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GI Databases and Information Systems Special Interest Group EMISA

16th International Workshop on Enterprise Modeling and Information Systems Architecture

2026-03-11

Managing the Complexity and Dynamics of Requirements in Situations of Exceptional Need

Horst Kremers
Chair, RIMMA CoE
Engineering Management and Information Sciences, Berlin (Germany)

Structure

1. Cross-Organizational Information Infrastructures (Semantics & Pragmatics)
2. Disaster „just-in-time“ Information Demands (Situation Reports, SOPs, SLAs)
3. RISK Domains Digital Strategies, Roadmaps, Governance
4. Complexity
5. What can we do ?

Source: Workshop on GMES / INSCRIT Information Service in Response to Crises, Disasters & Emergencies Nov. 7-8.2005, Conclusions by J.-P. Malingreau (JRC)

Joint Emergency Service Interoperability Programme (JESIP)

Working together with emergency service colleagues to help save lives.

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Also in this section

- Handling major incidents
- Joint Emergency Service Interoperability Programme (JESIP)
- Keeping safe during a major incident

Much work goes into planning for mass gathering events at fixed sporting or entertainment venues but also those which occur in town centres or other open venues. This planning activity can occur just from our own perspective but often involves cooperation with other organisation.

A great deal of emphasis is placed on education and training by the Resilience Team and in addition to ensuring that the team itself is sufficiently well trained to conduct its complex and diverse role, this includes the training of our ambulance commanders and operational staff too. Regular training includes that mandated through the JESIP, which is enacted in partnership with colleagues from police, fire and rescue and other responding agencies under the banner of 'Working together – Saving lives – Reducing harm'.

This joint working promotes wider understanding of the roles of each agency, a greater awareness of shared risks and a systematic approach to the effective and above all, joint management of incidents.

https://www.nwas.nhs.uk/services/major-incidents/jesip/

Table 4: Recommended use of BPMN, CMN, DMN related to process type, crisis phase and requirement of WFM

			BPMN	CMMN	DMN
Process type	Standard	Planned (P1)	x		(x)
		Unplanned (P2)		x	x
	Non-standard	Planned (P3)	x	x	x
		Unplanned (P4)		x	x
Crisis phase		Mitigation	x		x
		Preparedness	x		x
		Response		x	x
		Recovery		(x)	x
Requirement WFM		Support of resource management			x
		Progress display and current state	x		
		Adjustment of workflow before and during process		x	x
		Support delegation of measures	x	x	x
		Execution of workflow	x	(x)	

Niemz, Sandra; Gehrke, Sven; Ruhland, Johannes (2021). On Process Organization in Crisis Situations with BPMN, CMMN and DMN

