

ICSU / Future Earth

**INTEGRATED RISK
GOVERNANCE PROJECT**

Implementation Plan

2016-6-30

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1 Investigating systemic risks in global systems

The implementation of the IRG Project science plan is based on the approach to knowledge production known as Pasteur's quadrant (Stokes 1997). This approach starts from the insight that the familiar distinction between basic and applied research is insufficient to deal with key research challenges in the 21st century. The reason is the huge progress that research has already made. On one hand, in many fields of basic research the problems currently investigated are so complex that it is difficult to make further progress without focusing on a practical challenge. On the other hand, in many areas of applied research the problems have also reached a degree of complexity that makes it impossible to solve them by simply applying existing knowledge: new basic insights are required again and again. This is especially true with regards to environmental disasters (Vallero and Letcher 2012), but it holds for professionals tackling serious challenges in general (Schön 1983). For these reasons, besides traditional basic research and its twin, applied research, a third approach has become essential: the pursuit of use inspired, highly innovative research. It is the answer of the research community to the increasingly complex problems it has to tackle. And it is the approach pursued by IRG Project.

As explained in this science plan, for IRG Project the key complex problems that have to be tackled are those of new systemic risks arising in global systems. While it is straightforward to give examples of such risks – pandemics, mass extinction of species, climate change, global financial breakdowns are some of them – it is remarkably difficult to come up with a formal definition. This is not surprising given the fact that the scientific community is only at the beginning of understanding this new kind of risks. So we will start with the fruitful, but by no means final, definition offered by the Global Head of Risk Methodology at UBS Investment Bank and former senior staff member of the Federal Reserve Bank of New York, Darryl Hendricks (2010): “A systemic risk is the risk of a phase transition from one equilibrium to another, much less optimal equilibrium, characterized by multiple self-reinforcing feedback mechanisms making it difficult to reverse.”

As with new systemic risks, it is straightforward to give examples of global systems, too – the Internet, the international monetary system, the global city system, and the coupled humankind-climate system come to mind. But a reasonably comprehensive definition of global systems will become available only on the basis of in-depth future research. For a start, we use the following working definition: A global system is a coupled human-environment system with planetary reach, involving a plurality of nations, and whose existence requires an on-going process of solving coordination problems at multiple levels and scales. In the present world, global systems often involve decisions combining very high stakes with deep uncertainty about possible outcomes.

Against this background, IRG Project will pursue use-inspired, highly innovative research in the spirit of Pasteur's quadrant. This research will be structured by the following five focal research topics, each of which comes with urgent practical challenges:

- Disaster Risks along the Global Coastline
- New Systemic Risks in the Global Urban System
- New Systemic Risks in the International Monetary System
- Risk Governance in the One Belt One Road initiative
- Food, Water and Agricultural Insurance

Other issues may be added in the course of time, but these form the points of reference to begin with. The implementation of IRG Project in the next ten years will be based on them.

2 Focal Research Topics

2.1 Disaster Risks along the Global Coastline

Globally, 15 of the last 23 greatest natural disasters from 2000 to 2011 were coastal disasters. At the same time, population and economic resources are increasingly concentrated in coastal zones worldwide. Last but not least, extreme events enhanced by sea-level rise from climate change will become a key concern for urban and regional planning along the coasts of the world.

Integrated risk governance in coastal zones will be a key area of inquiry for IRG Project, not least because of the involvement of the IPCC lead author on coastal zones, Jochen Hinkel of the Global Climate Forum (GCF), and of excellent contacts with coastal zone experts in The Netherlands, the UK, China and other countries (Hinkel et al. 2015; Hinkel et al. 2014). Cooperation between Beijing Normal University (BNU) and GCF has started in view of applying the leading model for sea-level rise studies, DIVA, to the Chinese coastline. In this work, the risks from climate change will be considered together with those, often underestimated, of subsidence (Hu et al. 2004), in order to foster a truly integrated governance of the considerable risks coastal settlements all over the world will be faced with.

Cooperation with the Future Earth project LOICZ – Land-Ocean Interactions in the Coastal Zone, will be an important aspect of this work. IRG Project will look at coastal zones from a different angle, though, by emphasizing the perspective developed in the present document. This will lead to better assessments of the vulnerabilities of coupled infrastructure systems in coastal zones, as well as to suggestions for improving existing monitoring and disaster preparedness systems.

