Strategy Report

Challenges in Operational Risk Information Management

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Executive Summary

Big Data, New Approaches on Emergency Planning and Emergency Response, Data Availability vs. Data Demand, Data Quality Issues, Data Sharing with the Private Sector (Industries, Business, Insurances etc.), Complex Data Visualization and Comparability Issues

Resulting in: Recommendations, Standards needed, Information Complexity, UN Sendai Framework formal Requirements, Information Governance needed.

UN Sendai Framework formal Requirements
In the UN Sendai Framework for Disaster Risk Reduction (2015) [ISDR01], [UN01] information details mentioned explicitly in the text show convincingly that it is much more than just the indicators that need to be specified, compiled, monitored and analyzed.

UN ISDR compiled a Science and Technology Roadmap to support the implementation of the Sendai Framework [ISDR02], the European Joint Research Center corresponding strategy is documented in [PMG01]. Detailed R&D requirements have been published in RIMMA report series (see list in "Acknowledgements" below)

Very recent discussions already show that the role of information management in its broad sense of the Sendai Framework text is considered central to effective disaster management. (c.f. R. Glasser in [SFrMon17]). But the corresponding steps towards transparent cross-organizational information availability, interoperability enabling ontologies (much more complex by Interdisciplinarity and actors/organizations than the current (core) GeoInformation Infrastructures [OGC01]), and decision-supporting analysis processes are just in the beginning.

Information Governance needed
All facets of Data and Information Science are needed in Disaster Information Management. Though methods and technologies for handling complex tasks of Syntax, Semantics and Pragmatics are available, applications in the disaster information management domains are rather based on projects than on broad integration concepts. The overall complexity is in due need of getting its own governance, mainly because of the huge variety of organizations/actors involved and because of the vast demands in all phases of the disaster cycle.

Information governance is the set of multi-disciplinary structures, policies, procedures, processes and controls implemented to manage information at an enterprise level, supporting an organization's immediate and future regulatory, legal, risk, environmental and operational requirements [WIK01].

Legal issues on all information management aspects, including discussions on ethical issues in open data provision and use, need to become part of Risk Information Governance. On the strategic level there is a strong effort in supporting cross-sectoral aspects of Digital Society, Industries 4.0, general Information Infrastructures [EC04], [EIF] and corresponding regulatory frameworks. The German government is planning a federal Digital Agency as a modern Centre of Excellence and Service Point to master major challenges to society [BMWI16, Ch. 10] and promote multi-sectoral approaches.

Risk information management in Europe will be embedded in EU strategies on EU Action Plan on the Sendai Framework Implementation [EUSF], Digital Agenda - Europe 2020 Strategy [DAE], and EIF European Interoperability Framework [EIF].

Supporting issues of accountability [AA08], [AA11], [BAKE], [RAMC] by appropriate information management strategies, implementations and operations.

Risk Information Management is broadly embedded in and supporting aspects of other international agreements, programs and strategies like UN HABITAT, UN Sustainable Development Goals, UN Framework Convention on Climate Change, Int. Platform on Biodiversity and Ecosystem Services IPBES and many others.

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Challenges in Operational Risk Information Management

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In this report, we compile the current challenges and recommendations within the broad field of Risk Information Management in all disaster cycle phases with special emphasis on Research and Development needs and in respect to the vast variety of organizations and actors involved mainly on the basis of RIMMA participants' presentations and discussions.

Keywords: natural hazards, environmental hazards, risk information management, disaster risk management, risk models, data science, big data, multi-organizational and multi-actor issues, complexity, situation documentation, data gathering, data quality of emergencies records, auditing, risks and decision thresholds, early warning, event management and preparedness, standardization of emergencies documentation, social vulnerability, business process risks, social media, information governance, UN Sendai Framework on Disaster Risk Reduction

The workshop was organized by CODATA-Germany in cooperation with the "Commission on Risk, Disaster, Security" of the German Society for Cartography, supported by the International Cartographic Association "Commission on GIS and Sustainable Development" and Technical Committee on Environmental Informatics of the German Informatics Society. The workshop covered a broad spectrum of issues: application methods from environmental perspectives, social vulnerability of exposed populations to natural hazards, technical risks, standardization, major disaster event management and standardization of emergencies and response documentation, applied information risk science and use social media.