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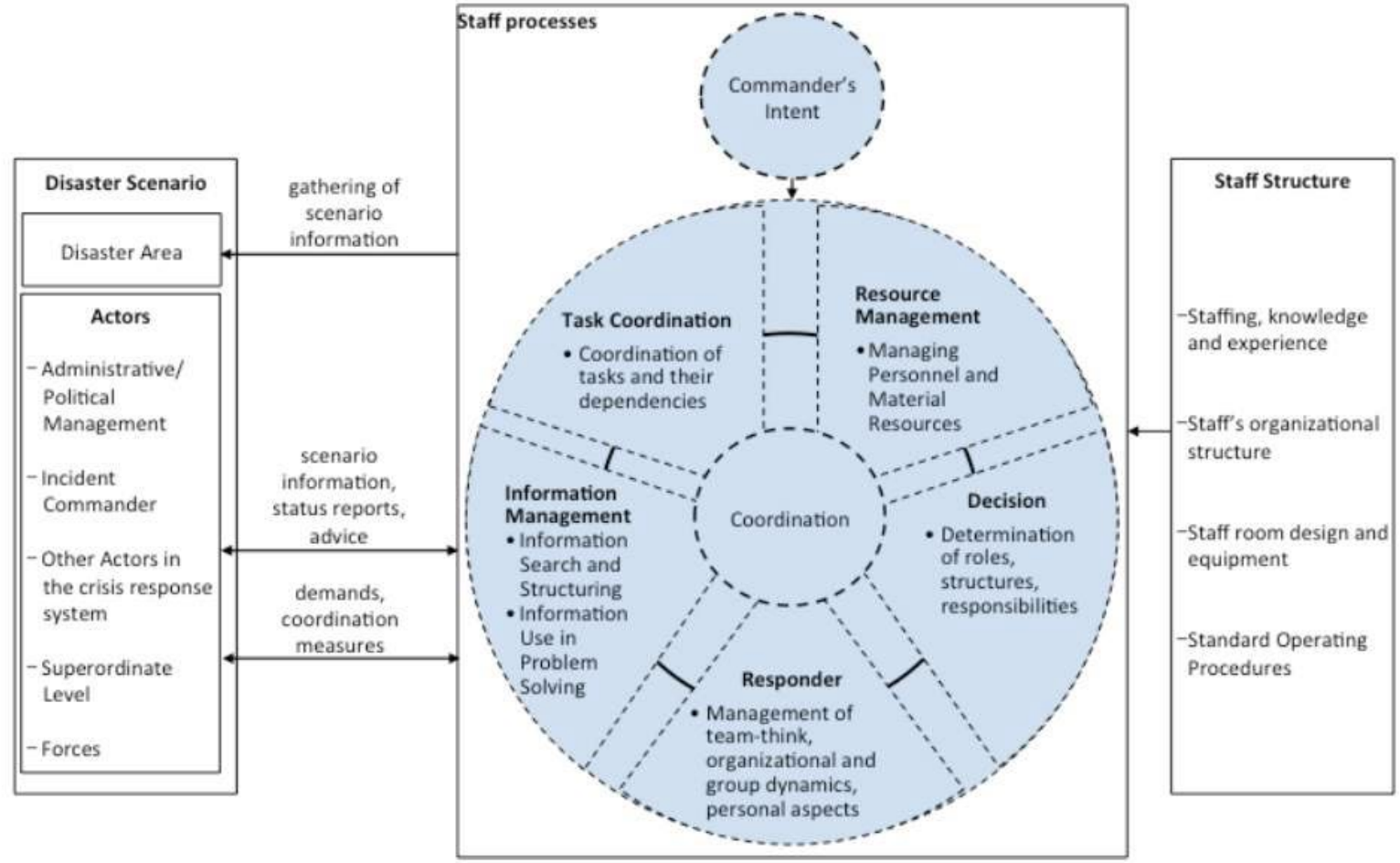
Processes (1)



Heumüller/Richter/Lechner (2012): Towards a conceptual model of staffs in disaster response organizations

Table 3
Wellington region - planning emergency levels of service[a] - PRELIMINARY FRAMEWORK.

Sector	The first week: self-sufficient for seven days	For the rest of the first month: basic functionality	For the second and third months: moderate functionality	Beyond: significant functionality
Water	Minimum of 3 L per person per day[b], but recommended 20 L per person per day, as stored at homes by individuals	15–20 L of water per person per day[c] within 1 km of the house	80% of supply of potable water to 80% of customers[d]	At least 80% of individuals receive at least 80% of 'BAU' delivery
Roading	Limited road use – only priority 1 routes[e] are open to emergency vehicles. Walking access to local medical centres and to Community Emergency Hubs is available.	Priority 1 routes are open and managed[f], priority 2 roads are open to emergency vehicles. Road access is available between dwellings and local medical centres and Community Emergency Hubs and between water stations and distribution points.	Priority 1 and 2 routes open and managed, and priority 3 and 4 routes open for emergency vehicles only.	At least 80% of individuals receive at least 80% of 'BAU' delivery
Food and LPG (for cooking)	As stored in individual homes, provided by FMCG suppliers who are still operating, or emergency food supply brought in with priority to vulnerable people	Access to a supplied supermarket or distribution point[g] within 2 km[h] following an event for urban areas	Access to a supplied supermarket or distribution point within 2 km in urban areas	At least 80% of individuals receive at least 80% of 'BAU' delivery
Fuel	Strict rationing to priority list of users (e.g. emergency services) using fuel storage in place at time of emergency	Strict rationing to priority list of users (e.g. emergency services) using fuel storage in place at time of emergency and any immediate re-supply	Priority service stations are operating	At least 80% of individuals receive at least 80% of 'BAU' delivery
Power (electricity)	Households use from local sources and response priority sites use own pre-arranged power supply for essential functions.	Households use from local sources and response priority sites use own pre-arranged power supply for essential functions[i]. Ability to charge telecommunications devices (such as phones and tablets) at a location within a local area such as at a local Community Emergency Hub.	Power to response priority sites and key infrastructure sites[j]. Ability to charge phones and tablets at a location within a local area such as a local Community Emergency Hub.	At least 80% of individuals receive at least 80% of 'BAU' delivery
Telecomm-unications	Ability to send and receive texts (albeit with potential delays). Satphone usage where phones are charged.	Access mobile data for minimal functionality at defined locations such as at Community Emergency Hubs.	Access mobile data for almost normal data capability. Priority users have full service.	At least 80% of individuals receive at least 80% of 'BAU' delivery
Broadcast	FM radio – Priority Stations[k]: fully operational[l]	Fully functional for priority radio stations, no TV	Fully functional for priority radio stations, no TV	At least 80% of individuals receive at least 80% of 'BAU' delivery
Sanitation	Self-sufficiency by the community for sanitation needs (long-drops, two buckets or similar (no council service)).	Service, according to the 'two buckets' plan.[m]	Service, according to the 'two buckets' plan.	At least 80% of individuals receive at least 80% of 'BAU' delivery
Shelter	Shelter within own property or with immediate support network or at mass temporary accommodation sites.[n]			

