



**GI:DRM**

Global Initiative on  
Disaster Risk Management

# INFORMATION GOVERNANCE

## FOR DISASTER RISK REDUCTION

## Table of Contents

Abbreviations.....	3
Setting the Scene – Coherent DRR Action requires Information Coherence .....	5
Definitions.....	5
Problem Statement – Challenges with Information and its Coherence .....	6
Information Governance (IG).....	8
Guidance and Good Practice.....	9
<i>People</i> .....	9
<i>Governance</i> .....	10
<i>Processes</i> .....	11
<i>Technology</i> .....	12
Common IG Gaps and Solutions for Information Coherence .....	14
Benefits of Information Governance and Information Coherence .....	16
Selected Case Studies and Examples.....	18
References .....	19

## Abbreviations

ADPC	Asian Disaster Preparedness Center
AI	Artificial intelligence
BPM	Business Process Management
BMZ	German Federal Ministry for Economic Cooperation and Development
CoP	Community of Practice
DRM	Disaster risk management
DRR	Disaster risk reduction
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
GIDRM	Global Initiative on Disaster Risk Management
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
IG	Information governance
IM	Information management
IT	Information technology
IaaS	Infrastructure as a Service
KM	Knowledge management
MEL	Monitoring, evaluation and learning
NSOs	National Statistics Offices
PaaS	Platform as a Service
RCC	Regional Consultative Committee on Disaster Management
SaaS	Software as a Service
SDG	Sustainable Development Goals
SFDRR	Sendai Framework for Disaster Risk Reduction
SFIA	Skills Framework for the Information Age
SFM	Sendai Framework Monitor
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
WoG	Whole-of-government
XaaS	Everything / Anything as a Service

### **Disclaimer and Acknowledgements**

This information governance (IG) guidance targets disaster risk management (DRM) and disaster risk reduction (DRR) leaders and practitioners in government agencies at the national and sub-national level and across sectors, horizontally and vertically. This includes government collaboration partners for DRM data and information such as the National Statistics Offices (NSOs), Planning and Finance departments, Information Technology (IT) and others. The document further aims to guide global and regional development partners and others who support data, information, and technology approaches.

This publication has been developed based on stakeholder consultations and research within the Global Initiative on Disaster Risk Management (GIDRM), an initiative commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ) and implemented by the GIZ. GIDRM supports international and national, governmental and non-governmental stakeholders in their efforts to strengthen coherent planning, implementation and reporting on DRR towards the goals of global development agendas. The global agendas include the Sendai Framework for Disaster Risk Reduction (SFDRR), the Paris Agreement, the Agenda 2030 also known as the Sustainable Development Goals (SDG), the New Urban Agenda and others.

Prepared for: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Prepared by: Jutta May

Graphics designed by: Thinkplace

## Information Governance for Disaster Risk Reduction (IG4DRR)

### Setting the Scene – Coherent DRR Action requires Information Coherence

The global development agendas such as the Sendai Framework on Disaster Risk Reduction (SFDRR), the Paris Agreement and the Sustainable Development Goals (SDGs), together with national frameworks and local plans, **share the goal to reduce the risks and effects of disasters and climate change** in order to build resilience and ensure sustainable development. To support the planning, implementation, and reporting of disaster risk management (DRM) and disaster risk reduction (DRR) in line with development agendas, **significant amounts of data and information are required**. Opportunities exist to **mobilise synergies and efficiencies** for disaster and risk related data and information. In other words, coherent DRM action requires information coherence<sup>1</sup>.

Having the right information at the right time and in the right format can be a challenging task. Often, **around 30 different agencies** are involved to coordinate data and information for DRM operations or DRR reporting across government entities and sectors such as agriculture, health, infrastructure, and others. In fact, **no country**

can currently satisfy all reporting requirements for the Sendai Framework Monitor (SFM)<sup>2</sup>. Solutions are needed to unlock the potential of data and information, while addressing the gaps and duplication of continuously evolving information needs or data requirements. Contemporary **information governance (IG) is an opportunity to address complex information challenges**. This study introduces IG and prerequisites to manage, share and reuse data and information for coherent planning, risk-informed sustainable development, and reporting.



### Definitions

#### *Coherence in DRM*

An approach to integrate, as appropriate, the objectives of the global frameworks and the pursuit of sustainable development, disaster risk reduction, and climate change adaptation<sup>3</sup>.

<i>Data</i>	The representation of facts, concepts or instructions in a formalised (consistent and agreed) manner suitable for communication, interpretation or processing by human or automatic means. Typically comprised of numbers, words or images. The format and presentation of data may vary with the context in which it is used. Data is not information until it is utilised in a particular context for a particular purpose. Examples include: Coordinates; registration numbers; population data; or an official picture in jpeg format <sup>4</sup> .
<i>Information</i>	Any collection of data that is processed, analysed, interpreted, classified or communicated in order to serve a useful purpose, present fact or represent knowledge in any medium or form. This includes presentation in electronic (digital), print, audio, video, image, graphical, cartographic, physical sample, textual or numerical form. Information may also be a public record or an information asset if it meets certain criteria <sup>4</sup> . This publication uses information as a general term which includes data and knowledge unless it is specifically mentioned.
<i>Information Coherence</i>	An approach to <b>harmonise and standardise information, within and across stakeholder agencies</b> , to mobilise synergies and efficiencies for interoperability or integration while reducing duplication and redundancy <sup>5</sup> .
<i>Information Governance (IG)</i>	The <b>system or organisational structure and framework to manage, operationalise and control information as an asset</b> .
<i>Information Management (IM)</i>	The collection, processing, organisation, storage and dissemination of data and information for a specific purpose <sup>6</sup> .
<i>Knowledge Management (KM)</i>	Management with attention to knowledge <sup>7</sup> , which includes leveraging people, resources, processes, and information in order to achieve a strategic objective <sup>4</sup> .

## Problem Statement – Challenges with Information and its Coherence

Most of our **work today is information based with much focus on technology**. This includes DRM and DRR where countries need information for the operations, planning and reporting of local and national or global development agendas. In fact, **disaster data and information needs have evolved** from reactive response and single hazards or single events to proactive risk management including all hazards with vul-

nerability and exposure<sup>8</sup>. Different stakeholders have different information needs to perform disaster related tasks, and information is often managed in isolated approaches or silos. Even within the smallest teams it can be easy to lose track and access to information, especially when roles and responsibilities for managing information, analysing data, or sharing knowledge are unclear.