2.2 New Systemic Risks in the Global Urban System

One of the most important aspects of globalization is the emergence of a global urban system (Pumain et al. 2015). One cannot understand cities like New York or London, Tokyo or Shanghai without taking into account their role in a global network of interactions – based on flows of energy, material goods and information. Nor can one understand the dynamics of Orange County in California or the art district in Beijing without paying attention to the same network again.

Familiar risks of urban life are taking a new form in the global urban system. Congestion, contagion and crime are traditional risks of urban life and continue to be relevant as of today (Glaser and Sims 2015). But globalization has led to new kinds of interactions. A dangerous virus can spread by plane over the whole planet within weeks, and so can new forms of cybercrime. A century ago, air pollution in London or Chicago may have been little better than today in Delhi or Beijing, but people did not see blue skies of other cities in the world on TV. And as long as only a small part of humankind was burning fossil fuels, carbon emissions did not threaten the global climate the way they do today.

Today's urban risks are hard to deal with because they are not simply properties of single cities or national city systems, but rather systemic properties of global networks. A large body of research has shown that remarkably stable relations exist between city size and a variety of per capita attributes. These relations can be expressed through power laws characterized by just two parameters. Such parameters have been identified for attributes ranging from income to carbon emissions, from crime to traffic jams, and many more (Bettencourt 2013).

A good example is carbon emissions. First findings suggested that the growth of cities would not change the rate of carbon emissions per capita (Fragkias et al. 2013). Then, more detailed investigations showed a tendency for larger cities to have larger emissions per capita (Oliveira et al. 2014). However, given global demographic and economic dynamics it is hardly possible – and perhaps hardly desirable (Bai et al. 2012) – to slow or reverse urbanization at a global scale. This raises serious questions about the extent to which it may be possible to reduce new systemic risks in the global urban system, and the measures that might be effective to do so.

Three cases must be distinguished. First, single agglomerations may reach an outlier position in the global urban system. For example, the small Alpine municipality of Davos, known for its status as host of the World Economic Forum and a world-famous ski resort, has been able to achieve an exceptional status in terms of global visibility, foreign visitors, income per capita etc. But it is obviously impossible for many more agglomerations with just 10'000 inhabitants

to imitate this remarkable feat.

The second case refers to the fact that the parameters characterizing power laws in the global urban system differ among nations or groups of nations (Pumain et al. 2015). The value of these parameters clearly depends on system characteristics, and it may be possible to modify these by political measures. There is remarkable little research on what those system characteristics are and what measures might be most suitable to modify them. IRG Project will engage in research of this kind.

The third case then concerns the fact that there must be characteristics of the global urban system that influence the parameters defining new systemic risks in that system. Again, IRG Project will engage in research about such characteristics and possibilities of strategic interventions in order to modify them. However, it is unlikely that major characteristics of the global urban system will be actively influenced by some top-down procedure in the foreseeable future. But a series of actors including national and municipal authorities, citizens of urban regions (Bai et al. 2014), multinational companies, research institutions etc. may engage in loosely coordinated actions that will end up making a difference at a global scale. This would need to start in particular places from where the process could then be scaled up to national, international and finally global levels.

Fruitful research in this direction will need computer simulations at different scales, from local to global, and a clear focus on a practically tractable and relevant example. An interesting possibility is given by the plan of the Chinese government to form an integrated urban region – named Jing-Jin-Ji – through coordinated development of the three neighboring provinces of Beijing, Tianjin and Hebei. The new region might achieve a unique status in the global urban system. At the same time, together with the two similar regions of the Pearl River Delta and the Yangtze River Delta it may be possible to actively modify the whole Chinese city system in order to reduce its systemic risks. What is more, a region like Jing-Jin-Ji may become a hotbed for new environmental technologies – from filter systems to co-generation, from urban gardening to renewable energies. But there is also the risk that the development of a megalopolis like Jing-Jin-Ji will miss the opportunities of green growth that it could offer (Pan and Liu 2015).