Standard Operating Procedures

The database documents the physical resources of each participating organization. For instance:

The Feeding Support Group enters information related to its resources and capabilities such as:

- Availability of a food pantry.
- Ability to provide meals (hot or cold).
- Availability of a mobile delivery service.
- Number of meals that can be served in one day during a disaster.

The Shelter Support Group enters information related to its resources and capabilities such as:

- Number of people the space that can be accommodated.
- Availability of volunteers to assist in staffing each shelter.

The Points of Distribution (POD) and Disaster Assistance Center Support (DAC) Groups enter information related to their resources and capabilities such as:

- Availability of site.
- Number of volunteers available to staff each site.

The Warehousing Support Group enters information related to its resources and capabilities such as:

- Dimensions of the space available.

The Volunteer Support Group enters information related to its resources and capabilities such as:

- Number of community volunteers available.
- Whether these volunteers can assist in mitigation activities (shuttering, debris removal).

The Services for the Elderly and Crisis Counseling/Spiritual Care Support Groups enter information related to their resources and capabilities such as:

- Number of volunteers available.
- Area in which these volunteers will serve.

The Mass Communication Support Group enters information related to its resources and capabilities such as:

- Availability of communication networks.
- Type of media used.

By documenting resources and facilitating communications, the M-D C.O.R.E. database assists in the overall collaboration of the disaster relief effort. This will include identifying resource gaps, reducing response time, and increasing the speed of recovery within the community.

Miami-Dade Communities Organized to Respond in Emergencies (M-D C.O.R.E.), Manual – Volume II, Standard Operating Procedures (SOP) 2015 32 p https://www8.miamidade.gov/core/library/manuals/manual-volume-2.pdf

Elementary Sample of Service Level Agreement

Perform below steps before assigning the human task to the potential owner

1. Execute the SLA rule and get the SLA Levels, SLA Duration and Potential owner
2. Calculate the SLA Breach date by adding the current date + SLA Duration
3. Update in the table PROC_SLA
4. Run SLA notification Job scheduler every day
5. Get the records from table PROC_SLA where SLA Breach date is today's date.
6. Get the required request details from request master table if required
7. Trigger the email from a Java mail service with required details.
8. To improve the database performance we can delete the record from table on completion of the process.
9. We can code the scheduler such a way that, it should send a consolidated email to Manager and CEO every day with list of requests which are breached SLA.

Processes (2)

Table 1 Comparison between Business Process Management and Disaster Process Management

Criteria	Business Process Management	Disaster Process Management
Process Management Lifecycle	Planning, Implementation and Monitoring of processes are sequential steps, each taking a lot of time	Planning, Implementation and Monitoring of processes in parallel, no start and end of these steps, highly iterative steps
Modeling	Control-flow oriented: complex routing of information between activities. Processes can be managed in isolation to each other	Temporal dependencies between activities. Processes cannot be managed in isolation to each other
Execution	Frequently, few exceptions, change is seldom	Executed seldom/once, many exceptions, change is the rule
Monitoring	Key performance indicators and business goal violation	Activity status and violation of temporal dependencies
Cross-organizational Aspects	Global definition of inter-organizational processes, few interfaces/interactions between organizations (organization to organization)	No global definition of inter-organizational processes, many interfaces/interactions between organizations (people to people), ad hoc definition of new interfaces/interactions based on personal contacts

Jörn Franke and François Charoy
Proceedings of COOP 2010, Computer Supported Cooperative Work, p. 57-75

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Elements/Steps of Service Level Agreement

Template Definition
Offering
Negotiation
Mapping and Translation of Monitoring Metrics
Service Provision
Monitoring
Violation Detection
Violation Prevention
Violation Corrective
Violation Escalation
Termination
Accounting & Billing
Resolution
Archiving
Review

https://www.researchgate.net/publication/308614557_SLA_Object_and_SLA_Process_Modelling_using_WSLA_and_BPM_Notations_Towards_defining_a_Generic_SLA_Orchestrator_Framework