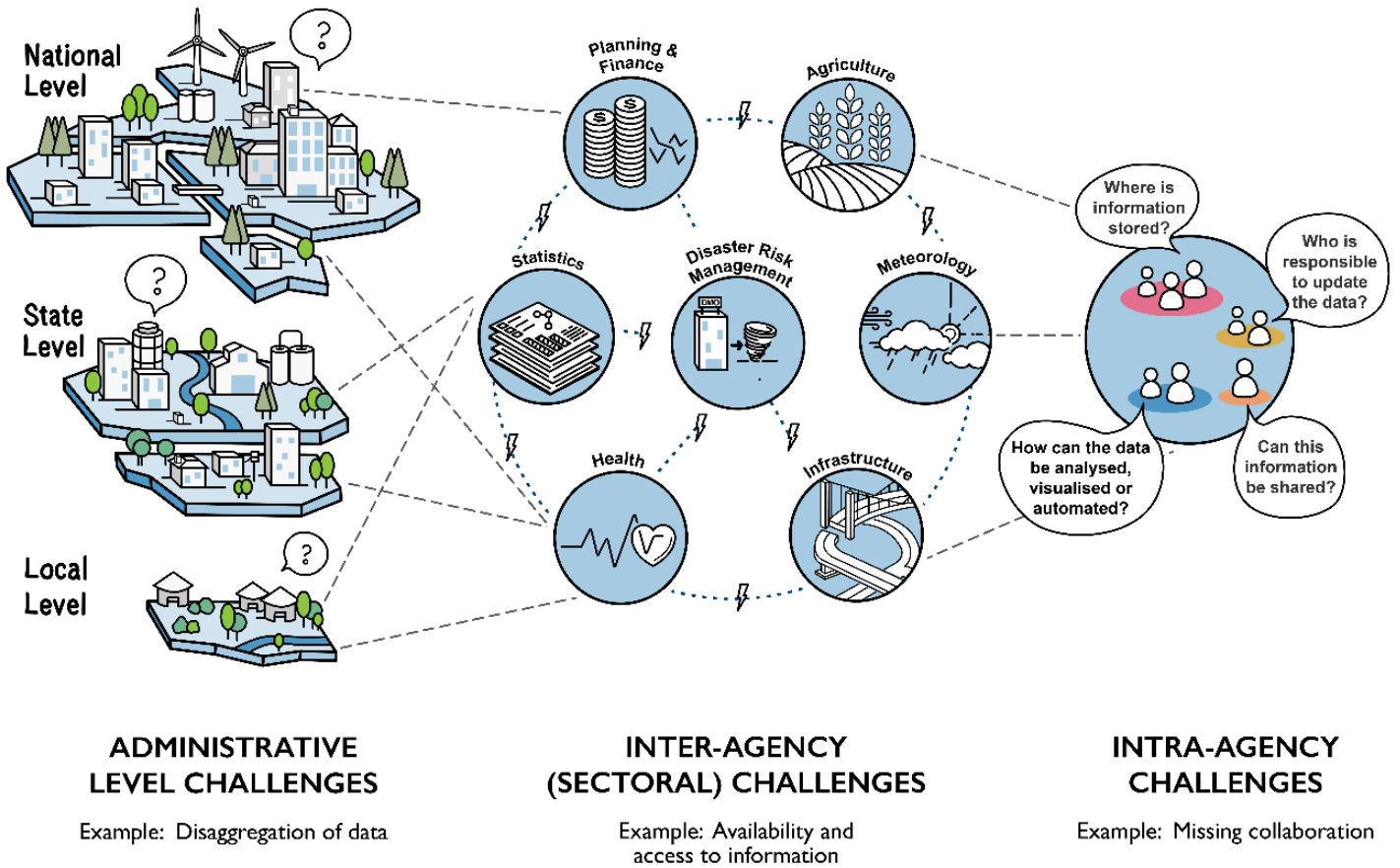


Figure 1: Common Information Management Issues in Countries

As a **result, information is not coherent** and not regularly updated, exists in different formats, is not shared but duplicated in different locations etc. It is not planned jointly to support different actors, lacks interoperability, and therefore does not necessarily respond to specific or shared needs. It needs to be drawn from multitudes of local, sub-national and national government agencies across various sectors, as illustrated in Figure 1, because processes and governance mechanisms for managing information and data are negligible. These contemporary information challenges are **often perceived and framed as technology**

**issues**, while they usually **relate to gaps and weaknesses in the enabling environment**<sup>9,10</sup>. For example, the volume and diversity of data and information have grown substantially, while the capacities and processes for managing information are not proportionally adapted. Essentially, institutional, or operational and political barriers limit the effectiveness of information much more than technology as such<sup>11</sup>. Information Governance provides the organisational structure and framework to manage and operationalise information as an asset with appropriate resources to establish good practice.

## Information Governance (IG)

IG is the theory and practice (or structures and mechanisms) to manage information and data effectively as an asset. It is a **component of organisational governance and represents good governance**.

IG provides an organisational framework to institutionalise and operationalise information and data with appropriate resources and accountability<sup>12</sup>.