In cooperation with the European Center of Excellence for Global Systems Science, led by Prof. Jaeger, IRG Project will study options for reducing new systemic risks in the global urban system with the help of multi-scale simulations on supercomputers. The scale of the simulations will vary from the global level to the level of small cities, with urban regions like Jing-Jin-Ji in between. For a start, the focus will be on the prospects of e-mobility. This will concern the future of the global car industry as much as the future of urban air pollution, and offer an

important example for the opportunities and difficulties to move from the traditional growth model towards a more sustainable model of green growth.

2.3 New Systemic Risks in the International Monetary System

In no area has research on new systemic risks been carried out with more effort than with regard to the international monetary system. This research has of course been greatly intensified in the wake of the global financial crisis that set off in 2007 and whose effects are far from over (Battiston et al. 2016; Bullard et al. 2009).

The international monetary system has been defined as “the interplay of financial companies, regulators and institutions operating on a supranational level. The global financial system can be divided into regulated entities (international banks and insurance companies), regulators, supervisors and institutions like the European Central Bank or the International Monetary Fund” (Financial Times Lexicon 2016). Clearly, this is a global system.

A definition of systemic risks in the international financial system has been provided by the Group of Ten (2001, p. 126): “Systemic financial risk is the risk that an event will trigger a loss of economic value or confidence in, and attendant increases in uncertainty about, a substantial portion of the financial system that is serious enough to quite probably have significant adverse consequences for the real economy.” The Group of Ten is the group of (presently eleven) countries that agreed to participate in the agreement to provide the International Monetary Fund with additional funds in case of necessity – a necessity that is of course closely related to systemic risks in the international monetary system.

Research on such risk has focused to a considerable extent on the propagation of disastrous events – like bankruptcies – through financial networks. While disaster cascades are well known from studies of natural disasters, there are few areas where such cascades are more relevant than on financial markets. The increasing speed of trade and the increasing interdependence of transactions make it extremely difficult to manage the global systemic risks arising on those markets. The financial crisis of 2007 has shown that the institutions and know-how developed in Western economies so far are not sufficient to avoid massive economic damages from the propagation of shocks through financial markets. The Shanghai stock market plunge of 2015 has highlighted the importance of this challenge for emerging economies in general, and China in particular.

IRG Project will look at financial risks in view of similarities and differences with disaster risks in other global systems. A key tool for this purpose will be the notion of consilience (Shi et al. 2014). It shall be used to analyze the relevance of the May-Wigner theorem for the stability of financial markets and other global systems. This theorem contradicts the widespread hypothesis that in ecosystems

greater biodiversity implies greater resilience. With regard to financial markets, it provides an argument for broad, simple measures and against increasingly complex regulatory schemes.

An example of such an approach is the proposal to stabilize stock markets via qualitative easing (Farmer 2013). This would complement the present actions of central banks to ensure monetary stability with actions to dampen excess volatility on stock markets. Consilience analysis can help assessing and improving such proposals, and it can do so in ways that draw on the trans-disciplinary character of much Future Earth research, including IRG Project.

For Future Earth, it is not sufficient to ask how financial markets can be stabilized. Rather it is essential to find ways for financial markets to become engines of sustainable investment and green growth. IRG Project will pursue this question in an exchange with the Munich Climate Insurance Initiative. This initiative brings together financial intermediaries, researchers and NGOs with the goal of designing and implementing feasible steps towards a low-carbon economy. Clearly, this is an ambition of great relevance for Future Earth.

Other stakeholders whose relevance for systemic risks in financial markets is often overlooked are professional associations. Three examples are the World Economics Association (WEA), the Association of Management and International Association of Management (AoM-IAoM), and The Association of Corporate Counsel (ACC).

- WEA was launched in 2011 in order to fill a gap in the international community of economists – the absence of a truly international, inclusive, pluralist, professional association. WEA promotes a pluralism of approaches to economic analysis and welcomes, as members, non-economists interested in economics and its relationship with their own field of interest.
- AoM-IAoM spans the academic world of debate and theory, and the corporate/practitioner world of action, decision and practicality. It strives to be the Association of choice for academics, researchers, professionals and practitioners of management.
- ACC is the world's largest organization serving the professional and business interests of attorneys who practice in the legal departments of corporations, associations and other private-sector organizations around the globe.

