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Recording Disaster Losses

Recommendations for a European approach

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ABSTRACT

In a study commissioned by Directorate General Humanitarian Aid and Civil Protection of the European Commission, the Joint Research Centre formulates technical recommendations for a European approach to standardize loss databases. Loss data are useful for the implementation of disaster risk reduction strategies in Europe (from local to national scales) and to help understand disaster loss trends at global level.

Taking stock of existing work, the study defines a conceptual framework for the utility of loss data which allows a cost-benefit analysis of implementation scenarios. The framework considered loss accounting, disaster forensics and risk modelling as key applications. Depending on the scale (detail of recording) and scope (geographic coverage), technical requirements will be more or less stringent, and costs of implementation will vary accordingly.

The technical requirements proposed in this study rely as much as possible on existing standards, best practices and approaches found in literature, international and national organisations and academic institutions. The requirements cover very detailed recording (at asset level) as well as coarse scale recording. Limitations and opportunities of existing EU legislation are considered as the EU context.

EXECUTIVE SUMMARY

The Hyogo Framework for Action foresees as one of the priority actions to identify, assess and monitor disaster risks. The EU disaster prevention framework promotes improvements in the knowledge base for disaster management including disaster loss databases. It is widely recognized that risk assessment requires accurate recording of previous disasters and in particular the associated losses in terms of human casualties, property and environment damage as well as economic loss.

The European Commission DG for Humanitarian Aid and Civil Protection (DG ECHO) requested the JRC to perform a critical review of existing activities and standards for disaster loss databases at international level (including work and publications of UNISDR, IRDR, CRED, UNDP/GRIP, US), at EU level (including existing policy on civil protection, solidarity funds and INSPIRE data exchange legislation), and at Member State level. The main objective was to establish recommendations for the development of EU guidelines for recording disaster losses. There are two main goals for the European Union: first, to find a mechanism to record systematically the losses in the European territory, and second, to supply European loss data to international initiatives at providing global loss trends.

The study identifies the requirements – in terms of required detail of loss data – for policies in Europe and international activities (notably the Hyogo Framework for Action). They are captured within three application areas which become the basis of the EU conceptual model:

- **disaster loss accounting** – the primary motivation for recording disaster loss with the aim to document the trends and aggregate statistics informing local, national and international disaster risk reduction programmes;
- **disaster forensics** – which identifies the causes of the disaster through measuring relative contribution of exposure, vulnerability, coping capacity, mitigation and response to the disaster, with the aim to improve disaster management from lessons learnt; and
- **risk modelling** – which aims to improve risk assessment and forecast methods, for which loss data are needed for calibrating and validating model results in particular to infer vulnerabilities.

The information of losses required for the three applications are overlapping but differing in granularity ranging from detailed loss at asset level, through aggregate statistics or estimates at municipality, regional and national level, and all the way to globally aggregated trends and statistics. To be cost effective, the scale (granularity) of recording losses and the scope (coverage) of loss databases should be optimized based on the requirements of the application area. The scale and the scope of methodologies of many existing loss databases were analysed in terms of fitness for the three of the application areas.

Further, JRC considered alternatives for development of a European approach by taking stock of existing international experiences and existing EU laws. The current document provides the analysis of the uses of loss data as well as technical requirements for the database design and different scenarios for implementing loss databases in a country.

The technical requirements are outlining the principles of the conceptual model. The EU's ambition is to record loss data at fine scale and to manage them globally. To achieve interoperability with other international databases, recording losses at regional/national scale and managing them at global scope would be sufficient. Nevertheless, to provide guidance to EU Member States who wish to record losses at finer scale, the framework for EU methodology should be standardized at asset level.

The aim of the recommendation is:

- to provide a framework that satisfies the principles of the EU conceptual model,
- to propose different levels at which the standard can be developed and to explain the consequences of its applicability,
- to give enough freedom to Member States to decide which application areas are of their interest,
- to provide guidance to Member states in their choice of implementation,
- to show the way of harmonisation of the loss data at international level, and
- to consider implementation aspect, including data sharing and quality assurance mechanism.

This document is the result of a 3-month study based on literature review, interviews and meetings with selected professionals. The document is a preliminary step that will be followed by the engagement and the active involvement of EU Member States. It recommends that a formal discussion forum should be created where a consensus can be built among stakeholders on the scope and the technical definition of the standard.

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CONTENT

1 WHY LOSS DATA?

Graphics, pictures and descriptions of the devastating effects of disasters are routinely presented to the public and policy makers. However, not only scientist and practitioners but increasingly also **policy makers** and the general public have started to questions the reliability of this information. It is often asked if those upwards trends from existing statistics is due to more scrupulous reporting and data availability, or the perception of increased dangerous world that we have to deal with and adapt to. Or, is it related to more frequent and more severe hazardous natural phenomena or to the increase in population and assets at risk that lead to more potential for losses as before (Figure 1-Figure 2). And if we have to adapt to a more dangerous world will one be able to maintain and improve the protection we need against hazardous events? Similar questions are asked by **local authorities**, including mayors of small and large cities. Why did this event turn into a disaster? Which part of town has increasing losses and why? Are my disaster risk reduction measures paying off?

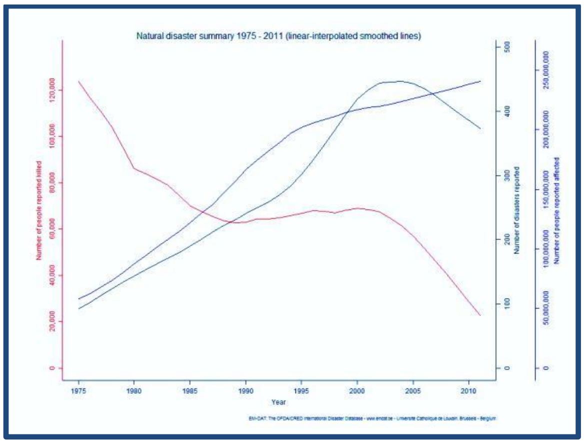

Figure 1: EM-DAT CRED – Trends in number of disasters, affected people and death toll[1].

Trends in loss data allows one to **measure progress in the path towards resilience** (Figure 3). A society resilient to natural hazards is one that can absorb hazardous events impact; that can distribute the risk among the different stakeholders; that can adapt to the changes in frequency and severity of hazards, as well as the continuous increase of assets, and continue to prevent disaster to happen. No measure better than loss over time can provide objective understanding of the path towards resilience. Resilience assumes risk management and risk management requires measurements of hazard exposure and losses. It is often said that what is not measured cannot be managed. As a consequence, a lack of loss data is an obstacle to understanding societal resilience.