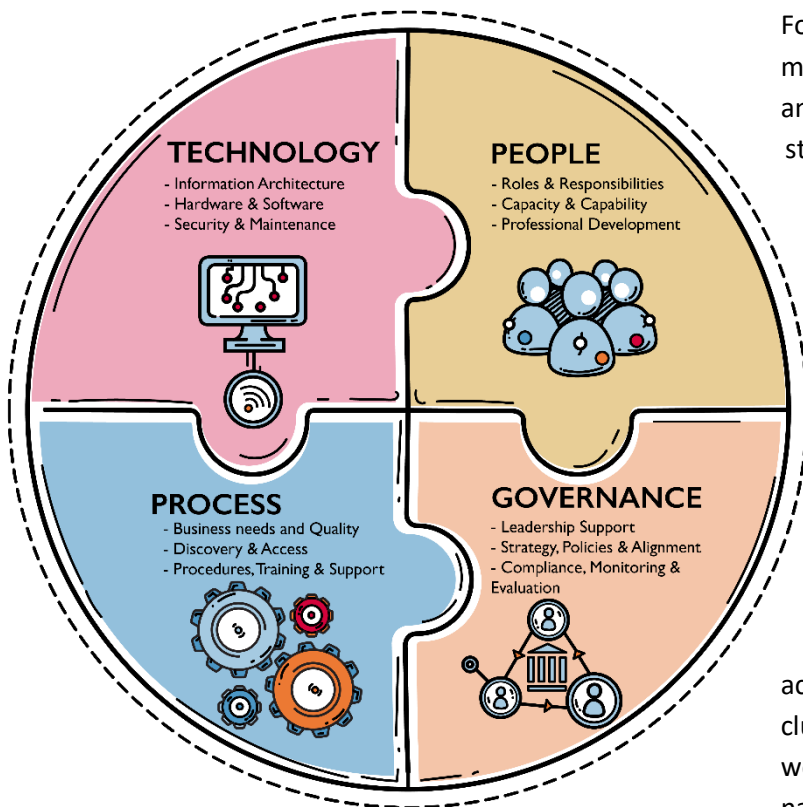


Figure 2: Information Governance Components

IG comprises the enabling organisational environment with **people, governance, processes, and technology**, as illustrated in Figure 2. All four aspects are vital to establish

good practice, while visible leadership and time are required to institutionalise positive change. Collaboration, standards, and procedures are essential prerequisites to optimise the quality, interoperability and use of digital information. These prerequisites **need to be in place and applied before the digital information is created**. Only then synergies and efficiencies can be mobilised, and risks and duplication can be reduced. Follow up tasks without clear specifics mostly fail due to the volume of information and the pace of change. A better understanding of IG and contemporary IM requirements are recommended to optimise the enabling organisational environment and progress its maturity. With **good information governance practice in place**, data and information is collaboratively planned, well-structured, interoperable, timely accessible, and reusable to support risk-informed development effectively and efficiently. In other words, data can be produced once and reused many times, from local to national level, across different sectors and purposes, including the national risk or resilience frameworks and global development agendas. Finally, IG contributes significantly to the **digital transformation to optimise e-governance and e-government**, mobile devices and smart technology, Internet of Things (IoT), big data, artificial intelligence, and related aspects of Industry 4.0 approaches.



## Guidance and Good Practice

**Governments require** platforms for disaster information sharing, minimum standards, and capacity building on data and information management to mobilise common information requirements for local, national, and global agendas<sup>13</sup>. There is also a **need** for strengthening disaster loss data systems with respective statistics and establishing good information management practice with frameworks and processes to connect data and information for policy making and reporting while improving efficiencies. To drive sustainable development together with transparency and accountability, open

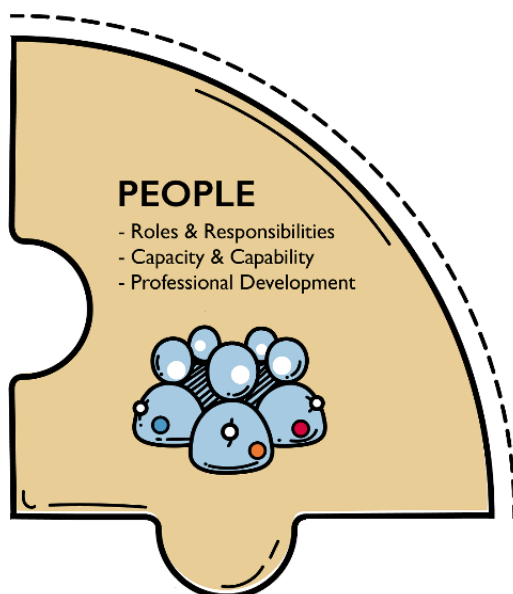
or protected data, and interoperable or integrated information and systems are desired<sup>14</sup>. The transformation towards **information coherence requires all IG components**, namely people, governance, processes, and technology. The following sections describe the prerequisites and selected good practice for each component to establish planned and effective end-to-end information lifecycles or workflows which respond to needs or demands for disaster information, with examples provided in the Appendix.

### People

**Who** is responsible and accountable for updating the disaster loss database, or for analysing and visualising the assessment results, or for filing and archiving the situation report, or for information sharing, or for optimising data processes, or ...? Disaster **information management staff are vital as many tasks are not yet automated** enough

to replace human resources. In other words, people and specific skills are needed to address the volume, complexity, and diversity of disaster information. Considering that business data and information doubles in volume every year, human and financial resources are needed to cover various tasks in the enabling environment of information, or the data ecosystem, beyond technology<sup>15</sup>.

**All staff need to understand their information needs and responsibilities** to ensure coherent quality information. Consequently, all staff should have the **skills, capabilities, and training** to manage information according to their accountabilities. IM and IG requirements should be documented in job descriptions. Processes such as onboarding, and performance measurement need to include IM and IG. Good practice includes a harmonised capability matrix for all staff and different levels. The levels comprise leadership, executives, managers,

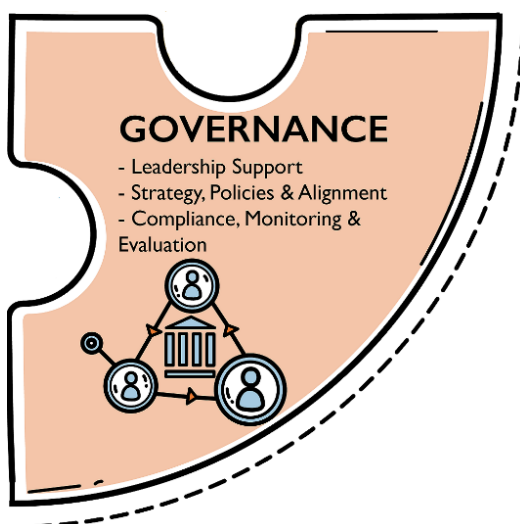


operational, technical and support staff, information specialists and others. Essentially, **leaders and human resources managers need to ensure that dedicated and skilled people are in place** as a prerequisite for effective and coherent information and data management.