Disaster Impact Analysis

- Appropriate mechanisms for effective information, communication, consultation and cooperation of all stakeholders (information flow, decision support and resources availability)
- Impact assessment must always take account of the **costs of not taking action** and of longer-terms costs and benefits in monetary and qualitative terms
- **Alternatives**
- Disaster Impact Cascades and Consequences
- Need of better ex-post evaluation of adopted and implemented measures

HACCP Hazard Analysis and Critical Control Points Management Principles

- Conduct a hazard analysis
- Identify critical control points
- Establish critical limits for each critical control point
- Establish critical control point monitoring requirements
- Establish corrective actions
- Establish procedures for ensuring the HACCP system is working as intended
- Establish record keeping procedures

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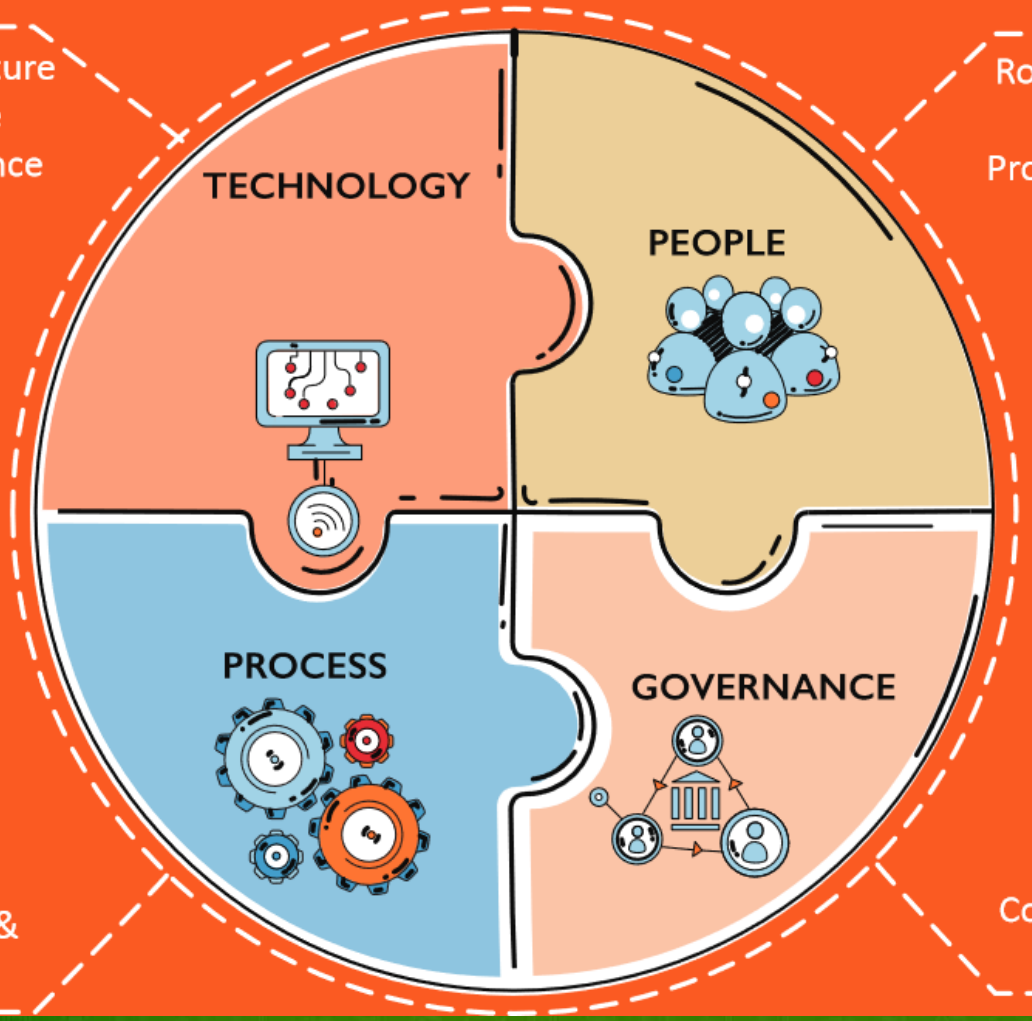
5. What can we do ?

All four IG components are vital to establish good practice.