As in relation to other focal research topics, IRG Project will search a constructive dialogue with this kind of organizations in order to enrich the arena of debate about systemic financial risks by their important voices.

Enriching this arena is essential if new, innovative solutions are to be found. Until now, research on systemic risks in financial markets is centered on the

network structure resulting from financial interdependencies between financial operators. There is no doubt that this is an essential aspect of the problem, and through synergies with the other focal research topics IRG Project will be able to make significant contributions to this kind of analysis. However, the global dimension of financial markets requires in-depth research on a further aspect of the problem: the relation between financial markets and the system of nations (Rodrik 2011; Schoenmaker 2011). This leads to problems similar to the macroeconomic trilemma of the open-economy well known to economists (only two of the following three policy choices are applicable at the same time: monetary independence, free capital flows, currency pegs). It is reminiscent of arguments advanced by Keynes in the historical Bretton Woods conference where a new financial order was defined after World War II. In a nutshell, coupling economies of different nations generates global systemic risks.

This difficulty has been largely ignored in debates about the global financial crisis of 2007, with the remarkable exception of the analysis provided by the governor of the People's Bank of China (Warner 2015; Zhou 2009). Within IRG Project, work on the resulting questions has already started (Jaeger et al. 2013) and will be continued in view of systemic risks in financial markets and the different strategies of dealing with them.

2.4 Risk Governance in the One Belt One Road Initiative

The One Belt One Road (OBOR) initiative, announced in 2013, suggests one of the largest projects to be undertaken in the world economy in the coming decades. Estimates for its overall costs cover a range of 1 to 8 trillion US-Dollars (Mansharamani 2016; Wo-Lap 2016). As this has certainly to be spread over more than a decade, annual investments between 70 and 500 billion USD might be expected. Given global gross investment in the order of 20 trillion USD per year, China's foreign reserves of more than 3 trillion USD and a Chinese trade surplus that over the past years averaged more than 200 billion USD, this is certainly feasible, but far from trivial.

In fact, such a megaproject brings the challenges of risk governance to a new level. This has two different aspects. First, the distinction between natural and man-made disasters loses its grip, requiring new skills and know-how in dealing with disaster risks. And second, it becomes severely misleading to assume that decision-makers can know the costs and benefits of the possible options and identify their respective probabilities in order to identify the one optimal decision.

Regarding the first point, for a long time disaster research has focused mainly on what was unequivocally considered *natural* disasters. Historically, such disasters acquired huge relevance with the establishment of civilizations

based on large-scale infrastructures. Nowadays, disasters threatening critical infrastructures cannot be neatly separated into natural and man-made anymore. The Future Earth project IHOPE – Integrated History and Future of People on Earth – has analyzed these developments in view of sustainability challenges. Through the involvement of one of IHOPE’s founders and long-time co-chairs, Sander van der Leeuw, IRG Project will bring its distinctive perspective to this research. It will do so by considering infrastructures of critical importance for green growth, in particular the ones envisaged by the OBOR initiative.

The perspective of green growth is crucial if humankind is to deal successfully with the new systemic risks of the 21st century. In this century, billions of people will strive – one hopes successfully – to overcome poverty, attain a decent standard of living and share the affluence of high-income societies. As the example of these societies shows even massive natural disasters like major earthquakes will lose much of their present scare. But in the 21st century, humankind as a whole will have to learn to avoid the systemic risks generated by traditional economic growth. Both tasks imply a need for huge investments into infrastructures with which we are not yet familiar.

This leads to the second point: beyond traditional risks, there is an additional kind of risk to be dealt with by the OBOR initiative (and megaprojects in general). It is the risk of misplaced and mismanaged investments aiming at sustainable development. This kind of risk is especially serious in view of the large-scale investments that will be not only inevitable, but also indispensable if humankind is to realize the potential of a prosperous world society. An important example is the risk that such investments will create mostly low-skilled jobs that can hardly contribute to sustainable green growth (Jaeger 2016).