[1] http://www.emdat.be/natural-disasters-trends.

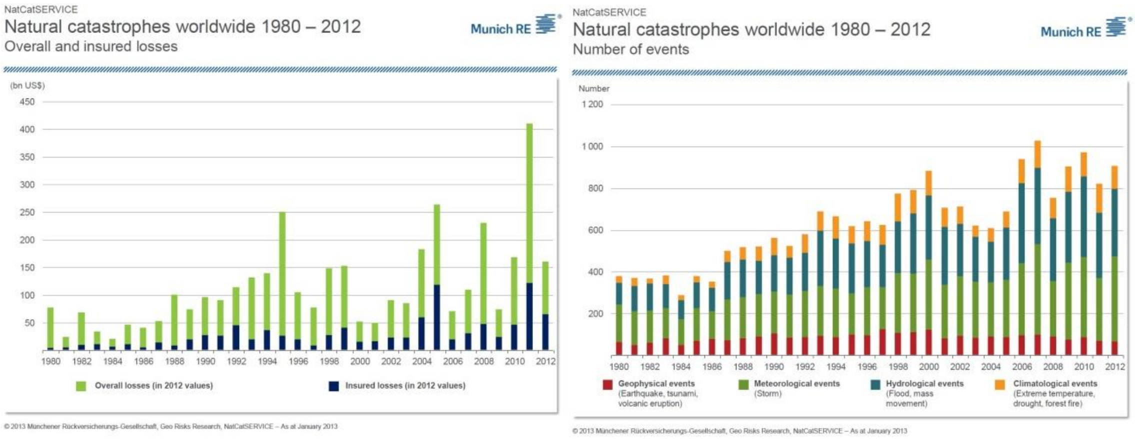

Figure 2: Munich RE: Trends in number of disasters and insured/overall losses[2].

Loss accounting is not new. International loss databases like EM-DAT have the credit to have initiated the process to maintain long term trends of essential statistics, i.e. following trends in human losses (Figure 1). Similar databases are available from Re-Insurance companies and others are maintained by UN bodies and national governments. Yet, despite the need for quantifying losses and the perceived abundance of data collected by government agencies, private insurance companies (Figure 2) and other organizations, **objective measurement of losses remains inadequate to understand the trends**. This is due to a number of reasons that include: the diversity of intent, the lack of agreed definitions, the lack of standardization on how to collect data, and last but not least a lack of legislation and accompanying funding measures to support mandated institutions.

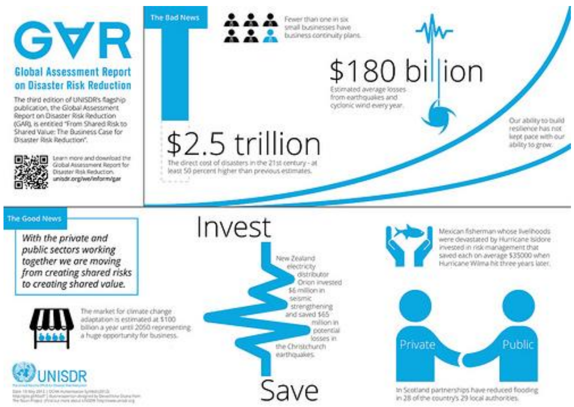

Figure 3: Example of how loss data is used as evidence for disaster risk reduction messages [50].

[2]http://www.munichre.com/en/reinsurance/business/non-life/georisks/natcatservice/default.aspx.

Loss accounting is part of the Hyogo framework for Action[3] [47], and is being considered in a more explicit manner for inclusion in the 2015 revised Hyogo Framework for Action. At international level loss data are collected in international projects including the Global Earthquake Model (GEM)[4], the Dartmouth Flood Observatory and are part of the research priorities of the Global Facility for Disaster Risk and Recovery (GFDRR)[5]. Improvements in current practices are addressed in international platforms including the Integrated Research on Disaster Risk's (IRDR) DATA (Disaster Loss Data) working group[6].

Establishing loss databases is common practice in many countries although not always in standard compatible formats. Many European Union Member States account for hazard losses through a number of institutions. Loss data accounting is supported by legislation that mandates the institutions and corresponding resources. Promoting improvements in the knowledge base for disaster management including disaster loss databases is a **key priority of the EU disaster prevention framework** agreed in EU Council conclusions of 30 November 2009 [6]. The European dimension of loss databases is particularly important to understand and manage the trans-boundary effects of disasters and to contribute to the international dimension.

Disaster management and loss accounting at the European level is also addressed in other policies.

- The **European Union Solidarity Fund** (EUSF)[7] was established to support countries that are affected by a disaster. European Union Member States may qualify for solidarity fund when the estimated losses due to natural hazard are larger than 3 billion € (as of 2002), or account for at least 0.6% of the GDP for that year or 0.03% of GDP for regions ([7], [15]).
- The **Flood Directive** [12] calls for establishing mechanisms to asses risk to flooding in Europe and to provide room for disaster risk reduction. Flood risk assessments require information on past floods to establish the probability of flood impact occurrence.
- The **INSPIRE Directive** [11][8] provides a standardization of terminology, and technical standards that apply also to natural disasters, as well as established methodologies to implement data standards at EU level.
- The Green Paper on **Insurance of Natural and Man-made Disasters** [17], on the potential for the European Union to facilitate and support increased coverage of appropriate disaster risk insurance and financial risk transfer markets, as well as regional insurance pooling.

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[3] Priorities set in the Hyogo Framework for Action: (i) Ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation; (ii) Identify, assess, and monitor disaster risks – and enhance early warning; (iii) Use knowledge, innovation, and education to build a culture of safety and resilience at all levels; (iv) Reduce the underlying risk factors; and (v) Strengthen disaster preparedness for effective response at all levels.

[4] Global Earthquake Model , http://www.globalquakemodel.org/

[5] Global Facility for Disaster Risk and Recovery, https://www.gfdrr.org/

[6] http://www.preventionweb.net/files/globalplatform/519467d593b82IRDR_DATA_Summary_April_2013.pdf

[7] http://ec.europa.eu/regional_policy/thefunds/solidarity/index_en.cfm

[8] Annex III of INSPIRE – spatial data themes 12 Natural risk zones (Vulnerable areas characterised according to natural hazards (all atmospheric, hydrologic, seismic, volcanic and wildfire phenomena that, because of their location, severity, and frequency, have the potential to seriously affect society), e.g. floods, landslides and subsidence, avalanches, forest fires, earthquakes, volcanic eruptions.)

