies Taiwan has adopted to fight Covid-19.”

This article is based on a podcast recorded by National Taiwan University’s Risk Society and Policy Research Center (RSPRC).

TAGBLATT

Article – Gefahr durch Deepfake-Videos: Schweizer Start-Up will den Betrug stoppen (“Danger from deepfake videos: Swiss start-up wants to stop fraud”), about [Forged authenticity: Governing deepfake risks](#)

[translation] “What began as an internet gimmick has turned into a danger. The technology can be used to defame people, cheat or even steal their identity. ‘Deepfakes are increasing rapidly and are becoming a risk,’ says A. Collins, deputy director of the IRGC at EPFL, who deals with the subject in his research. There is already fear in the US that deepfakes could have a decisive impact on the 2020 elections.”

About IRGC

The EPFL International Risk Governance Center is an interdisciplinary unit within EPFL (Ecole polytechnique fédérale de Lausanne). It works to improve the understanding and governance of systemic risks with impacts on human health and safety, the environment, the economy and society at large. IRGC develops risk governance concepts and frameworks, and provides policy advice to decision-makers in the private and public sectors on key emerging or neglected risks. IRGC's work focuses in particular on the governance of risks related to emerging technologies, as well as other areas characterised by high degrees of complexity, uncertainty and ambiguity.

The EPFL International Risk Governance Center works in close collaboration with the IRGC Foundation, which has shaped the global agenda on international risk governance since it was established in 2003, and which continues to play a guiding role in the work of the Center.

The two entities have separate governance and advisory structures.

EPFL International Risk Governance Center

Management Committee: James Larus, Academic Director, Marie-Valentine Florin, Executive Director, Gérard Escher.

Advisory Board: James Larus, David Bresch, Catherine Burger, Janet Hering, Stéphane Jacobzone, Kenneth Oye, Janos Pasztor, Arthur Petersen, Jonathan B. Wiener, Lan Xue.

IRGC team at EPFL in January 2021: Marie-Valentine Florin, Aengus Collins, Romain Buchs, Luana Huguenin, Stephanie Parker, Anca Rusu.

For further details, visit irgc.epfl.ch

IRGC Foundation

Foundation Board: Granger Morgan, Chairman, Martha J. Crawford, Caroline Kuyper, Ortwin Renn.

For further details, visit www.irgc.org

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EPFL International Risk
Governance Center

EPFL IRGC
Station 5, BAC
1015 Lausanne
Switzerland

+41 21 693 82 90

irgc@epfl.ch
irgc.epfl.ch