A considerable part of the workshop was focused on decision support for all actors and experts in multi-disciplinary domains of risk management to present and discuss new models, platforms, standards and procedures, applications and technological developments, and provide new views and approaches to risk analysis linked with social media data, with the potential of transferability of methodologies, research tools, and visualization of environmental and technical risks. A special focus was delivered on social vulnerability in the modern Russian arctic ethnographic context. The discussion also covered applications used in the business sector with linking of risk analysis and sociograms visualizations for analysis of choice preferences. An important part was dedicated to the operational strategies for implementation of the UN Sendai Framework [ISDR01], [UN01].

It should also be noted that the workshop was marked by crossed-mixed themes that are traditionally distant and separated by hermetic chapels, this shows the dynamism of the ongoing change that revolutionizes the classic approached of pure risk information management embedded with acute social issues. As example it's possible to cite the following themes:

- The involvement of big data in risk assessment by the means of data from social media showed the new implication of classical risk analysis with semantic web researchers and computational linguistic, in helping the massive reading of news streams. It brings up the problem of weighting the information sources and the trust given to sources {Van Erp}.

- A cross-cutting new approach linking classical ethnographic and anthropologic issues with modern risk analysis and vulnerability patterns was discussed. The vulnerability of a variety of indigenous population inside a large territory submitted to a brutal change of its environment in

the Russian arctic, by being exposed to extremely high pollutant levels, has been rarely studied under this perspective {Dushkova}.

- Also, if the territorial dimension on risk management has begun to be deeply investigated, it is innovative to strength up vulnerability assessment methodologies on the transportation network in order to put forward points of disruption by the mean of a composite vulnerability index using accurate socio-economic data, stressing the necessity to bring the knowledge and expertise to the local level and actors {Tavares}.

The workshop was marked by the arrival of new problematics which are emblematic of the new digital development, it's the evolvement of big data and platformization, new approaches on emergency planning and emergency response. The risk analysis data issues shows innovative perspectives in the following field; data quality issues [WANG], [AA99], data sharing with business issues and transferability, data visualization and comparability issues.

Big Data:

- The use of social media data for example for the Sendai framework with participatory aspects of risk management {Jarosch} propulse automatically the classical risk analysis community inside the challenges of the big data world and it's problematics to which the world of risk analysis is already in a good part, well aware.

MASSIVE, COMPLEX DATA, ANALYSIS, AND DECISION SUPPORT

- Therefore, the arrival and consequent processing of these new data types in amazing volumes will bring to rethink the classical technology portfolio and infrastructure used by the risk analysis community. The first challenge is linked to the obsolescence and consequent remodeling of technology linked to classical analytical databases and data warehouses. Another well-known and identified challenge by the risk analysis community is the strengthening of data integration. Nevertheless it's important for the risk analysis community to be aware on which way they will implement this new technology for processing all of the data and technology now in place. How can existing technology and data used for risk analysis, be improved by adding big data from social media? How can new forms of analytics and applications use both the old and the new risk analysis and emergency response data framework?

- Among these applications linked to cloud computing, the risk analysis community the risk information management community will face new evolutionary computing challenges in the risk domain, for example by new techniques like genetic algorithms, ant colony optimization in order to resolve the problem of load balancing in cloud environment, bees algorithm for grid balancing solutions. The objective will be to enhance the performance analysis of large scale risk analysis projects by load balancing algorithms in cloud computing.

Platformization:

- It is a new penetrating thematic for the risk analysis community that can bring important paradigmatic changes in the way to address risk analysis and emergency response items. The study of platform explores how computing devices and software environments affect the characteristics of application software built upon them, including programmability, affordances and constraints, connection of heterogeneous actors, and accessibility of data and logic through application programming interfaces

- Platformization issues were addressed for global volcanic issues, a long term plan that strengthen the problematic of data analysis (comparability problems of volcanic events), with multi hazards and risks assessment, showing the urgent need for more IT support, more cooperation and collaboration of scientists with the difficult access to limited and comparable data {Nayembil}. The Ensure project of platform for coordination of unaffiliated helpers in disaster management shows the problem in the mixture of terms in the international literature with unaffiliated helpers and the control of registered data, the check of ethical availability and use of private data {Schuchardt}.