The Commission is also supporting international efforts to improve disaster loss data and through Development Aid is co-funding the UNISDR to collect loss data in a number of developing countries as a part of resilience strategy [16].

This document aims to provide guidelines to establish loss data at the European level. There are two main goals at the European Union:

- to find a mechanism to record systematically the losses in the European Union territory,
- to supply European loss data to international initiatives aiming at providing global loss trends.

Summary: Loss data accounting is now in demand at all levels from national, to European and international. Many countries and institutions record loss data but there is no authoritative loss database that can provide a trend at European or global level. Due to the diversity of purposes and data collection procedure, available databases cannot be combined.

2 WHAT IS LOSS DATA?

Disaster loss databases systematically account for human, physical and economic losses. **Human losses** typically include casualties, injured and displaced persons as results of the disaster. The **direct physical damage**, damage to buildings and civil works [22], are quantified by engineers and typically translated by economists into **monetary loss**. Direct physical damage includes also that originating from damage to agricultural system and the natural environment. **Economic losses**, those that ensue from interruption of services and other economic activities, are usually grouped into three categories: **direct**, **indirect** (e.g., business interruption) and **macroeconomic effects** (e.g. loss of GDP). Most monetary loss assessments in post disaster events consider direct economic losses that relate to physical damage assessment. A physical damage assessment is used by governments and donors to address emergency and reconstruction needs and to settle insurance claims. Long term economic losses due to interruption of economic services and impact to the economy are more difficult to estimate and result in very variable estimates with high uncertainties [30].

Loss data are generated through systematic loss accounting based on pre-defined methodologies. Each loss database relies on a given procedure. For instance, a widely used methodology to address international catastrophe's is a **Damage and Loss Assessment (DALA)** developed by the UN Economic Commission for Latin America (ECLAC) in the 1970s [18]. It provides a standardized tool for the monetary evaluation of disaster damage (in physical assets, capital stock, material goods) and losses (in flows of goods and services, income, costs) that arise due to the temporary absence of the destroyed assets. The DALA highlights the possible impact of disasters on the growth of the national economy, the external sector and the fiscal balances, as well as the impact due to decline of income and livelihoods of households or individuals.

Another well-known methodology is developed by CRED[9]at Louvain University in Belgium and is implemented in the **Emergency Events Database (EM-DAT)**. It is an example of a scientific approach that focuses more on human loss indicators. They follow very strict data entry procedures using multiple sources (Table 18) and predefined entry criteria. CRED has established a method of ranking the sources according their ability to provide trustworthy and complete data. In the majority of cases, a disaster will only be entered into EM-DAT if at least two sources report the disaster's occurrence in terms of people killed or affected.

A third aspect of accounting the losses is highlighted by practices of **insurance companies** (e.g., Munich RE or Swiss RE) which are able to provide detailed economic losses both insured and uninsured attributable to the event. The entry criteria are adjusted to address disasters causing physical property damage and business interruption in the first place. Therefore they can be a valuable source for estimates of indirect losses.

It is important in making decisions about allocating resources to apportion the losses among all those who bear them (at least initially). In ECLAC [18] the distinction is made between public and private sector damage in order to determine where the weight of the reconstruction might fall.

[9] http://www.emdat.be/source-entry

In some cases this approach is not sufficiently detailed because in both sectors part of the loss is covered by insurance companies. A better approach [38] is to define the type of the owner (individuals, business, government, non-governmental organizations) and then also who bears the losses (individuals, business, government, non-governmental organizations and insurance companies).

The various dimensions of loss data will be discussed further on. For comparing or combining data from multiple sources, it is important to have standard terminology and definitions as well as a good understanding of which dimensions are considered in a methodology or database.

Summary: Loss data account for human, physical and economic losses. There are a number of methodologies that have been developed that mirror the purpose. However, there is no authoritative methodology that is taken up as model.

3 THEORETICAL MODELS OF LOSS DATABASES

Loss databases are established to track the expenditures ensuing from disasters and to plan disaster reduction strategies that may decrease the human, physical and economic losses in the future. That goal is best addressed at national and subnational level by the governmental departments or institutions addressing crisis management. Local authorities benefit from detailed assessments for managing disaster risk, while national authorities (and global institutions) need aggregate statistics for optimizing disaster risk policies. In the absence of agreed standards, each institution defines its own methodology and data structure and resulting loss data is incompatible and cannot be compared or aggregated.

Loss data are also collected with two other objectives: disaster forensics and disaster risk assessments. Forensic studies are conducted to better understand the unfolding of a disaster and identify lessons learnt. Deterministic and probabilistic disaster risk studies aim to address respectively high risk areas in order to prioritize disaster mitigation measures, and event return periods to quantify future disruptions. In both cases loss data play a critical role for identifying the vulnerabilities at stake.

Establishing loss databases rests with the legislation and policies implemented at national and/or sub-national level. Routine loss data collection – in particular with high level of detail – demands resources, and can only be justified if required by one (or more) policies. In this section, we develop a theoretical framework that will allow us to link technical requirements of loss databases and loss recording methodologies with policies and application areas. It is meant to bring insight into fitness of use for existing databases and design requirements for new systems.

3.1 Conceptual model: 3 application areas

There are at least three applications that require information on losses. The loss data are used for loss accounting, for forensic analysis of disasters, and for disaster risk modelling. The information required for the three application areas is overlapping, even if the forensic and modelling applications require information at higher detail (Figure 4).

3.1.1 Disaster Loss Accounting

Loss accounting is the principal motivation for recording the impact of hazards and aims to document the trends. Loss accounting also allows for spatial comparison. The information will have to be available at different levels: decision makers at local level (i.e. mayor as responsible for the risk mitigation measures), at the subnational level, at the national level for fund allocation for addressing disaster reduction and for mitigation and at the international level for international financial and humanitarian aid.

Most existing loss databases at global level are intended for loss accounting. For instance, the UNISDR Global Assessment Report uses globally aggregated loss statistics to assess needs and improvements (trends) in disaster risk reduction. The most cited loss database, EM-DAT (see further), aims at providing an objective base for vulnerability assessment and priority setting. In Europe, the Solidarity Fund is triggered based on loss accounting[10].