The OBOR initiative offers no less than an opportunity to realize a trajectory of green growth on the Eurasian continent, with obvious relevance to the world as a whole. This cannot happen by following some allegedly risk-free scheme for managing critical infrastructures. Rather a long-term monitoring and analysis of how the OBOR initiative will evolve is required. IRG Project will contribute to this effort.

Addressing local risks like extreme events so as to pay attention to possible disaster cascades is one example of the tasks IRG Project will perform. Research on disaster risks in the OBOR project can help to establish integrated risk governance as an on-going process of learning how to keep risks in an acceptable domain, including learning from experiences of disaster, relief and reconstruction. The work of IRG Project in the past years as well as its cooperation with UNISDR (The United Nations Office for Disaster Risk Reduction) makes it an ideal platform for this purpose.

A major risk of the OBOR initiative is that China will not meet a corresponding strategically conceived initiative at the Western end of Eurasia.

The risk is especially important because, on one hand, China has already begun to invest strategically in the greater Balkan region as the door to Europe (MacDowall 2014), while Europe has a long record of failures in trying to stabilize this region. Presently, the nexus between the EU and the Balkans is acquiring new relevance due to sluggish growth and rising regional disparities across the EU, due to diverging national interests exacerbated by the migrant crisis, and due to the increasing relevance of Islamic fundamentalism in the region.

In this situation, a “Green Corridor” linking the EU with the Balkans through a multimodal infrastructure for the transport of people, goods, energy and information has been proposed as a constructive answer of Europe to the OBOR initiative (Mangalagiu et al. 2016). The idea of the Green Corridor is to induce a joint learning process of the Balkans and the rest of Europe; a learning process in which both gradually outgrow unsustainable patterns of governance and economic development. This goal cannot be achieved by the myriad of initiatives presently undertaken in the Balkans, although many of these initiatives are highly valuable. The reason is simple: the present initiatives are too small and lack a shared mission. The Green Corridor on the other hand offers the opportunity for mission-oriented innovation, bundling a range of projects including:

- a high-speed train track for passenger transport
- a freight train track for containers and goods
- a broadband Internet backbone
- a high-voltage direct-current backbone
- a highway equipped for sustainable mobility

Each one of these projects involves building blocks like partial stretches of the Green Corridor, and each building block in turn involves and induces a whole set of smaller initiatives like training courses in existing schools, co-development of software tools by local programmers, service provision by small and medium enterprises, etc.

However, there is no guarantee that building the Green Corridor will lead to steps towards green growth across the Balkans and Europe as a whole, just as there is no guarantee that the OBOR initiative will lead to green growth in Eurasia. Indeed, two risks of failure are intimately connected here. In-depth studies are required to identify necessary and perhaps even sufficient conditions in order to manage these large-scale risks successfully.

Key questions to be addressed by such studies are:

- 1) What are the economic and cultural impacts OBOR should have in Eurasia

- 2) How can immediate economic impacts that will be felt within a few years be connected to the slow cultural impacts that will be felt within decades?
- 3) Who are key stakeholders for the initial development phase of OBOR, and who are key stakeholders to be involved at later stages?
- 4) What are approximate lower and upper bounds of total yearly investments required for achieving the desired impacts?
- 5) How can synergies between public and private financing be envisaged without the wishful thinking that often mars such projects?
- 6) What are main steps in the development of OBOR and what are initial steps that can pass a cost-benefit test independently of the overall scheme?
- 7) What is a plausible, not over-optimistic timeframe for the whole development, from initial planning to maintenance of the completed structure?
- 8) What are the main risks of the project as a whole, for China and for other countries?
- 9) How can OBOR interact with a European “Green Corridor” initiative on the Balkans?
- 10) What are reference cases to be used for benchmarking OBOR and what investment profiles follow from these benchmarks?

An initial overview study should sketch the vision of OBOR, relate it to relevant literature, and outline opportunities and risks of such a project in a perspective of integrated risk governance. On that basis, a series of more narrowly focused studies should be undertaken, addressing one or several of the key questions outlined above, preferably with a focus on sub-regions of Eurasia and a specific risk aspect of OBOR.