Information and data **skills are diverse, specialised, and different from traditional IT** roles. Training and education for these skills is a growing sector which includes research into future digital skills<sup>16</sup>. The Skills Framework for the Information Age (SFIA)<sup>17</sup> provides insights to the range and diversity of IG and IM requirements. Continuous professional development is needed to follow the

### Governance

**What** information is needed for national and global reporting and **why** is it outdated and duplicated; or what disaggregated information is available and why can we not access it; or what are our key disaster information assets and why; or what data do we have and why is this important but not validated; or ...? Disaster practitioners and decision makers struggle to find the right infor-



fast-evolving information needs and trends. **Formal and informal working groups** or Communities of Practice (CoPs) provide opportunities for collaboration, learning and knowledge exchange. Good practice includes the **collaboration between DRM and Statistics departments** to address disaster data for national and global reporting. In fact, secondments and shared positions between DRM and Statistics departments can mobilise coherence, synergies, and efficiencies. This leads to better coordination, information sharing and analysis, and reduced duplication in addition to salary cost efficiencies.

mation at the right time and in the right format. Different case studies show that on average more than 30 agencies are involved in disaster information coordination or reporting. **Good governance and collaboration are required to define and operationalise key information assets** for local, national, and global DRR and development goals and priorities. This requires significant change, while the **lack of leadership support** is often mentioned as a key challenge to strengthen information and data.

Like for organisational governance, **visible leadership support** is the most compelling enabler and **driver to institutionalise IG** effectively. In other words, leaders and decision makers must embrace, support, and promote IG if positive change is desired or expected. This includes appropriate resources and budgets beyond technology investments to institutionalise and manage information better. Information champions

can mobilise and influence discussions and support at different levels.

**Collaboration and coordination** are required to connect information **horizontally and vertically**, which includes the intra-departmental and inter-ministerial levels. This is important to reduce duplication and redundancies or silos. Collaboration with whole-of-government (WoG) approaches, and whole-of-society aims, can mobilise and optimise synergies and efficiencies for information and data. Barriers to collaboration need to be addressed, which include delicate topics such as **trust and power** to share and use information<sup>18</sup>. It also needs time to allow for positive change. **Development partners can assist with initiating and convening meetings** to establish and moderate discussions about information and data, its management and governance.

**Strategies, frameworks, and standards are needed to guide information and digital transformation efforts.** Many standards for information including metadata exist. These are global or thematic standards complemented by corporate or organisational frameworks. Good practice includes **data dictionaries or data catalogues** and **quality metadata or information resource description** to address various issues. These efforts optimise data and information **discovery and access, sharing and interoperability**, in

### *Processes*

**How** do we get information when we need it, or how can we avoid the duplication of information while ensuring its validation, or how do we prepare for timely and risk-informed decisions, or ...? **Disaster data and**

addition to the **reuse or protection** of information through specific licences. Metadata can also improve the **trust or reliability and (un)certainly** of information through clear source or provenance details.

Overall, metadata with exchange standards and other information management tasks reflect the work of **libraries and archives who are excellent collaboration partners for IG**. Essentially, government disaster data and information are records which need to be managed accordingly. Time and resources are required to produce and manage quality metadata, while cost efficiencies, reduced duplication and other benefits can be measured and demonstrated.

Finally, **monitoring, evaluation and learning (MEL)** is an opportunity to demonstrate information benefits and efficiencies with progress and gaps. This includes maturity measurement tools with different levels of readiness and progression. MEL can support **systematic improvements** through regular stakeholder engagement to gather feedback and inputs. Information economics or infonomics is a growing trend which assists with measuring information and its value. In fact, MEL together with knowledge management and effective communications can be helpful to understand information needs and behaviours. This can be useful to **design specific services and support functionality** for users or stakeholder groups.

**information processes are complex** with different assessments, situation reports, briefings, and local, national or global reporting. These information processes are rarely planned and designed or structured.



**Unstructured information processes often reflect paper-based thinking** with steps such as print, sign, scan, and repeat. This is inefficient and risky, and **information gets delayed, lost or duplicated**.

DRR discussions have quickly evolved from data collection to risk-informed decision making. While data collection is one essential step, various steps and activities are required to enable risk-informed decision making. **Defining and mapping all steps**, before and after data collection, is needed to establish a workflow and process or information lifecycle. This includes templates, procedures, testing, training, and support. It also includes quality control to ensure that steps and details such as metadata and updates or disaggregation are not missed. **Without clearly defined steps and processes, the aims and results of disaster data and information cannot be achieved.**

End-to-end processes or end-to-end services are often mentioned in relation to early warning or forecasting, national or global reporting, and other mechanisms. These comprehensive processes include various stakeholders with specific information needs or business requirements. Different stakeholders might require and use the same data or information for differ-

## Technology

**Where** do we find this information? Technology is likely the most evolved and functional aspect of DRM information systems. Relevant elements such as hardware, software, information architecture, security and maintenance are often in place and resourced. At the same time, expectations are

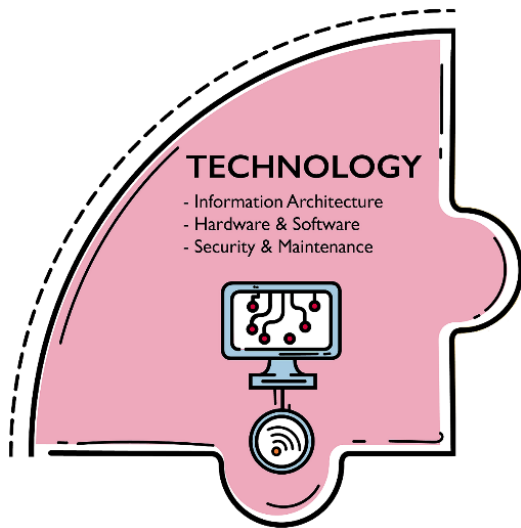


ent purposes and at different times. To ensure that information is accessible and efficiently shared, the **joint planning and collaborative mapping of information is essential**. Use cases and scenarios can assist to model information needs and processes.

Good practice for information processes includes **business process management (BPM)**, a discipline to model, analyse, optimise, and automate workflows in response to general or specific data and information needs. BPM is an opportunity to control and improve information flows or lifecycles while reducing duplication and saving time. As information and needs keep changing and evolving, **regular reviews of requirements and continuous improvements of processes are recommended**.

high and tasks such as information management or information governance are often **assumed** IT functions or responsibilities, while clear definitions or boundaries are missing.