For loss accounting, the main requirements are the use of standard definitions, transparent handling of uncertainty as well as comprehensiveness. The aim is to have consistent databases that can be aggregated at higher level up to global level data for statistical analysis.

3.1.2 Disaster Forensics

Disaster forensics analyses the unfolding of a disaster and identifies its causes. From the lessons learned, experts and decision makers may guide the reconstruction process and, most importantly, quantify risk and implement risk reduction and mitigation measures for areas with similar characteristics and risks.

Typical examples are the Post Disaster Needs Assessment[11] process of the World Bank, United Nations and European Union, where the partners collaborate and develop a common approach to post-crisis needs assessments and recovery planning. In Europe, most large disasters are followed by detailed evaluations, and in particular for using the Solidarity Fund a structured damage assessment is required. Recent examples include the earthquakes in l'Aquila (2009) and in Modena in Italy (2012), the eruption of Eyjafjallajökull in Iceland (2010) and the floods in the United Kingdom (2007), each triggering forensic studies and subsequent changes to emergency management practices.

The emphasis in disaster forensics is on a sectorial approach to assess direct and indirect losses per sector, as well as a breakdown by who bears the loss. While there are some differences, both the DALA method (from ECLAC) and the Solidarity Fund method are compatible.

3.1.3 Disaster Risk Modelling

Risk modelling aims to improve risk assessments and forecast methods. Loss data are used to infer vulnerabilities and to identify sectorial areas for disaster risk reduction and mitigation measures. More details on the spatial, temporal and quantitative uncertainty are required to match recorded losses with results of detailed hazard models. For instance, a single tsunami wave generates different inundation heights along the coast (depending on local bathymetry); for validation tsunami models or inferring structural vulnerability to tsunami waves, the precise location of damaged houses (notably position along coastline and height above sea level) is necessary to link the impacts to the model results.

Examples include risk modelling in the Global Assessment Report of UNISDR, work undertaken in the Global Earthquake Model (GEM) and EU policy on harmonized risk assessment [6]. Loss data are used in each of these examples to calibrate and validate models.

[10] The application form for the Solidarity Fund has a sectorial approach and is available at http://ec.europa.eu/regional_policy/thefunds/solidarity/index_en.cfm#1

[11] http://www.undp.org/content/brussels/en/home/partnerships_initiatives/results/EU-UNDP-PDNA.html

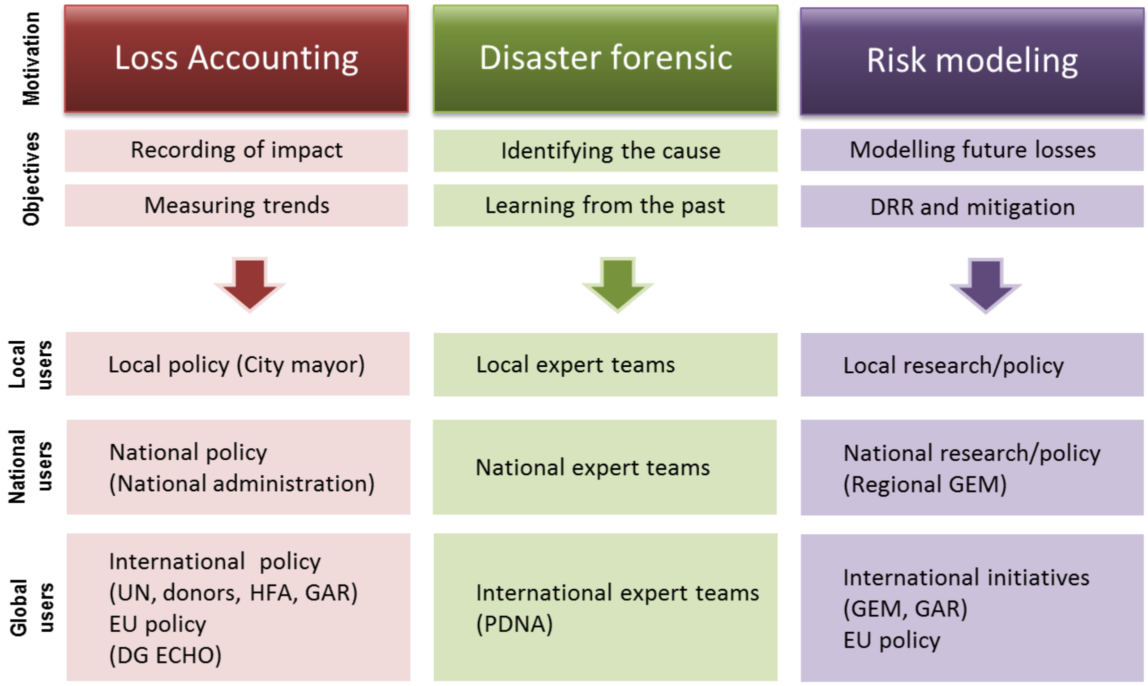

Figure 4: Conceptual model of application areas for loss data (JRC, 2013).

3.2 Scale and Scope

Disasters come in different sizes. The public and policy makers are mostly informed on the outcome of mass disasters: those disasters that receive the attention of international media. In fact, most of the disasters occur at more limited geographical space and this depends on the hazard that triggers them. For example, landslides are geographically local but are very widespread across the globe. The cumulative losses of landslides may be very high even if landslides seldom make it to the news. High intensity earthquakes fortunately are much less frequent even if the cumulative impact of smaller earthquake events may be equally large. Other examples include pandemics (only in rare cases more than 100 000 casualties) versus seasonal epidemics (seasonal flue causes between 250 000 and 500 000 casualties per year[12]). MunichRe estimates[13] that tropical cyclones represent about half of the windstorm damage, while up to 43% is caused by smaller thunderstorms (2010 figures in the US).

Figure 5 shows a schematic diagram of the frequency of events related to the geographical area where they occur and the administrative boundaries within which these may be recorded. The comprehensiveness of a disaster loss database will depend on the cut-off threshold for entering events.

[12] http://www.who.int/mediacentre/factsheets/fs211/en/
[13] http://www.munichre.com/en/media_relations/press_releases/2012/2012_10_17_press_release.aspx

3.2.1 Scope, or coverage

The recording of the losses may occur at the very detailed level or more generally at coarser geographical units. Figure 6 shows that damaging events can be recorded at the asset level, at municipality level, or at coarser regional or national level. Losses are also made available at global level for global comparison and trend analysis. These five geographical levels – asset, municipality, regional, national and global level – are identified on the horizontal axis of Figure 6 to Figure 7 and are referred to as the **scope**. The geographical levels are useful also to identify the geographical extent of the disaster. Disaster outcomes may affect more than one asset and more than one municipality or even region. Mass disasters typically extend beyond municipalities and regions. Most of the international databases do not record disasters at local or municipal level – those with spatial extent below the region – failing therefore to provide an accurate assessment of global losses.