2.5 Food and Agricultural Insurance

The future of the global food system is marked by a series of new systemic risks (Godfray et al. 2010). Economic growth not only helps billions of people to overcome poverty, it also leads to increased demand for meat. Producing one calorie of meat requires much more water than producing one calorie of grain or vegetables. This leads to increased demand for water. Moreover, in many countries the amount of arable land required to feed their population exceeds domestic resources. As a result of these two processes, more and more regions of the world depend on food imports from the few regions with abundant freshwater resources, especially Europe and North America. This in turn means that global weather variability can lead to massive price swings and food shortages in large parts of the world. Climate change makes these fluctuations

even less predictable than they already are. Fluctuations in the income of poor people in developing countries are closely linked to the variability of the prices and quantities of global agricultural supply. These fluctuations can lead to malnutrition and famines when people cannot pay for imported food. This means that instability of global markets for foodstuff exacerbates the challenges of poverty alleviation.

The global food system does not consist only of agriculture. Food processing is a global industry with increasingly complex supply chains. This makes monitoring and guaranteeing of food quality difficult and opens up possibilities for many kinds of abuse. Food security is becoming a major issue worldwide (Moreno 2012). The problem is greatly aggravated by soil degradation and pollution. Restoring soil quality, if at all feasible, will take decades and require considerable resources.

Beyond the risks for quantity and quality of food, the generation and spread of non-sustainable agricultural practices has led to risks beyond the food system itself. Examples include concerns about biodiversity in terrestrial and aquatic ecosystems. Coral reefs, e.g., are threatened, among other causes, by excess fertilizers from agriculture. Moreover, water pollution from agriculture in many places leads to health risks for humans beyond the mentioned risks of food insecurity.

Insurance companies have begun to respond to these challenges (Yuzva et al. 2013; Eschenbrenner 2009). Experience shows, however, that without public intervention agriculture remains underinsured. As an answer to this difficulty, in many countries public policy is expanding the scope for crop insurance and fostering new insurance schemes that target not only harvest quantities but also product qualities and the incomes of farmers.

While a wide array of initiatives is undertaken by insurance companies and public authorities worldwide, these initiatives tend to stabilize the present state of the global food system; a state that is hardly sustainable. A far-reaching transformation of agriculture and food processing worldwide is required to master the systemic risks of the global food system. The research and development efforts to achieve this transformation are still in their infancy, and it is here that IRG Project will make its contribution.

In view of the integrated governance of agricultural disaster risks, a first contribution of IRG Project will be to develop and maintain its world risk atlas (Shi and Kasperson 2015). The atlas can be used by policy- and decision-makers from all governments and will be helpful for the development of appropriate prevention and contingency plans. A global risk ranking system is also important to measure a country's efforts, capacities and vulnerabilities, and with this be able to better allocate international resources for the national capacity building efforts. For the production of a world risk atlas it is both mandatory and feasible

at the present stage to take advantage of advanced technologies like big data from remote sensing and processing capabilities from high-performance computing.

Second, comparisons of regional case studies will be conducted to understand how one and the same society deals with different risks and how different societies deal with one and the same risk. In a close dialogue with businesses (both from the food and the insurance industries), public authorities, farmers' associations and other stakeholders IRG Project will monitor and investigate regional pilot experiences (Wu and Pretty 2004; World Bank 2016). In particular, we will look for opportunities of green growth in rural areas. There sustainable agriculture can transform neglected possibilities into resources for the people, and enable them to alleviate concerns about food security in urban centers.

Third, by working closely with UNISDR, IRG Project will help turning good science into good decision-making. It has been recognized for quite a long time that in order to make systematic decisions across different spatial and temporal scales a two-way communication between scientists and decision-makers is needed. Unfortunately, developing appropriate applications regarding relevant scientific understandings of specific risks has always been a major challenge. And bridging the gap between policy-making and scientific expertise is even harder because there is no common language between both ends. By taking advantage of fast developments in information and communication technology (ICT), IRG Project will launch a range of initiatives to support more effective interaction between the two communities. This shall include the development of a visualization toolbox, which integrates relevant scientific understandings of risk and policy makers' needs. With this, IRG Project will support more effective co-production of knowledge in integrated risk governance.

