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Information Management Supporting Design, Implementation and Operation of Sustainable Systems

Horst Kremers

CODATA-Germany Secretary General
Engineering Management and Information Sciences, Berlin (Germany)

Lecture on Feb. 23, 2023

American University Kyiv (Ukraine)
SDT 172 **Technological, Social, and Sustainable Systems**

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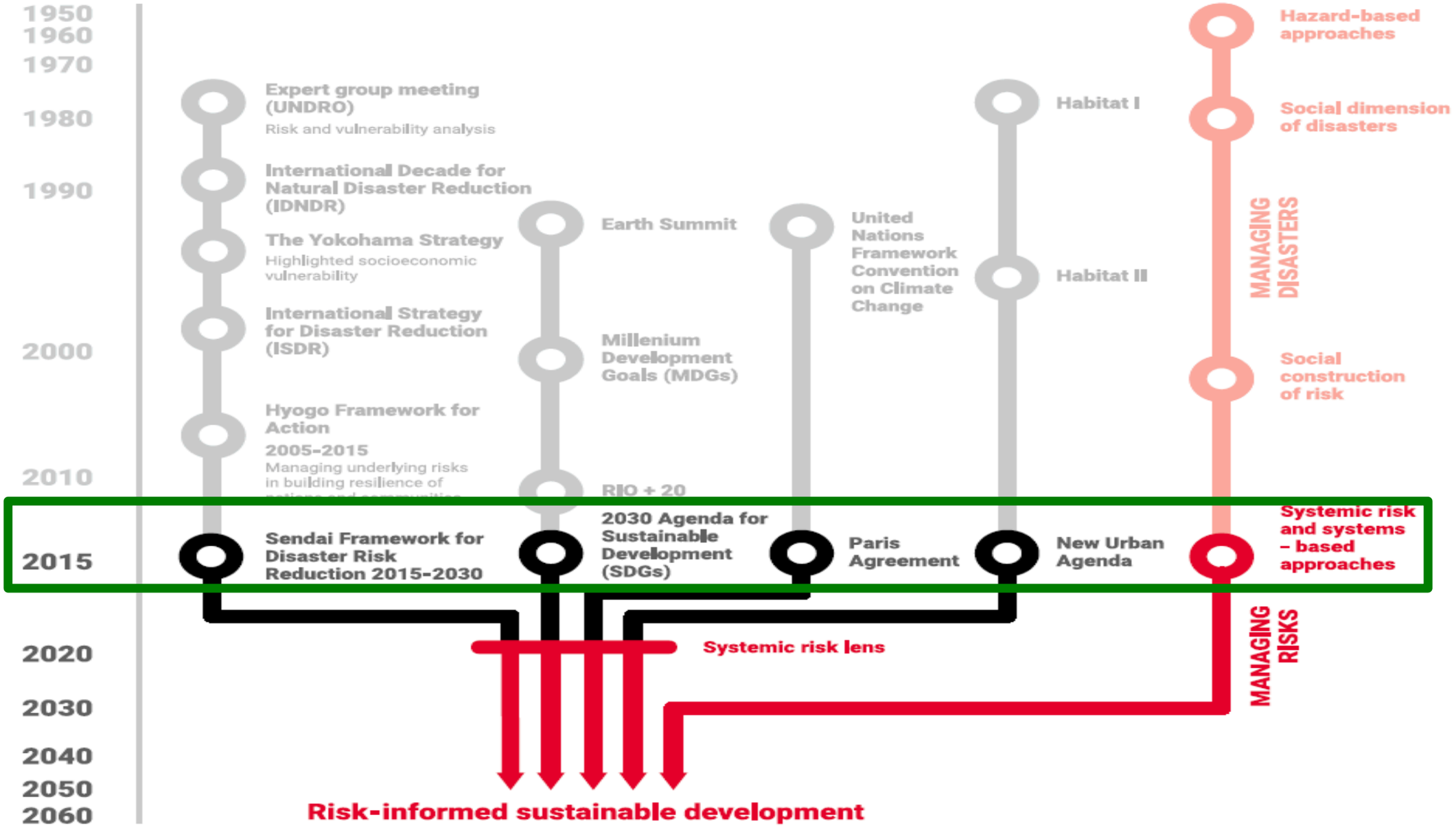