Information Architecture
Hardware & Software
Security & Maintenance

Roles and Responsibilities
Capacity and Capability
Professional Development

Business needs and Quality
Discovery & Access
Procedures, Training & Support

Leadership Support
Strategy, Policies and Alignment
Compliance, Monitoring and Evaluation

2

Information Governance (IG) is a critical enabler

- IG is the organisational structures and frameworks to institutionalise and operationalise information as an asset.
- IG is a part of organisational governance, and a scalable opportunity to address complex information challenges.
- IG promotes appropriate resources and accountability to establish good practice for disaster information.

Information Governance for Disaster Risk Reduction, 2021
https://www.gidrm.net/user/pages/get-started/resources/files/GIDRM_InformationGovernance_4DRR.pdf

Basic Management Principles

- critical thinking
- gaps and deficits analysis
- decision, action, and control cycle support
- transparent analysis
- control and extensive reporting obligations
- compliance to regulations and other boundary conditions
- consider phases and techniques in enabling of retrace
- include detailed 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)
- operations concept
- reexamination, analysis
- avoidance of malpractice
- extend concepts of FAIR information principles [FAIR] to support transparency goals and accountability
- indications on weaknesses/vulnerabilities

Fig. 4: Basic Management Principles

Kremers (2021)
http://www.susgis.net/LNIS_9_Geoinformation_for_Sustainable_Development__Berlin_2020.pdf #page=93

Elements of Safety & Security Information Governance (1)

Missing information	Without IG	With IG
People	Nobody has the role, responsibility, and accountability to manage information including metadata or resource description and filing or recordkeeping.	The management of information is documented in job descriptions.
		Staff have the knowledge and skills to manage information and records.
	Nobody has defined and designed the metadata, filing or recordkeeping specifics which ensure that the information is appropriately captured and recorded.	Somebody has defined and designed metadata and workflows which ensure that information is captured with quality metadata, filed and recorded appropriately.
	Coordination with archives, recordkeeping or the library is not in place to apply and monitor existing rules.	Coordination and links or boundaries with archives, recordkeeping and library are in place and enables efficiencies.
Governance	The importance or business value of this information for DRR goals is not specified.	The information is aligned with DRR goals which clarifies the value and importance of the information. This includes emphasis on retrieval and access of the information.
	Business information categories with templates, classification and other criteria are missing or not applied.	Templates are in place and used including opportunities to enable metadata automation
	Metadata and filing or recordkeeping rules and mechanisms or criteria are missing or not applied.	Metadata comprises relevant descriptive, administrative, technical, operational details to discover, access, and reuse the information, including public or protected information, licenses or copyright, retention and review periods, source or producer and contact for questions.
	Compliance is not monitored nor managed.	Compliance is monitored and missing updates or lack of compliance are managed.
	Leadership does not know about information challenges or they are not considered important.	

14 GIDRM | © GIZ | October 2020

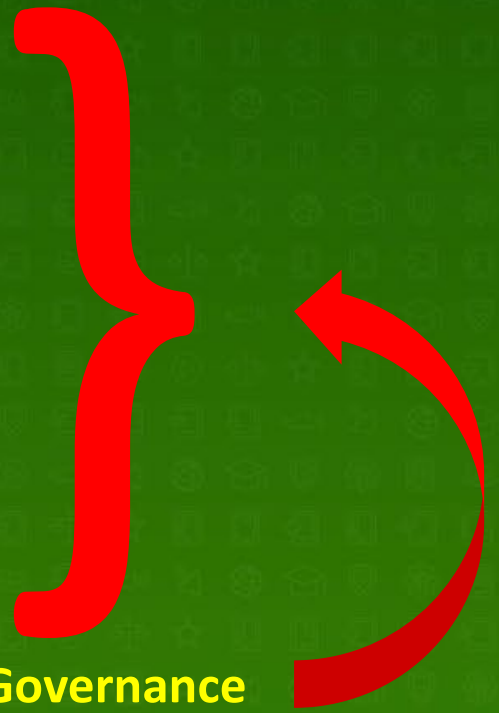
Information Governance for Disaster Risk Reduction, 2021
https://www.gidrm.net/user/pages/get-started/resources/files/GIDRM_InformationGovernance_4DRR.pdf

Elements of Safety & Security Information Governance (2)

- economic and business management issues,
- financing,
- economic instruments,
- sustainability in finance,
- recording and valuation of services,
- accounting,
- dialogue with private sector / companies / professional associations

Elements of Safety & Security Information Governance (3)

- methods,
- techniques,
- operations,
- control,
- accountability,
- ethics,
- risk management,
- compliance,
- administration,
- “all-of-society” participative Governance