Technology trends include **collaboration platforms** to optimise the coordination and sharing of information and other synergies.



Virtual aggregation is an opportunity to share and display information from its original source while reducing duplication. **Cloud services** can provide flexible volumes and security with cost efficiencies. This includes cloud computing infrastructure as a service (IaaS), platforms as a service (PaaS), software as a service (SaaS) or ‘everything / anything as a service (XaaS)<sup>19,20</sup>. However, this might not be possible or feasible everywhere considering the varying internet connectivity and affordability.

Further trends include the use of **open source software solutions** to reduce costs and enhance flexibility. This can enable the

customisation or tailoring, in contrast to proprietary software. However, it is recommended to reduce the scope of customisation where possible to maintain standards and interoperability while reducing the costs and dependency on specific vendors.

The use of **automation and artificial intelligence (AI)** is increasing with growing attention and opportunities for DRR and DRM. For example, automated damage assessments or metadata automation are used since years, while **significant challenges need to be addressed** to operationalise the potential of innovation<sup>21</sup>. Challenges which are often overlooked and understated include the **comprehensive and demanding human efforts with highly specialised expertise and new skills required** to transform satellite imagery to information for response decision making<sup>22</sup>. Solutions for risks such as **security, privacy, data bias, and various other aspects** are needed to manage and prevent risks of disinformation and harm<sup>23, 24</sup>. This includes related topics such as machine learning and deep learning, industry 4.0 and internet of things (IoT), big data and analytics, and other trends.

## Common IG Gaps and Solutions for Information Coherence

This section provides two examples of common information challenges or IG gaps with solutions for information coherence. It covers a) missing information in Table 1, and b) outdated data in Table 2.

a) Why is information missing or cannot be found?

Table 1: IG for missing information

Missing information	Without IG	With IG
<i>People</i>	<p>Nobody has the role, responsibility, and accountability to manage information including metadata or resource description and filing or recordkeeping.</p> <p>Nobody has defined and designed the metadata, filing or recordkeeping specifics which ensure that the information is appropriately captured and recorded.</p> <p>Coordination with archives, recordkeeping or the library is not in place to apply and monitor existing rules.</p>	<p>The management of information is documented in job descriptions.</p> <p>Staff have the knowledge and skills to manage information and records.</p> <p>Somebody has defined and designed metadata and workflows which ensure that information is captured with quality metadata, filed and recorded appropriately.</p> <p>Coordination and links or boundaries with archives, recordkeeping and library are in place and enables efficiencies.</p>
<i>Governance</i>	<p>The importance or business value of this information for DRR goals is not specified.</p> <p>Business information categories with templates, classification and other criteria are missing or not applied.</p> <p>Metadata and filing or recordkeeping rules and mechanisms or criteria are missing or not applied.</p> <p>Compliance is not monitored nor managed.</p> <p>Leadership does not know about information challenges or they are not considered important.</p>	<p>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.</p> <p>Templates are in place and used including opportunities to enable metadata automation</p> <p>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.</p> <p>Compliance is monitored and missing updates or lack of compliance are managed.</p>

		Leadership is using and promoting information for different purposes.
<i>Processes</i>	The workflow for managing and updating the data, including quality control, is not defined, and documentation such as procedures are missing.	The workflow for managing information including metadata, filing, quality control and other aspects are defined and established. Documentation such as procedures are in place and up to date. Training has been provided to enable information management efficiently and effectively.
<i>Technology</i>	Automation with workflow design and support tools are missing to embed the data updates with timely reminders and consequences.	Metadata creation is automated and support tools are in place. A workflow or business process tool is supporting the information management with monitoring, check points and consequences.

b) Why is data outdated?

Table 2: IG for updating data

<b>Updating data</b>	<b>Without IG</b>	<b>With IG</b>
<i>People</i>	Nobody has the role, responsibility, and accountability to update the data. Nobody has defined and designed the process which ensures that data is updated.	The update of (specific) data is documented in job descriptions. Staff have the knowledge and skills to update the data. Somebody has defined and designed a workflow which ensures that data is updated.
<i>Governance</i>	The importance or business value of this data for DRR goals, including respective updates or business requirements are not specified. Compliance is not monitored nor managed. Leadership does not know about data gaps and challenges or they are not considered important.	The data is aligned with DRR goals which clarifies the value and importance of the data. This includes emphasis on update requirements. Compliance is monitored and missing updates or lack of compliance are managed. Leadership is using and promoting current and relevant data for different purposes.
<i>Processes</i>	The workflow for managing and updating the data, including quality control, is not defined.	The workflow for managing and updating the data is defined and established, including effective quality control.

	Documentation such as procedures are missing.	Documentation such as procedures are in place and up to date.
		Training has been provided to enable data updates efficiently and effectively.
<i>Technology</i>	Automation with workflow design and support tools are missing to embed the data updates with timely reminders and consequences.	A workflow or business process tool is supporting the data management and respective updates with monitoring, timely reminders and consequences.

## Benefits of Information Governance and Information Coherence

IG can mobilise significant value and benefits for disaster information and its coherence. In fact, incoherent information generates about **20% productivity loss**, with respective time and expenses, when information is *not* managed well<sup>25</sup>. Workers spend more than a quarter of their time

searching for information, often without success. Between **50 to 80% of our data is not used at all**, due to its missing structure and lack of organisation<sup>26, 27</sup>. This creates significant **costs and risks** for DRM operations, for IT maintenance and security, and for each staff individually.