(Source: UNDRR 2019)

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Basic Management Principles

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- critical thinking
- gaps and deficits analysis
- decision, action, and control cycle support
- transparent analysis
- compliance to legal and technical regulations and other boundary conditions
- include financial structures, budgets and the use of financial instruments in reporting and control
- constructive goal-reaching and effectivity control
- guidance on human resources (quantity, future competence levels)
- avoidance of malpractice
- extend concepts of FAIR information principles to support transparency goals and accountability
- extensive documentation and reporting obligations
- quality indications on confidence, weaknesses, uncertainties, error propagation, and vulnerabilities

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Establishing Cross-Organizational Information Infrastructures

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- Catalog of Information Sources Metainformation
- Improved Data Access (Time and Cost Savings)
- Enable and Improve Data Exchange between different Institutions and Application Domains
- Consistent and Efficient Use of Data
- More Efficient Development of Services using existing Data and Standards
- High-Quality Data for Decision-Making Support and Action Alternatives
- Service-Level-Agreements (preparatory, operational and ex-post evaluation/audit)
- Improvement of Strategic, Tactical and Operational Decisions
- Possibility of Decision-Making about Policies (Administration, Jurisdiction etc.)
- Including the Private Sector
- Facilitating the Development of Knowledge Generation, Communication and Comparison
- Comprehensive Documentation and holistic Ex-Post Analysis
- Analysis Across all Phases of Planning, Implementation, Operation and Control of Goal-Reaching Effects

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Selected Domains and Organizations of Current Interoperability Best Practice

- Environmental Information (UNEP Digital Transformation towards a Global Data Strategy, EU INSPIRE Directive)
- Geoinformation (Open Geospatial Consortium OGC)
- Observational Health Data Sciences and Informatics (OHDSI)
- European eHealth Directive
- Essential Biodiversity Variables (EBVs)
- Group on Earth Observations
- Resource Description Framework (W3C)
- Process Modeling Standards (BPMN)
- Data Documentation Initiative (DDI)
- International Image Interoperabilty Framework (IIIF)
- W3C Data Activity: Semantic Web

... and many more

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The Complexity Challenge (1)

- Complexity and Dynamics of Facts
- Complexity and Dynamics of Contexts
- Complexity of Actors
- Complexity of Organizations
- Complexity of Stakeholders – „those that are involved / affected“
- Complexity of Systems Interdependence
- …

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The Complexity Challenge (2)

- Information capturing and data analysis
- Information documentation and permanent access
- Data-driven understanding of our world
- Abstractions
- Decision-making support and control
- Thresholds, signals, triggers
- Alerts
- Processes, Workflows
- (re-)Action
- Goals-reaching
- Effects, Consequences

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Transparency of Algorithms, Procedures and Abstractions

- ensuring fairness, transparency, explainability and human oversight of algorithms, procedures and abstractions;
- collecting, processing and analyzing data from various sources to assess the opportunities, risks and socio-economic impact of algorithms, procedures and abstractions;
- documentation and evaluation of algorithms, procedures and abstractions;
- auditing algorithms, procedures and abstractions;

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Multiple Representations, Hierarchies, Generalisation, Abstractions

- Location, Geometry
- Emergence of Order
- Cognition, Patterns
- Change and its dynamics including macroscopic effects
- Time, time structure and its relevance to Action Structures
- Behavior Representation,
- Complex Social Systems
- Singularities (of action space)
- Black and white views as a generalization principle, Contrast
- Symbolization, Categorization, Abstraction, Model Building
- Ontology, Multiple Representations, Representation Change / Transition
- Information Mining
- Dimensionality reduction, Clustering
- Trend analysis and application, Periodicity, use of transforms (Fourier transform / frequency space / attribute spaces, action spaces)
- Uncertainty propagation in Generalization
- Continuous vs. Step-by-Step Generalization
- Algebraic Properties of Generalization Transforms (recursiveness, inverse properties, invariants etc.)
- Generalization of dynamic 3+ -dimensional phenomena e.g. of Movement Patterns
- Context Generalization