New approaches on emergency planning and emergency response:

- Innovative coupling of weather forecast adapted for decision making for fire brigades shows the importance of the threshold accorded and the role that can be devolved to insurance players in case of event cancelations {Göber}

- New operational focus on exceptional unplanned emergencies and large planned events showed the problem of access of data and different views by actors {Jasnoch}

INFORMATION INFRASTRUCTURES AND STANDARDS

- For the planning of security measures for major sports events, a practical method in ten steps which includes a scoring process will help to proportionate the costs of the future safety system that will be needed to implement, helping the involved actors to find a consensus {Pisapia}

- The standardization of that field is an important issue, that begins newly to be addressed by the risk analysis community, also if standards of risk analysis are well established since years at ISO, the other step of emergency management (preparedness, response, continuity and response) are in the implementation process {Döbbeling}, also if the ISO 22 330 norm for response was recently played in an exercise at both sides on Mont-Blanc tunnel. It is important to notice that these standards are not legally binding and that auditing standards are mandatory to comply.

Data Availability vs. Data Demand:

- The UN Sendai Framework explicitly requests all details of cross-organizational and interdisciplinary data for the operational as well as for the strategic tasks and addresses all management levels. There is currently a large debate on the term "Available Data", especially with regard to official statistics agencies holdings. It should be clear that such data will only meet fractions of the requirements written in the Sendai Framework text. Data Readiness is one of the central concepts of operational interoperability and information infrastructure requirements [EC04]. It would be more adequate if cross-organizational data demands for each of the specific requirements of the Sendai Framework would soon find its adequate attention in comparison with the statistics data discussions needed currently especially not for operational but for strategic issues (indicators). The overlap of Geoinformation combined with Statistical Information with all the vast amount of data needed for operational management is marginal.

UN SENDAI FRAMEWORK INFORMATION DEMANDS

- Gaps in cross-organizational data availability, incompatible data quality and missing interoperability are well-known today to disable best possible decisions and services [DRG], [PIY01] in disaster phases in all types of countries [TAME].

- Information demand for operational purposes reaches far beyond rescue and first aid requirements. The step forward from the former Hyogo Framework especially broadens the concern towards all kind of effects of disasters (natural and technical). The corresponding holistic view is very well described in the Sendai Framework but still needs to find adequate attention by Information Management Governance.

CROSS-ORGANIZATIONAL INTEROPERABILITY

Data Quality Issues, Data Sharing with the Private Sector (Industries, Business, Insurances etc.), Transferability:

- The example of the US national inventory of disaster loss, showed the complexity of the data reporting of sensible private data, owned and coming from different sources with management issues regarding loss data, compatibility between databases, integration of different data cultures like public health and weather services, the open data problematic. The goal will be to deal with better aggregated data having a better coverage across all magnitudes of the data cycle. Interesting

issues with future collaboration with the insurance business branch are very promising, how to deal with disaster loss data, cost concepts, and property values.

- A future issue can be to look at a data sharing ecosystem who provides space for multiple diverse datasets in order to encourage multidisciplinarity and data sharing benefits by solutions like data remixing and combining, a benefit can come from the opportunity to re-analyze older data using contemporary methods, text mining for searching added values and discoveries, data remixing and combination, semi-automated, or algorithmic, hypothesis generation for meta-analysis.

Complex Data Visualization and Comparability Issues:

- Environmental data issues processing {Talhofer} shows the complexity of visualization of environmental risks, the complexity of visualizing hazards and the quasi impossibility to produce understandable risk maps in case of chemical accidents on waterways is eloquent {Susini}, actually the more developed risk visualizations are mainly developed for human hazards and vulnerability.

- The problems arise that there are no international standards for risk visualization and therefore it brings a lot of problems linked to comparability and understanding of risk maps. Themes like vulnerability do not have a unified visualization framework, because the notion of vulnerability itself is rather vague because the word suffers from a semantic overflow mainly because it covers several notions evoking both dependence, fragility, insecurity.

- Infrastructure of underground network elaborated and visualized with the creation of artificial intelligence tool brings also new insights about visualizations of the undergrounded networks and the furnitures and interesting corresponding new risk visualization patterns dealing with uncertainties {Lacroix}.

- The new methods and paradigms inside business risk, allows to revivify the classical operational research field in business with an automated production of actors involved sociograms {Fragnières}, in that way opening new perspectives for the risk analysis community, helping them better taking account, the positions and open or hidden issues of involved of actors inside a risk thematic.

Recommendations.

The RIMMA 2016 Workshop represented a unique forum which facilitated a discussion for holistic evaluation of disaster risk management area and its linkages to global risk management domain. Many innovative ideas and insights emerged from the many forum debates. All these emerging topics regarding the generation and the use of risk analysis data, are deeply embedded in the future remodeled digital political economy, that in the age of social media, big data and cloud computing will soon or later sharply condition the production framework of risk analysts.