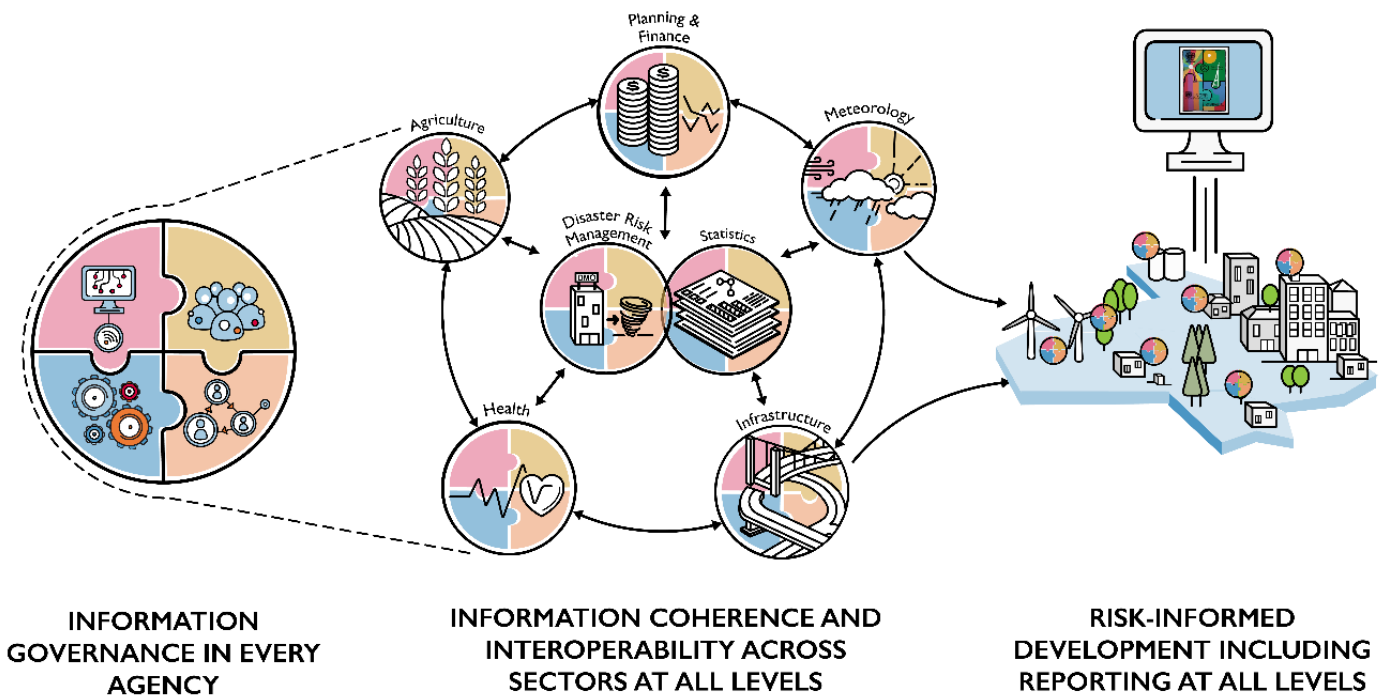


Figure 2: Information Governance for Risk-informed Development



IG can enable efficiencies and coherence such as **entering data once and reusing it many times** instead of re-entering data manually in different systems at the local, national, and global level. IG can **mobilise information coherence through well-designed digital processes** which comprise timely updates, validation, analysis, visualisation, and quality control for the same data or information across different purposes and stakeholders. It means **more reliability and less uncertainty** of data and information, together with less manual and time intensive tasks. Figure 3 illustrates IG for risk-informed development.

IG can strengthen the availability and access of identified information assets while reducing duplication. This means **faster access to existing quality information and retained organisational knowledge products** such as briefings, lessons learnt, reports, data and analysis, which cannot be replaced by general or commercial information

sources from search engines. It also enables new staff to be faster, more productive and effective. Information professionals can create and add value, while providing a **return on their investment** through better and faster information and knowledge with support and services for everyday business.

In conclusion, IG represents **good organisational governance practice to identify and address persistent challenges** with DRM and DRR data and information. In addition to technology, **people, governance, and processes are essential to transform digital information assets into operational knowledge** and practical value for risk informed development. Only with all four IG components effectively in place, synergies and **information coherence can be mobilised for coherent DRM and DRR action** including the planning, implementation, and reporting in line with local, national, and global development agendas.

## Selected Case Studies and Examples

For more information, please consult the following case studies and examples:

- [Information governance \(2020\)](#)<sup>28</sup>
- [Data interoperability maturity model \(DIMM\) \(2020\)](#)<sup>29</sup>
- [FAIR \(findable, accessible, interoperable and reusable\) principles \(2020\)](#)<sup>30</sup>
- [Metadata \(2020\)](#)<sup>31</sup>
- [Data responsibility guidelines \(2019\)](#)<sup>32</sup>
- [Data Management Body of Knowledge \(DMBOK\) \(2019\)](#)<sup>33</sup>
- [Principles for digital development \(2019\)](#)<sup>34</sup>
- [The role of data and information exchanges in transport system disaster recovery: A New Zealand case study \(2019\)](#)<sup>35</sup>
- [Australian natural hazards exposure information framework \(2018\)](#)<sup>36</sup>
- [Constructing a data reliability framework for the natural hazard exposure information system \(2018\)](#)<sup>37</sup>
- [Data Communication for Efficient Water Resource Management Among Multiple Stakeholders—A Case Study in the Bago River Basin, Myanmar \(2018\)](#)<sup>38</sup>
- [The Handbook on Water Information Systems; Administration, Processing and Exploitation of Water-related Data \(2018\)](#)<sup>39</sup>
- [Information management and data capabilities \(2018\)](#)<sup>40</sup>
- [Information Management Maturity Measurement tool \(IM3\) \(2018\)](#)<sup>41</sup>
- [Specific Hazards: Handbook on Geospatial Decision Support in ASEAN Countries \(2017\)](#)<sup>42</sup>
- [Information and Knowledge Management for Climate Change \(IKM4CC\) Guidelines \(2016\)](#)<sup>43</sup>
- [Information and Knowledge Management for DRR \(IKM4DRR\) Framework and Score-card \(2013\)](#)<sup>44</sup>