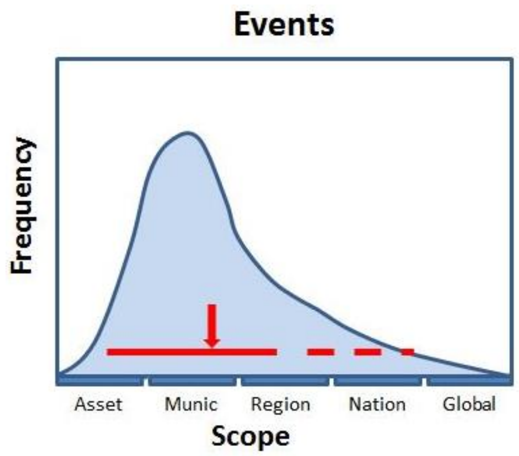

Figure 5: A conceptual representation of frequency of disastrous events related to their geographical extent (JRC, 2013).

3.2.2 Scale, or granularity

Successful establishment of loss databases is strictly related to the collection process of loss data. There cannot be precise statistics on disaster losses if there is no detailed data collection methodology. The GAR 2013 report showed that moving from global to national databases increased global loss estimates by 50% [50].

The detail of recording is expressed in this document as the **scale**. Scale is often referred also as granularity. It provides an indication of the precision of the measurement. Figure 6 shows a scatter plot using horizontal axes as the scope with the 5 geographical levels and the vertical axes as the scale with the 5 geographical levels. The asset - on the vertical axes - refers to measurement of the damages performed at the building level (the asset). That is typically measured in insurance claims. Information may be aggregated to the municipality level and then regional or national level. Its precision, or scale, is still at the asset level. The information is simply aggregated.

Loss measurements may be carried out at coarser spatial scales (vertical axes), for example with estimates at the municipality level, regional and national level. The information may be collected at the municipality level by civil protection officials or disaster experts that provide an overview assessment based on rapid field surveys using sampling techniques. The same assessment with even less precision may be carried out at the regional level. Alternative loss analysis may be also carried out through remote sensing techniques, which, depending on the type of imagery used, can also provide physical damage assessment to a certain extent. Moving from the asset level on the vertical axes up to the global level, the information may become less precise or more uncertain. In fact, loss data are often derived from media reports, unverified government figures, often provided only at regional or national level, that lack evidence-based measurements. These estimates are quickly generated as preliminary estimates of damage and often remain the only source of information and thus enter the international loss databases.

The link between scale and scope is important. The information can be collected at the asset level, and be very precise. The data can then be aggregated at the next geographical level (i.e., municipality) and further on at the regional and national level. The ideal database has national scope and local scale.

This is the case, for example, when the information is collected based on census information, or when citizens report themselves, like for insurance claims (although the latter's completeness depends on insurance penetration rates). Also crowdsourcing techniques are relevant here, although on must consider their strengths (capillarity, redundancy, timeliness) and weaknesses (non-homogeneity, low quality, difficult to screen). In these databases, the property's physical location, size and value are reported. The loss is a fraction of the total value. That information may be aggregated for every property but will remain highly accurate even when in aggregated form.

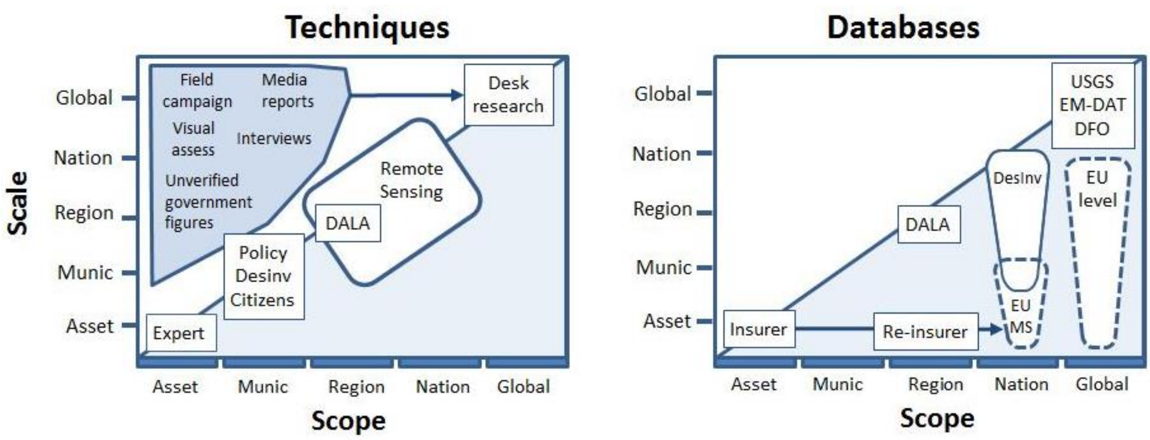

Figure 6: Scatter plots illustrating scope and granularity of information for loss data collection techniques and databases (JRC, 2013).

In reality, loss data are seldom collected at the level of the assets (e.g. damage level and reconstruction cost). Most of the time the data are estimated based on rapid surveys by professionals that provide estimates at the municipality levels (e.g. 10% of houses destroyed, 30% damaged). In mass disasters, when government functions are disrupted, and the mandated institutions are impaired, then the information may collected by external actors on an ad hoc basis without necessarily reporting at the municipality level (e.g. DALA methodology). The data may even be provided by government institutions at the regional or national level without a thorough systematic accounting.

3.2.3 Fitness for use

The three applications – accounting, forensics and risk modelling – often need overlapping loss information. However, the three areas differ by the scale and the scope of the information required.

3.2.3.1 Loss Accounting

Loss accounting is the most requested application for the establishing loss databases. It is in high demand for understanding global change issues as well as global comparisons as addressed in this document. However, loss accounting is implemented in many nations at all levels if nothing else for monitoring the success of the disaster reduction measures.

Accounting must rely on adequate loss information. For example, accounting at the local level requires loss data at the asset level. However, regional trends at regional level have also to rely on data collected at the municipality or regional. The precision must be related to the geographical area of aggregation and the precision or the error needs to be well documented. In Figure 7 only the data collected under the red area should be considered. Ideally all data should be made available with the finest detail and aggregated in standardized loss databases for comparison at a scale not coarser than the regional level.