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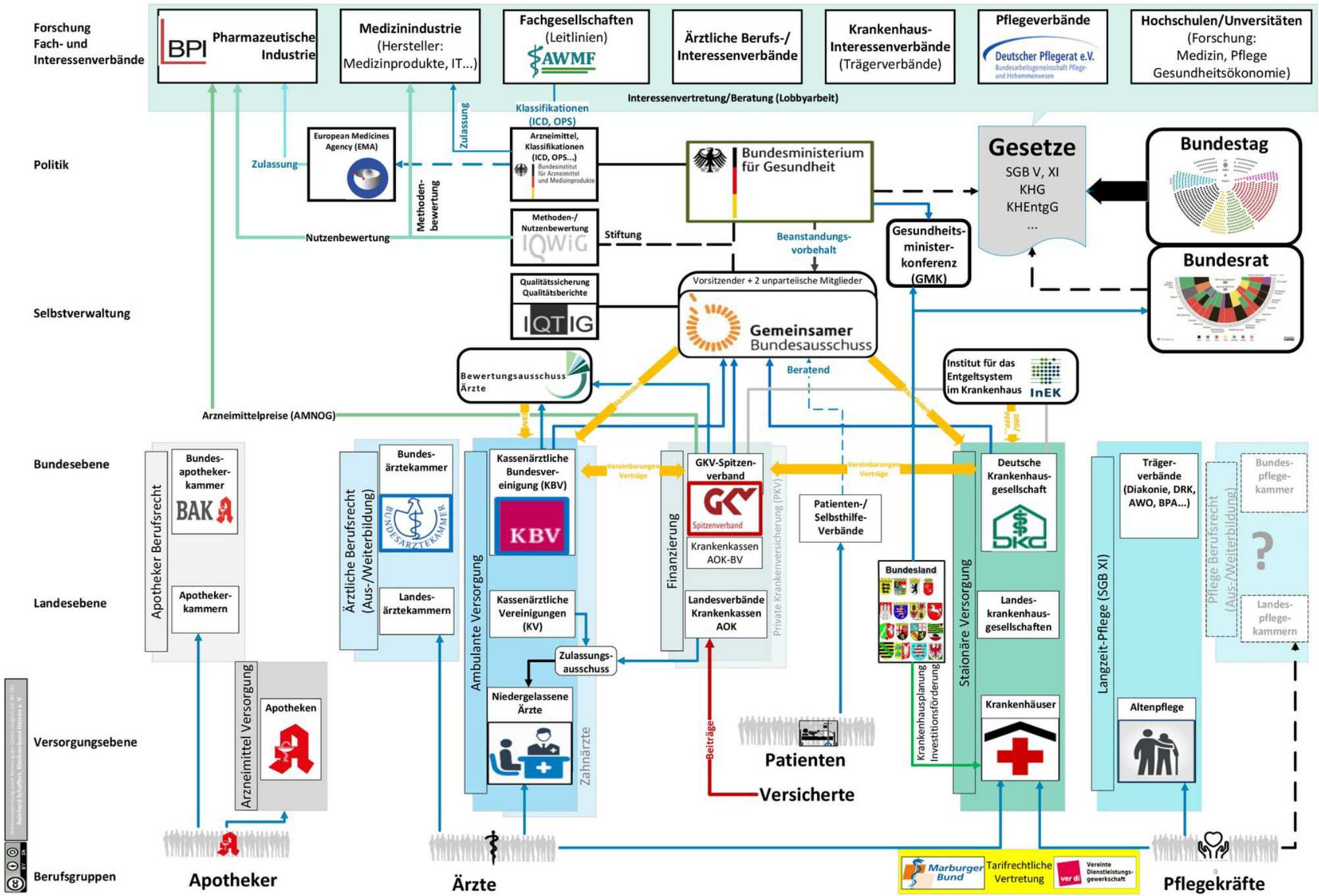
https://www.klinikverbund-hessen.de/fileadmin/_processed_/a/1/csm_Gesundheitssystem_a4c1bc50d1.jpg