## References

- <sup>1</sup> 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>
- <sup>2</sup> United Nations Office for Disaster Risk Reduction (UNISDR). (2017). Disaster-related data for sustainable development: Sendai Framework Data Readiness Review 2017; Global Summary Report. Retrieved from <https://www.unisdr.org/we/inform/publications/53080>
- <sup>3</sup> Global Initiative on Disaster Risk Management (GIDRM). (2020). What is coherence? Retrieved from <https://www.gidrm.net/en/coherence>
- <sup>4</sup> Australia. Queensland Government Enterprise Authority (QGEA). (2018). Information (Definition). Retrieved from <https://www.qgcio.qld.gov.au/publications/qgea-glossary/information-definition>
- <sup>5</sup> Vu, Q. A. N., Hassas, S., Armetta, F., Gaudou, B., & Canal, R. (2011, October). Combining trust and self-organization for robust maintaining of information coherence in disturbed MAS. In 2011 IEEE Fifth International Conference on Self-Adaptive and Self-Organizing Systems (pp. 178-187). IEEE. Retrieved from [https://www.researchgate.net/profile/Benoit\\_Gaudou/publication/224265059\\_Combining\\_Trust\\_and\\_Self-Organization\\_for\\_Robust\\_Maintaining\\_of\\_Information\\_Coherence\\_in\\_Disturbed\\_MAS/links/09e4150ed4fd319313000000.pdf](https://www.researchgate.net/profile/Benoit_Gaudou/publication/224265059_Combining_Trust_and_Self-Organization_for_Robust_Maintaining_of_Information_Coherence_in_Disturbed_MAS/links/09e4150ed4fd319313000000.pdf)
- <sup>6</sup> United Nations Office for Disaster Risk Reduction (UNDRR, former UNISDR). 2013. Information and Knowledge Management for Disaster Risk Reduction (IKM4DRR) Framework and Scorecard. Retrieved from <https://www.preventionweb.net/publications/view/35238>
- <sup>7</sup> International Organization for Standardization (ISO). (2018). ISO 30401:2018 Knowledge management systems — Requirements. Retrieved from <https://www.iso.org/obp/ui/#iso:std:iso:30401:ed-1:v1:en>
- <sup>8</sup> World Health Organisation (WHO). (2019). Health emergency and disaster risk management framework. Retrieved from <https://www.who.int/hac/techguidance/preparedness/en/>
- <sup>9</sup> United Nations Development Programme (UNDP). (2017). Data ecosystems for sustainable development: An assessment of six pilot countries. P. 12. Retrieved from <https://www.undp.org/content/undp/en/home/librarypage/poverty-reduction/data-ecosystems-for-sustainable-development.html>
- <sup>10</sup> Internews. (2015). Why information matters. A foundation for resilience. Retrieved from <https://internews.org/resource/why-information-matters-foundation-resilience>
- <sup>11</sup> Mackay, S., Brown, R., Gonelevu, M., Pelesikoti, N., Kocovanua, T., Iaken, R., ... & Mackey, B. (2018). Overcoming barriers to climate change information management in small island developing states: lessons from Pacific SIDS. *Climate Policy*, 19(1), 125-138. DOI: 10.1080/14693062.2018.1455573. Retrieved from <https://www.pacificclimatechange.net/sites/default/files/documents/Overcoming%20barriers%20to%20climate%20change%20information%20management%20in%20small%20island%20developing%20states%20lessons%20from%20pacific%20SIDS.pdf>
- <sup>12</sup> National Archives of Australia. (2019). Information governance. Retrieved from <http://www.naa.gov.au/information-management/information-governance/>
- <sup>13</sup> Regional Consultative Committee on Disaster Management (RCC). (2019). Policy brief: Coherence across global frameworks; policy paths. Retrieved from <https://www.gidrm.net/user/pages/03.get-started/03-re-sources/files/RCC%20Policy%20Brief%20on%20Coherence.pdf>
- <sup>14</sup> United Nations Development Group (UNDG). [2017]. Data privacy, ethics and protection: Guidance note on big data for achievement of the 2030 Agenda. Page 7. Retrieved from [https://unsdg.un.org/sites/default/files/UNDG\\_BigData\\_final\\_web.pdf](https://unsdg.un.org/sites/default/files/UNDG_BigData_final_web.pdf)
- <sup>15</sup> Systems Innovation. (2018). Dark data analytics. Retrieved from <https://www.youtube.com/watch?v=GHPgkumcils>
- <sup>16</sup> Institute for the Future (ITF). (2020). Work and learn futures. Retrieved from <https://www.iftf.org/our-work/global-landscape/work-learn-futures/>