The following key areas were identified as a priority to be shared at upcoming strategic meetings on regional, national and international level, as well as for structuring of appropriate R&D programs.

- Critical technical, business and social infrastructure data and processes
- Risk communication : participation and public investment
- Development of new approaches for risk communication not only for operations but also for public involvement
- Data availability and data quality measures (including uncertainty, reliability and "fit for use") from local to global level
- Data quality global and consistent assessment
- Data systematization and standardization on a global level including regional, sectorial and local strata

- Harmonization of Risk Information Management Models, terminology and communications to enable cohesive and more effective disaster risk prevention

- Social inclusion and dissemination of Risk Information Management best practices

- National and International legal frameworks for cross-organizational disaster risk information management [ZIE01], and climate change, including private sector domains

- Addressing data and model uncertainty

- Functional and operational issues in principles and practices of Threshold

- Creation of action plan which enhances risk resilience

- Model validation and reliability of data

- Continuity of the disaster management projects and related information gathering efforts

- Risk analysis linked to evolving technologies

- Addressing the use and consequences in terms of costs, respectively finances, at every risk analysis step and for anticipated alternatives of decision and action

- Standardization of data, improvement and availability of socio-economic data for calculation of social vulnerability

- Enhancement of business risk management and industrial process management, (food and products/parts) supply, transport and logistics in risk information analysis [DES01], DRAH], [GARC], [LEOB1], [NRF01]

- Formal specification and unification of process chains modeling for information flow, analysis and use in all phases of the disaster cycle [WES01], [WES02], [VRST], ZIKO]

- Compliance and audit information management [KNRE] [AA99]

APPLYING PRINCIPLES OF INFORMATION MANAGEMENT INFORMATICS

TECHNOLOGY AND METHODS TRANSFER

Standards needed

The current deficits are best characterized by missing standards for documenting disasters (facts, flows, analysis, use and communication). There are exceptional cases where in specific disasters there were special efforts on data and information documentation. The very detailed and comprehensive investigations on "Unpreparedness" in the Hurricane Katrina (2005) disaster [US01] [US02] depicts the huge demands of post-event information analysis and in this case, of course, depicts the missing availability and consequences of non-interoperability, information flows, information use, incompatibility, misinterpretation scenarios etc. etc.

Even in disaster exercises, the only reliable information documentation can be expected from the official rescue teams of fire brigade, police, ambulance etc. Currently, no comprehensive information strategy covering preparation phases, operations, and post disaster analysis and accountability issues is formalized. There is specific demand for institutions like Public Prosecution Service, Liability Insurance Associations, Labour Inspectorate and others.

Current standardization practices mainly address specific (semantic, technical) topic issues. In addition to this there is a need to develop standardization concepts that cover complete modules of disaster situational needs [BSD1]. Modularization is extremely helpful in specification and implementation of typical scenarios as well as for operational / decision supporting systems [BORK], [KRE10].

DATA, PROCESSES, DECISIONS, CONTROL

Without concise and comprehensive documentation in the sense of the UN Sendai Framework, learning from disaster will not be possible at the level that members and organizations of information society would expect in striving for a responsible, secure, safe and reliable environment.

Information Complexity

Future research and development in those areas will bring a significant contribution to all the cycle of risk analysis and the disaster management area only if the inherent complexity of interdisciplinary/cross-organizational data, data analytics, data transmission and use processes, and sophisticated ontology models for situation prediction along with consequences scenarios for all types of actors is based on standards and Information Infrastructure principles [EU03], [ORCH].

Risk Information is in due need of very broad systematic integration, processing and evaluation of large amounts of data of heterogeneous origin in real time. Big Data offers the appropriate technology to integrate data from the various sources, to analyze it and to make it available for decision processes, operations guidance and goal-reaching control according to user requirements.

UN Sendai Framework formal Requirements

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Implementation [EUSF], Digital Agenda - Europe 2020 Strategy [DAE], and EIF European Interoperability Framework [EIF].

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SYNERGIES FROM OTHER „DIGITAL STRATEGIES" PROGRAMMES

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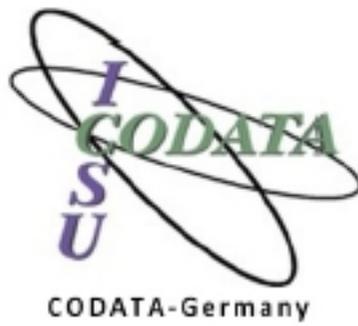
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