Kremers, Horst: ISGI 2005, Proceedings, International CODATA conference of Generalization of Information. ISBN 3-00-016253-4 (2006) vi + 243 p, CODATA-Germany, ISBN 3-00-016253-4
https://www.horst-kremers.de/ISGI_2005_Berlin/LNIS_Vol_1_ISGI_2005_Generalization_of_Information__Proceedings.pdf

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Pragmatics / Process Modeling

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Pragmatics Models

- Processes
- Web Service Compositions
- Workflows
- Action Models
- Behavior Models
- Event Chains
- Dependencies

applied in the formal ontologies for the management concepts of dynamic situations and operational decision and action, as well as in modeling goal reaching

Fig. 1: Pragmatics Models

Kremers, Horst: Global Programs and Conventions: Coherence and Mutual Synergies from Holistic Information Management. LNIS Lecture Notes in Information Sciences. Selected Papers. Geoinformation and Sustainable Development 9 (2020) 90-100, CODATA-Germany, ISBN 978-3-00-062981-5 https://tinyurl.com/GlobalProgramsCoherence2020

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Challenges in Process Models and Techniques (1)

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„An increased availability of business process execution data, combined with advances in Artificial Intelligence (AI), has laid the ground for the emergence of information systems where the execution flows are not pre-determined, adaptations do not require explicit changes to software applications, and improvement opportunities are autonomously discovered, validated, and enabled on-the-fly”

“... event knowledge graphs which encode behavioral and causal inter-dependencies of objects and actors over time in the context of process flows and process knowledge allow to symbolically represent situations of all kinds for situation-aware reasoning.

Such techniques may be used to facilitate the (automatic or by humans) tracking of execution consistency, for better understanding of process flows and process outcomes, and to drive ongoing process improvements (at either design- or retraction at run-time)”

Marlon Dumas, Fabiana Fournier, Lior Limonad, Andrea Marrella, Marco Montali, Jana-Rebecca Rehse, Rafael Accorsi, Diego Calvanese, Giuseppe De Giacomo, Dirk Fahland, Avigdor Gal, Marcello La Rosa, Hagen Völzer, and Ingo Weber. 2022. Augmented Business Process Management Systems: A Research Manifesto. 1, 1 (February 2022), 19 pages

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Challenges in Process Models and Techniques (2)

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In addition to current basic efforts to achieve cross-instrument information coherence, future technical implementations will need to address decisions about the choice and possible change of innovation stages,
as well as appropriate management methods and techniques in the areas of

- Cloud Computing, IoT, AI
- Situations Models, Facts, Actors, Documentation, Procedural Use
- Processes, Processes Groups, Chains, Networks,
- Standards
- Clearinghouses, Observatories, Testbeds
- Quality-of-Service Measures,
- Quality Management of Information (syntactic, semantic, pragmatic)
- Multiple Representations, Hierarchies, Generalisation, Abstractions
- Synergy Effects (cross-domains / cross-organisational / cross-border)

Complex cross-domain information models supporting just-in-time critical operations typically include a large number of variables and complex dependencies on functional, analytical, and operational constraints (affected people, resources, actors, time, space, facts, decisions, actions).

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Summary

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The UN Declarations and other UN Instruments texts increasingly enforce the demands for Coherence and mutual Synergies

There is special emphasis on

- defining the basic elements of coherence
- consequences for holistic information management across programs and conventions
- rising awareness on the key role of stakeholder driven participative information governance needed to foster of cross-domain and cross-organizational national as well as international implementations.

Timeliness implementations guided by the principles of holistic information management are key prerequisites in societal, natural, technical, humanistic and ethical aspects for the future of people and planet.