Most applications for loss accounting are strategic, i.e. to guide global and national policy making. However, to be accurate enough, the collection of loss data is expected to be done at local level. But pure loss accounting is of little interest at local level (e.g. civil protection actors), which is one hurdle for establishing such databases. The organisations that are best positioned to record detailed losses have little benefit doing so. Linking loss accounting to other application with local benefit (such as forensics and risk modelling) may be a way to achieve this objective.

Many developing countries have not yet established mechanisms for loss accounting even if through the Hyogo protocol there are initiatives at the government level as well as the local level to establish loss databases.

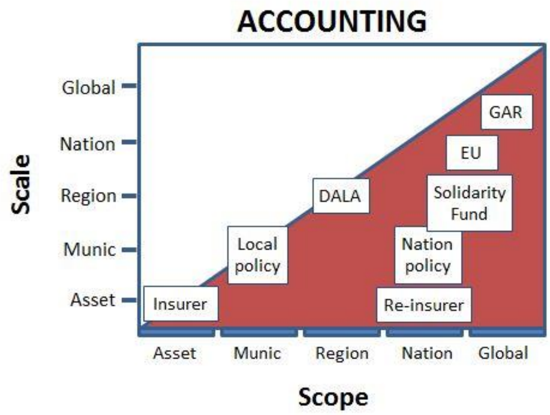

Figure 7: The scope and scale of loss data for loss accounting (JRC, 2013).

3.2.3.2 Disaster forensics

Forensics of disasters requires more detailed loss information. The losses need to be recorded with sufficient detail to understand the context of the disaster. For example, an analysis must show whether people were impacted because of an unforeseen complication (e.g. dike break during a hurricane), foreseeable exposure (e.g. living in the area of the 100 year return period of a storm surge), or inadequate disaster management (e.g. late or no evacuation). For small earthquakes with few casualties, conclusions for earthquake engineering should be different if they were caused by heart attacks or by collapsed structures.

The dynamics of the disaster may require the analysis also at coarse scale to pinpoint systemic failure in the disaster management system. For example, evaluation of responsibilities at the institutional level may be addressed at the regional and national scale. Figure 8 shows in green the area where loss data have enough precision for forensic applications.

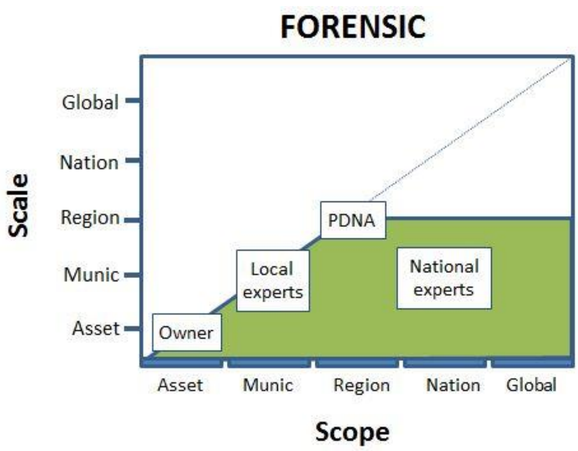

Figure 8: Loss data for forensic studies must be available at local scale (JRC, 2013).

3.2.3.3 Disaster risk modelling

Hazard modelling doesn't necessarily require loss data, but rather an understanding of the statistics of the physical processes. However, **disaster risk modelling** needs loss data to infer the vulnerability of society. The impact of hazards on infrastructure, people and society is too complex to model deterministically and relies instead on empirical models that are calibrated by hindcasting historical losses.

Disaster risk studies may be conducted at different geographical levels. Earthquake engineers need loss data – and in particular structural damage data – to improve earthquake engineering models, update building codes and recommend retrofitting solutions. Consequence analysis tools, as utilized in insurance and reinsurance industry, use statistical estimates of building and societal vulnerability that are derived from historical loss data. Global studies and models use empirical methods and proxy data for vulnerability that is largely based on loss data, including the Global Disaster Alert and Coordination System [9], [26], studies on European floods [2] and the Global Earthquake Model[14].

At the municipality level understanding risk is important to address mitigation of hazards, while at the regional level and national level it is important to address the funding required. Typically, the loss data needed as evidence must be at lower scale than the scope of the DRR actions. For instance, DRR actions at the municipality level may be addressing civil works such as the construction of levees for flood prevention. DRR actions at the regional or national level may address coordination plans of flood prevention or evacuation. The EU's ambition is to develop evidence-based disaster prevention policies at all levels of government: local, regional, national and EU level [6]. Figure 9 shows in violet the area under which numerical data have to be obtained.

There are also global risk modelling initiatives. For instance the Global Earthquake Model aims to provide risk at different geographical levels including the fine local level. These models are based on risk models that provide quantitative measures and thus require accurate numerical data.

The EU's aim is to provide Community guidelines on methods of hazard and risk mapping, assessments and analysis taking into account the work at national level and ensure the comparability among Member States [6]. Harmonised loss data are an essential element of this process.

[14] http://www.globalquakemodel.org/gem/mission/risk-assessment/

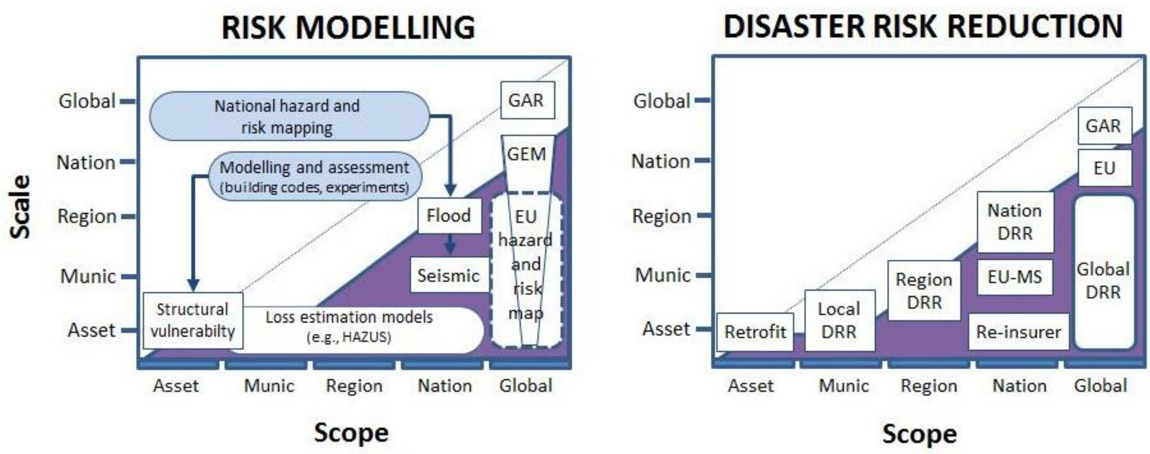

Figure 9: Loss data requirements for disaster risk studies (JRC, 2013).