Das Gesundheitssystem in Deutschland



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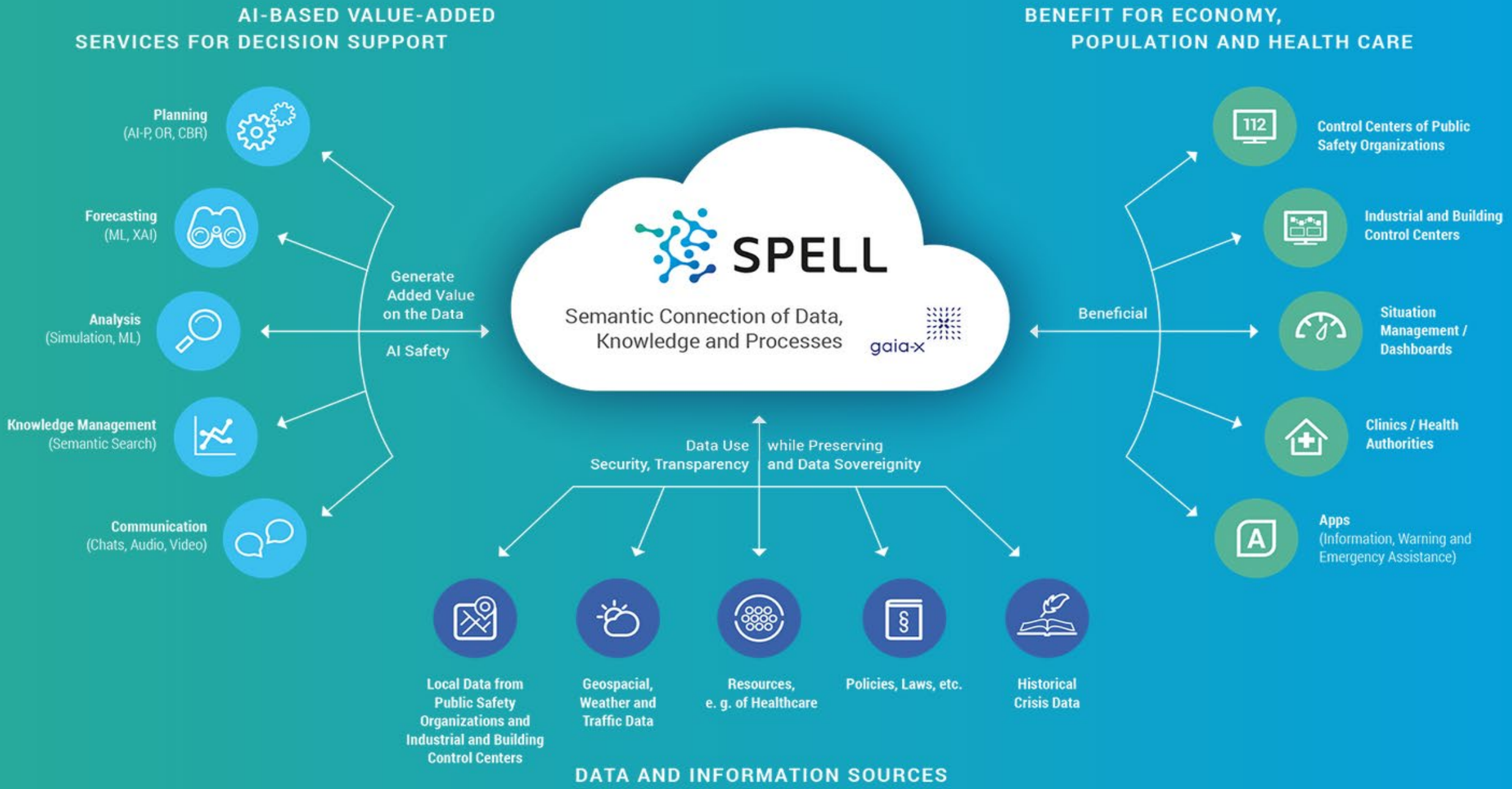
Stakeholders / Pillars of Societal Resilience in all Phases of the Disaster Management Cycle

Organizations that stand up for people
Parliamentarians
Lawyers
Insurance companies
Local and national charities
Organizations for family caregivers
Technical and material assistance for reconstruction
Professional Support in the search for financial aid
Sociologists, psychotherapists, psychologists and behavioral consultants
Nursing (practitioners, professional organizations, etc.)
Ambulatory care midwifery
Advocacy for patients
Children in care homes
Medical associations
Chambers of pharmacists
Chambers of nursing
Chambers of psychotherapists
Health insurance companies
Health and care providers Organizations and Associations (public and private services)
Chambers of industry and commerce
Chambers of engineers
State Council for Building Regulations
Property owners' associations
Surveillance
Refugee-migrant organizations of people with disabilities (OPDs)
Organizations run by deaf people
Standardization organizations
Promoting policies that benefit children
Faith-based organizations and communities Health institutions (local, regional, national)
Salvation Army, missions
School services/parent-teacher associations
Medical care organizations
Community research and service centers
Amateur radio associations
Media (radio, TV, newspapers, magazines, etc.)
Social media
Food industry, nutrition logistics, transportation and distribution
Animals (zoo, pets, farm animals)
Consumer protection organizations
Auditors (public and private)
Legislators