3 Managing IRG Project as a complex network

The use-inspired, innovative research on these focal topics must be organized as a global complex network itself in order to be successful. As already discussed in previous sections, the network will be structured around a triangle between a Chinese, an American and a European institution, namely Beijing Normal University (BNU) in Beijing, China, Arizona State University (ASU) in Phoenix, USA, and the Institute for Advanced Sustainability Studies (IASS) in Potsdam, Germany. These three institutions are linked through many years of formal cooperation, including not only joint research projects but also joint teaching and extended visits, and of course management meetings, both face-to-face and electronically.

Each one of these institutions brings core and project funding to the joint

task. The Institute for Advanced Sustainability Studies (IASS), the leading German institute for sustainability research, is presently spending 230'000 Euro per year on IRG Project activities – two thirds financed by EU-projects and one third by internal resources of IASS. Arizona State University (ASU) is presently spending about the same amount, mostly from internal resources.

This network structure of partners, with each bringing in own resources, is then extended to a flexible range of additional institutions, presently including – among others – Australia National University, Colorado State University, Clark University, the Global Climate Forum, Kyoto University, Oxford University, and the Université Sorbonne Paris I. Moreover, vital links are those to UNISDR and to Future Earth, the international scientific program for global environmental change research.

This network is maintained by the project office at Beijing Normal University.

- The co-chairs, Prof. SHI Peijun and Prof. Carlo Jaeger, hold regular electronic or face-to-face meetings to monitor the progress of IRG Project activities, trigger new initiatives, define strategic priorities and strengthen promising research.

- They do so in close cooperation with the executive director, Prof. YE Qian, and his assistant, Dr. CHEN Jing, who are in charge of day-to-day management.

- Bi-annually, the scientific committee of IRG Project meets to reinforce synergies between the different IRG Project activities and make sure that IRG Project responds in a timely fashion to new challenges.

Three key instruments to ensure that IRG Project meets its goals are:

- the IRG Project book series, produced with Springer, a global leader in scientific publishing

- workshops and conferences either organized or supported by IRG Project

- the International Journal for Disaster Risk Science. The journal is accepted in the Institute for Scientific Exchange (ISI) indexing system. It enables IRG Project to foster the standard scientific process of publishing mature research results, while also providing a platform for fast communication of new ideas.

In the next phase of IRG Project, four deadlines shall help to ensure that the research on the five focal research topics not only leads to significant, practically useful results, but that synergies between the different research activities contribute to long-run improvements in global risk governance as well. At each deadline, a series of cross-cutting activities shall be completed. The farther a deadline, the more open the respective goals are to modifications based on future

events and experiences.

- 1 year:

- ✓ At least one high-level workshop brings together scholars from different countries working on different focal research topics of IRG Project
- ✓ At least one scientific paper presents findings that connect different focal research topics
- ✓ At least one scientific book presents a framework for understanding and tackling new systemic risks in global systems
- ✓ At least one international research project with additional funding starts

- 3 years:

- ✓ IRG Project presents results of integrative risk research at least at one international workshop and one international conference per year
- ✓ Based on those workshops and conferences, at least two scientific papers and one book per year communicate results of integrative risk research to the risk community
- ✓ IRG Project establishes an on-going stakeholder dialogue involving national and international public agencies and business firms as well as standard-setting professional associations dealing with global risks

- 6 years:

- ✓ The goals of the 3 year deadline are valid for this deadline, too
- ✓ IRG Project produces teaching materials for national and international education programs. The materials include at least one textbook and at least one Internet platform on integrated risk governance
- ✓ IRG Project contributes to standard-setting for global risks together with relevant professional associations

- 10 years

- ✓ The goals for the 6-year deadline are valid for this deadline, too.
- ✓ IRG Project is engaged in national and international efforts to turn risk challenges into steps towards sustainable development – e.g., turning policies to reduce urban air pollution into opportunities for new competitive technologies and jobs.

The great strength of IRG Project is its ability to foster unbureaucratic exchange and cooperation between established world-class researchers and new talents in an exceptionally open way. It involves a rare combination of senior and junior researchers, at the same time blending the knowledge base of well-established American and European research universities with the innovative potential of non-Western, especially Chinese, scientific institutions. With these resources, it is able to engage in use inspired, highly innovative research, structured by the five focal research topics of IRG Project in phase II.

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