The theoretical model presented in this section allows to evaluate existing databases for fitness for use for particular applications, or to understand the scale and scope – and the related investment – to develop new databases.

Summary: Loss databases need to be developed to monitor societal resilience and to implement disaster risk reduction measures. There are at least three linked application areas that require overlapping loss information: accounting, forensics and risk modelling. The three areas differ in scale (precision) and scope (coverage) requirements. A theoretical model allows to evaluate existing databases for fitness for use for particular applications, or to understand the scale and scope – and the related investment – to develop new databases. The key is to engage actors at local level to establish loss databases for operational use, which can then be aggregated at national and global level for strategic and policy making purposes.

4 ANALYSIS OF THE LANDSCAPE

The current landscape of systematic collection of loss data is varied, with actors from academic, private and governmental institutions. Know-how and expertise on loss data and their collection have been developed over many years in distinct communities. In general, there is a distinction in approach, purpose, scale and scope between global databases (EM-DAT, NatCatSERVICE, Sigma CatNet) and national databases (e.g. DesInventar). There is also a difference in methods used in data-rich countries (e.g. SHELDUS) and data-poor countries (mostly DesInventar). Less systematic loss collection occurs in hazard databases that include a loss component (e.g. Dartmouth Flood Observatory), and during dedicated but ad-hoc loss assessments for large disasters (PDNA's). There is also systematic loss accounting that is part of internal government procedures and that is not publicly shared (e.g. Slovenia). Some international working groups (including IRDR DATA) discuss progress and standardization in loss accounting.

4.1 Global loss databases

International loss databases have been established by different groups and often have a different purpose of reporting. They are typically multi-hazard global datasets. Some are focusing on humanitarian reporting while others focus on economic loss reporting. An overview of strengths and weaknesses is given in [52].

The main databases are:

- EM-DAT[15] (CRED[16]): a global database at national resolution with public access.
- NatCatSERVICE[17] (Munich RE): a global database at national resolution with no public access.
- Sigma CatNet Service[18] (Swiss RE): idem
- DesInventar: a national based accounting system and as such discussed in next section. However, given its implementation in a large number of countries it is becoming rapidly a global dataset and is used for example in the Global Assessment Report (GAR) on Disaster Risk Reduction 2011 [49].

EM-DAT is the first public available worldwide database on disasters. It is widely cited in policy documents and research analyses as in GAR 2011 [49]. It is maintained by CRED, the Centre for Research on the Epidemiology of Disasters, at Louvain University in Belgium with the initial support of US Aid and the World Health Organization. Loss accounting was initiated in 1988 to provide rapid and accurate information for humanitarian actions at national and international levels. CRED defines a disaster as "a situation or event which overwhelms local capacity, necessitating a request to a national or international level for external assistance; an unforeseen and often sudden event that causes great damage, destruction and human suffering". The database's entry criteria include: 10 or more people are reported killed, 100 or more people are reported affected, declaration of a state of emergency or call for international assistance. Its

[15] http://www.emdat.be/database
[16] CRED – Center for Research on the Epidemiology of Disasters
[17] http://www.munichre.com/en/reinsurance/business/non-life/georisks/natcatservice/default.aspx
[18] http://www.swissre.com/clients/client_tools/about_catnet.html

main strengths are is comprehensiveness and consistency over the years. Its main weaknesses are the lack of spatial reference, the relatively high threshold and a data collection approach primarily based on desk research.

Munich RE and Swiss RE are the two largest re-insurers in the world. They maintain loss databases to offer comprehensive information, tools and services in risk management and research to its branch offices and clients. The main interest lies in accurate numbers of material loss. NatCatService and Sigma CatNet service provide access of data to clients only. However, they regularly publish summary statistics of their data loss analyses.

EM-DAT data together with statistics from NatCatSevice and Sigma CatNet are often used to discuss losses trends. However, since the three databases were conceived and developed for different purposes and different clients, the data cannot strictly be compared. All three dataset suffer from incomplete data fields, and non-standardized definitions. Several attempts are underway to combine and align the loss recording of the three databases for future comparability [51].

4.2 Global hazard specific and multi-hazard datasets

There are number of specialized databases that monitor, collect and store data of specific hazard events from around the world. They are more hazard-based and mainly used for risk modelling; some also record hazard-specific losses with global coverage.

- Earthquakes: US Geological Survey[19] (USGS): Earthquakes with 1,000 or More Deaths since 1900; CATDATA[20] damaging earthquakes database and secondary effects.
- Floods: Dartmouth Flood Observatory (DFO)[21] at the University of Colorado: flood losses (killed, displaced, damage) since 1985.
- Tropical cyclones: Wikipedia portal for tropical cyclones[22]: comprehensive description of impact of cyclones; NOAA archives: National Climatic Data Center's monthly Storm Data publications[23].
- Tsunamis: NOAA/WDS Global Historical Tsunami Database[24], with total number of deaths, injuries and damage.
- Global Disaster Identifier Number (GLIDE)[25]: initiated as a mechanism to provide unique identifiers, it also allows recording losses that are associated to that given unique number.

Some examples of regional databases include:

- Technological disasters: Major Accident Reporting System (MARS)[26] reports about the industrial accidents in the European Union.

[19] http://earthquake.usgs.gov/earthquakes/world/world_deaths.php
[20] http://earthquake-report.com
[21] http://floodobservatory.colorado.edu/
[22] https://en.wikipedia.org/wiki/P:TC
[23] http://www.prh.noaa.gov/cphc/summaries/
[24] National Geophysical Data Center / (NGDC/WDS) Global Historical Tsunami Database, Boulder, CO, USA. (Available at http://www.ngdc.noaa.gov/hazard/tsu_db.shtml)
[25] http://www.glidenumber.net/glide/public/about.jsp

- European Forest Fire Information Systems (EFFIS)[27]: hosts a database on impacts of large forest fires in Europe.