- 
- <sup>17</sup> SFIA Foundation. (2019). Skills framework for the information age (SFIA): Skills at a glance. Retrieved from <https://sfia-online.org/en/sfia-7/sfia-views/full-framework-view?path=/glance>
- <sup>18</sup> Porter, J. J., & Birdi, K. (2018). 22 reasons why collaborations fail: Lessons from water innovation research. *Environmental Science & Policy*, 89, 100-108. <https://doi.org/10.1016/j.envsci.2018.07.004> . Retrieved from <http://eprints.whiterose.ac.uk/134105/10/1-s2.0-S1462901117313011-main.pdf>
- <sup>19</sup> Y. Duan, G. Fu, N. Zhou, X. Sun, N. C. Narendra and B. Hu, "Everything as a Service (XaaS) on the Cloud: Origins, Current and Future Trends," *2015 IEEE 8th International Conference on Cloud Computing*, New York, NY, 2015, pp. 621-628, doi: 10.1109/CLOUD.2015.88. Retrieved from <https://ieeexplore.ieee.org/abstract/document/7214098>
- <sup>20</sup> CIO Wiki. (2020). XaaS (Everything as a Service). Retrieved from [https://cio-wiki.org/wiki/XaaS\\_\(Everything\\_as\\_a\\_Service\)](https://cio-wiki.org/wiki/XaaS_(Everything_as_a_Service))
- <sup>21</sup> Sharma, V. K., Amminedu, E., Rao, G. S., Nagamani, P. V., Mohan Rao, K. R., & Bhanumurthy, V. (2017). Assessing the potential of open-source libraries for managing satellite data products—A case study on disaster management. *Annals of GIS*, 23(1), 55-65. Retrieved from <https://www.tandfonline.com/doi/full/10.1080/19475683.2016.1231718?src=recsys>
- <sup>22</sup> Xu, J. (2020). Machine learning-based damage assessment for disaster relief. [AI Google Blog, 2020, June 16]. Retrieved from <https://ai.googleblog.com/2020/06/machine-learning-based-damage.html>
- <sup>23</sup> Manyika, J. & Sneider, K. (2018). AI, automation and the future of work: Ten things to solve for. Retrieved from <https://www.mckinsey.com/featured-insights/future-of-work/ai-automation-and-the-future-of-work-ten-things-to-solve-for>
- <sup>24</sup> Cam, A., Chui, M., & Hall, B. (2019). Global AI Survey: AI proves its worth, but few scale impact. Retrieved from <https://www.mckinsey.com/featured-insights/artificial-intelligence/global-ai-survey-ai-proves-its-worth-but-few-scale-impact#>
- <sup>25</sup> Price, J. (2019). Why managing Information Assets badly is negligent. Retrieved from <https://www.experience-matters.com.au/wp-content/uploads/2019/04/Benefits-of-managing-Information-Assets-well-190412.pdf>
- <sup>26</sup> M-Files. (2020). 100 Information management statistics that will blow your mind. Retrieved from <https://go.m-files.com/WC-ABM-Working-Remotely-eBook-100-Info-Mgmt-Stats-EN-US.html>
- <sup>27</sup> Taulli, T. (2019). What you need to know about dark data. Retrieved from <https://www.forbes.com/sites/tom-taulli/2019/10/27/what-you-need-to-know-about-dark-data>
- <sup>28</sup> National Archives of Australia. (2020). Information governance. Retrieved from <https://www.naa.gov.au/information-management/information-governance>
- <sup>29</sup> National Archives of Australia. (2020). Data interoperability maturity model. Retrieved from <https://www.naa.gov.au/information-management/data-interoperability-maturity-model>
- <sup>30</sup> GO FAIR International Support & Coordination Office (GFISCO). (2020). FAIR principles. Retrieved from <https://www.go-fair.org/fair-principles/>
- <sup>31</sup> Australian Research Data Commons (ADRC). (2020). Metadata. Retrieved from <https://ardc.edu.au/wp-content/uploads/2020/03/Metadata.pdf>
- <sup>32</sup> United Nations Office for the Coordination of Humanitarian Affairs (OCHA). Centre for Humanitarian Data. (2019). Data responsibility guidelines: Working draft. Retrieved from <https://centre.humdata.org/introducing-the-working-draft-of-the-ocha-data-responsibility-guidelines/> and PDF download <https://centre.humdata.org/wp-content/uploads/2019/03/OCHA-DR-Guidelines-working-draft-032019.pdf>
- <sup>33</sup> Data Management Association (DAMA). (2019). Data Management Body of Knowledge (DMBOK). Retrieved from <https://www.dama.org/cpages/body-of-knowledge>
- <sup>34</sup> Digital Principles. (2019). Principles for digital development. Retrieved from <https://digitalprinciples.org/>
- <sup>35</sup> Blake, D. M., Stevenson, J., Wotherspoon, L., Ivory, V., & Trotter, M. (2019). The role of data and information exchanges in transport system disaster recovery: A New Zealand case study. *International Journal of Disaster Risk Reduction*, 101124. DOI <https://doi.org/10.1016/j.ijdrr.2019.101124>. Retrieved from <https://www.sciencedirect.com/science/article/pii/S2212420918314699>

- 
- <sup>36</sup> Nadimpalli, K., Mohanty, I., Vidyattama, Y., Kalantari, M., & Rajabifard, A. (2018). Australian natural hazards exposure information framework. Retrieved from <http://www.bnhcrc.com.au/publications/biblio/bnh-5215>
- <sup>37</sup> Vidyattama, Y. (2018). Constructing a data reliability framework for the natural hazard exposure information system. Retrieved from <http://www.bnhcrc.com.au/publications/biblio/bnh-5213>
- <sup>38</sup> Shirai, N., Bhagabati, S. S., Kodaka, A., Kohtake, N., Kawasaki, A., Acierto, R. A., & Zin, W. W. (2018). Data Communication for Efficient Water Resource Management Among Multiple Stakeholders—A Case Study in the Bago River Basin, Myanmar—. *Journal of Disaster Research* Vol, 13(1), 71. Retrieved from [https://www.researchgate.net/publication/323291938\\_Data\\_Communication\\_for\\_Efficient\\_Water\\_Resource\\_Management\\_Among\\_Multiple\\_Stakeholders\\_-\\_A\\_Case\\_Study\\_in\\_the\\_Bago\\_River\\_Basin\\_Myanmar\\_-](https://www.researchgate.net/publication/323291938_Data_Communication_for_Efficient_Water_Resource_Management_Among_Multiple_Stakeholders_-_A_Case_Study_in_the_Bago_River_Basin_Myanmar_-)
- <sup>39</sup> Haener, P. et al. (Ed.) & International Network of Basin Organizations (INBO). (2018). *The Handbook on Water Information Systems; Administration, Processing and Exploitation of Water-related Data*. Retrieved from <https://www.inbo-news.org/en/documents/handbook-water-information-systems-administration-processing-and-exploitation-water> and <https://www.riob.org/sites/default/files/documents/Handbook%20Water%20Informations%20Systems.pdf>
- <sup>40</sup> National Archives Australia. (2018). Information Management and data capabilities. Retrieved from <http://capabilities.naa.gov.au/>
- <sup>41</sup> Public Record Office Victoria, Australia. (2018). Information Management Maturity Measurement tool (IM3) with instructions, questionnaire and development documentation Retrieved from <https://prov.vic.gov.au/recordkeeping-government/learning-resources-tools/information-management-maturity-measurement-tool-im3>
- <sup>42</sup> United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). (2017). *Specific Hazards: Handbook on Geospatial Decision Support in ASEAN Countries*. P. 10. Retrieved from <https://www.unescap.org/publications/specific-hazards-handbook-geospatial-decision-support-asean-countries-0>
- <sup>43</sup> Griffith University and SPREP 2016, *Information and Knowledge Management for Climate Change (IKM4CC) Guideline 4: Metadata – Documenting and Describing Information*. Griffith University, Brisbane. Retrieved from <https://www.pacificclimatechange.net/document/information-and-knowledge-management-climate-change-ikm4cc-complete-set>
- <sup>44</sup> United Nations Office for Disaster Risk Reduction (UNISDR). (2013). *Information and Knowledge Management for DRR (IKM4DRR) Framework and Scorecard*. Retrieved from [http://www.unisdr.org/files/35238\\_ikm4drframe-workscorecard.pdf](http://www.unisdr.org/files/35238_ikm4drframe-workscorecard.pdf)