Aims

Coherence and Accountability Improvements according to Expectations of Information Society

WARSAW INTERNATIONAL MECHANISM
FUNCTIONS

The WIM promotes the implementation of approaches to address loss and damage associated with the adverse effects of climate change by undertaking the following functions:

Decision 2/CP.19, para. 5

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United Nations A/77/640

General Assembly

Distr.: General
31 January 2023

Original: English

Main findings and recommendations of the midterm review of the implementation of the Sendai Framework for Disaster Risk Reduction 2015–2030

37. Areas of disaster risk reduction financing in which investments have increased globally include adaptive social protection[26] – which can assist in addressing the multidimensional nature of vulnerability and the systemic nature of risk; and nature-based solutions, which countries increasingly see as scalable and effective in simultaneously addressing the growing challenges of climate change, biodiversity loss and disaster risks[27] and increasingly feature within countries' disaster risk reduction strategies.

https://rimma.org/un-sendai-framework-midterm-review-main-findings

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EUROPEAN COMMISSION

Brussels, 8.2.2023
C(2023) 400 final

COMMISSION RECOMMENDATION

of 8.2.2023

on Union disaster resilience goals

(4) The Union is facing more frequent and severe natural and man-made disasters. Climate change and environmental degradation are exacerbating the Union's risks by increasing the frequency and intensity of weather-related events, harmful pollution, water scarcity and biodiversity loss. Furthermore, disasters increasingly have effects across borders and sectors. In addition to claiming lives and impacting human health, disasters undermine economic prosperity and cause irreparable losses to the environment, the biodiversity and cultural heritage. Disaster resilience should therefore be strengthened at Union level and in the Member States. The Union disaster resilience goals are to contribute to strengthen disaster resilience and improve the capacity of the Union and its Member States to withstand the effects of current and future disasters. Comprehensive and integrated approaches to disaster risk management are key to strengthening resilience.

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https://rimma.org/european-union-disaster-resilience-goals-2030

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SusInf Community

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Sustainable Development Information Management

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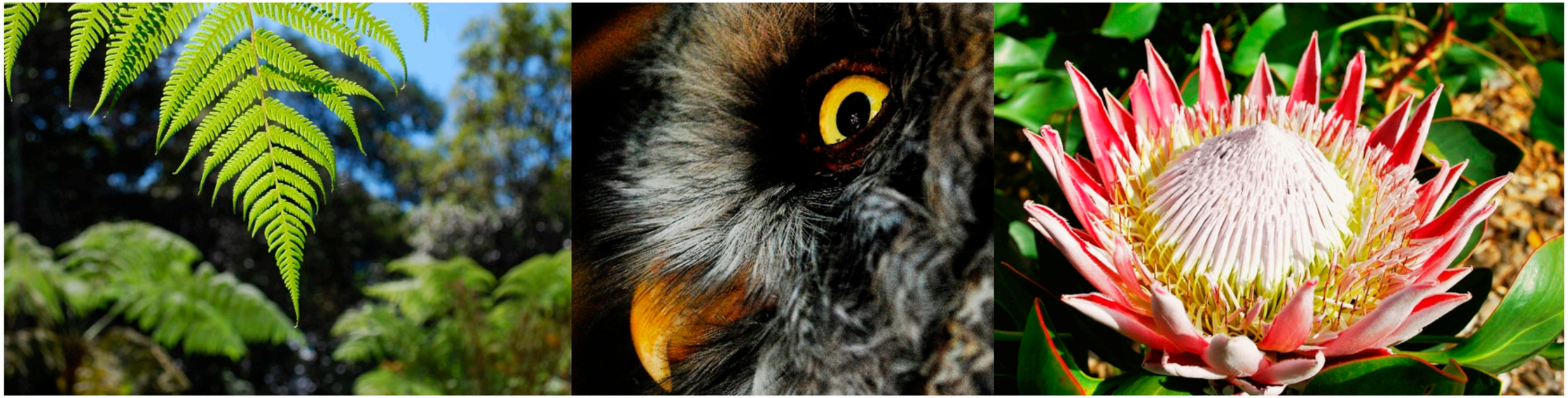

Sustainable Development Information according to the adopted UN 2030 Agenda for Sustainable Development and other related UN Instruments

The 2030 Agenda for Sustainable Development provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. The 17 Sustainable Development Goals (SDGs) have to be guided by strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests.

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THANK YOU for your Attention

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Berlin, 2023

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