... and others



https://spell-plattform.de/en/spell-plattform/
2024

NATO

seven baseline requirements for national resilience against which Allies can measure their level of preparedness

https://www.nato.int/en/what-we-do/deterrence-and-defence/resilience-civil-preparedness-and-article-3

1) **Assured continuity of government and critical government services**: for instance, the ability to make decisions and communicate with citizens in a crisis;
2) **Resilient energy supplies**: ensuring a continued supply of energy and having back-up plans to manage disruptions;
3) Ability to **deal effectively with the uncontrolled movement of people** and to de-conflict these movements from NATO's military deployments;
4) **Resilient food and water resources**: ensuring resilient supplies that are safe from disruption or sabotage;
5) **Ability to deal with mass casualties and disruptive health crises**: ensuring that civilian health systems can cope and that sufficient medical supplies are stocked and secure;
6) **Resilient civil communications systems**: ensuring that telecommunications and cyber networks can function even under crisis conditions, with sufficient back-up capacity. This also includes the need for reliable communications systems including 5G, robust options to restore these systems, priority access to national authorities in times of crisis, and the thorough assessments of all risks to communications systems;
7) **Resilient transport systems**: ensuring that NATO forces can move across Alliance territory rapidly and that civilian services can rely on transportation networks, even in a crisis.

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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

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Challenges in Process Models and Techniques (1)

„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

Challenges in Process Models and Techniques (2)

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, contexts, goals, decisions, actions).

Challenges in Process Models - Feasibility Studies

- Foresighting
- Situational Picture
  (Facts, Graphics, Analytics, Alternatives, Consequences)
- Standard Operational Procedures
- Service-Level Agreements
  (Qualities, e.g. by Implementing „Just-in-Time“)
- Multiple Representations
- Effectiveness
- Secure vs. Open Access Information
- Situations
- Behavior Informatics
- Context Models
- Complexity
- Structural Resilience / Robustness
- Synergies
- Decision Support Systems

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Challenges in Process Models
- From Feasibility Study to Domain Standard -

- Actors in „Situations of Exceptional Need“
- Post Disaster Documentation Analysis
- Cross-Organizational and Cross-Border Effectiveness
- Strategy & Roadmap
  compile, discuss, deliver
- Human Ressources
- Dynamics, Robustness, and Resilience
- Legal Framework
  making implementation mandatory

Industrial ecosystems \ EU data spaces	Manufacturing	Green Deal	Mobility	Health	Financial	Energy	Agricultural	Legal	Procurement	Security	Skills	Open Science	Media	Cultural heritage	Tourism	Construction	Smart communities	RISK (Proposal)
Construction	✓	✓			✓	✓		✓	✓		✓	✓		✓		✓	✓	✓
Tourism		✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓
Textile	✓	✓						✓	✓		✓	✓						✓
Proximity and social economy	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓
Mobility-Transport-Automotive	✓	✓	✓			✓		✓			✓	✓					✓	✓
Health	✓	✓		✓				✓			✓	✓						✓
Energy intensive industry	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓				✓	✓	✓
Energy renewables	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓				✓	✓	✓
Retail	✓	✓	✓		✓		✓	✓			✓	✓			✓			✓
Electronics	✓	✓				✓		✓			✓	✓						✓
Digital industries	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓
Cultural and creative industry	✓	✓						✓			✓	✓	✓	✓	✓	✓		✓
Agri-food	✓	✓					✓	✓			✓	✓			✓			✓
Aerospace & Defence	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Mappings between industrial ecosystems and common European data spaces

https://ec.europa.eu/newsroom/dae/redirection/document/83562

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Our Common Goals:

Digital innovation and Information Management

Increasing and ensuring efficiency

Cross-Organizational and Cross-Border coherence

granting just-in-time information availability and use

in line with All-of Society Demands based on interdisciplinary professional state of the art

and in line with societal expectations

RIMMA Community

https://RIMMA.org

join us today !

Community and Interdisciplinary International Conference Series on RISK Information Management, Risk Models and Applications

The RIMMA Community on Risk Information Management, Risk Models, and Applications will enable sharing of best practices as well as giving space for discussing methodological problems in risk (NaTech) and security (CBRNE) modeling from the information systems point of view for all phases of the disaster management cycle.

Thank You for Your Attention !

For further information, communication and cooperation please contact:

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