These databases have mostly been collected by hazard experts, and loss data figures may not be accurate. The uncertainty associated with the estimates is not published.

4.3 National level losses

A number of countries systematically collect loss data and maintain multi-hazard loss databases at national level. We can identify 6 different distinct methodologies:

- DesInventar (La Red): depository of national databases collected on subnational/local level with public access. Currently, there are 45 databases (see annex 12.3), and this is currently being expanded to over 100 countries.
- Spatial Hazard Event and Loss Database for the US (SHELDUS)[28]: a county-level hazard data set for the U.S. for 18 different natural hazard events types since 1960. The database has public access, and is hosted by the Hazards & Vulnerability and Research Institute at the University of South Carolina.
- The Canadian Disaster Database[29]: a national database for Canada, province/territory resolution with public access, with records from 1900.
- Emergency Management Australia Disasters Database[30]: a national database for Australia, regional resolution with public access, with records from 1622.
- Disaster Incidence Database[31] of Bangladesh (DIDB): a national database for Bangladesh, district resolution.
- Calamidat Disaster Event Database of Philippines[32]: a national database of Philippines.
- UNDP is working with national governments to establish loss recording systems in Bolivia and China.

An overview of different disaster loss database methodologies is presented in Appendix 12.2 (DesInventar, SHELDUS, Canadian Disaster Database, EM-DAT, NatCatSERVICE and Sigma CatNet Service, Emergency Management Australia Disasters Database).

We will discuss one methodology in more detail. DesInventar is a free (open source software) web-based disaster information management system. It was set up in 1994 by the Network of Social Studies in the Prevention of Disasters in Latin America (LA RED) and maintained and updated by Corporation Observatorio Sismologico del Sur Occidente (OSSO). It gained a special status when UNDP and UNISDR started to sponsor the implementation of DesInventar in developing countries of Latin America, Asia and Africa [46] as a tool to archive the loss data of historical events and maintain it to collect the loss data of new emergent situations. Over the years the DesInventar database and methodology have further developed to meet the emerging

[26] https://emars.jrc.ec.europa.eu/
[27] http://forest.jrc.ec.europa.eu/effis/
[28] http://webra.cas.sc.edu/hvri/products/sheldusproducts.aspx
[29] http://www.publicsafety.gc.ca/prg/em/cdd/index-eng.aspx
[30] http://www.emknowledge.gov.au/disaster-information/
[31] http://www.dmic.org.bd/didb
[32] http://calamidatph.ndrrmc.gov.ph/dm/web/

needs of countries and is now being used in 45 countries, that is 90% out of collected national databases and 70% in terms of population. At the time of writing, DesInventar covers 21.7% of the world population (Appendix 12.3).

DesInventar is also a methodology for recording and collecting loss data of future events. It enables the inventory of high resolution level where information corresponds to municipality or similar correspondent local territorial unit collected with the usage of record cards. Data fields recorded cover human loss, physical damage and economic loss. It includes all events that may have had any effect on life, properties or infrastructure, with no limit in size. The system can accommodate additional categories of hazards, data fields of impact indicators, and causes according to local conditions and needs, since it allows multi-user data entry and is able to manage complex surveys with multiple questions and sections in a relatively efficient manner.

Loss data in Europe are collected by different research and government institutions. Yet, no multi-hazard national database with the local resolution can be accessed publicly. A review of the status of loss data in Europe is required. Based on interviews with country representatives, the case of Slovenia and Italy are illustrated.

4.3.1 Slovenia

Slovenia has a country-wide and multi-hazard loss database. The data are not publicly accessible, mainly because they are linked to the cadastre, and therefore have certain privacy-related data.

Slovenia has developed a disaster loss estimation and validation methodology supported by a strong IT system called AJDA. The responsibility for recording losses lies with by the Administration for Civil Protection and Disaster Relief (ACPDR), a constituent body of the Ministry of Defence. There are three administrative levels in Slovenia, i.e. the national, regional and municipal level which is reflected in the organization of the current system of protection against natural and other disasters. At local level, the municipalities operate and manage the system of protection and rescue independently in their areas. The responsible authority is the mayor.

Loss estimation is triggered when the economic loss estimation at the national level will exceed 0.03% of the national budget. In the case of major disaster the mayor(s) communicates the losses to the regional headquarters of the civil protection, which after validation with field research reports transfers this to the national authority of the civil protection. Based on this early loss estimation the national authority of civil protection adopts in a matter of days a decision about the start of the collection process and passes it back to the municipality.

The loss is recorded at the asset scale by specialized, multi-disciplinary (sectorial) assessment teams established at municipal, regional and national levels. The collection methodology is based on a set of 8 types of record cards related to different sectors and it follows a bottom-up approach. In each municipality there are personnel with an access to the database system. Yearly training of staff involved in the data collection ensures effective data collection. The data fields of loss indicators are defined in the context of a standardized economic loss estimation based on a continuously updated price list. The accuracy of data is ensured through a validation process. The collected data are compared and cross checked with data in different national registers (including the cadastre) and monitoring inventories. This approach ensures the collection of high quality data which are verified at different levels of the aggregation process. This process allows the production of a loss estimate report in a short time, enabling the government to trigger a recovery plan based on evidence.

4.3.2 Italy

Italy has shown great interest in systematically recording losses, as well as establishing a historical record following best practices and standards. Different institutions are active in gathering loss data from National to municipal level. The DPC (National Department of Civil Protection) coordinates part of these efforts in gathering loss data at national level with the aid of different expert Centres such as among others CNR- IRPI (National Research Council), INGV (Istituto Nazionale di Geofisica e Vulcanologia), and CIMA (International Centre on Environmental Monitoring).

CIMA has experience of international standards Loss Databases from collaboration with UNISDR and IRDR and will make this experience available to harmonizing all existing national loss databases in the hands of private and public institutions into one multi-hazard database. Italy already has a comprehensive loss database covering floods and landslides event from 1900 to 2004, called *Aree Vulnerate Italiane Database* (AVI DB), and also has good national databases for earthquakes, forest fires, volcanic events, coastal risk and manmade disasters.

Specifically, CIMA works together with UNISDR and the Italian Civil Protection Department to make the existent databases compatible with DesInventar.

4.4 Event specific loss assessment

Mass catastrophe's often affect countries beyond their ability to cope. The international community, through international institutions and donors, support these countries that request assistance. The estimate of the losses is typically carried using the Post-Disaster Needs Assessment (PDNA). PDNAs and related guidance are a joint effort by the UN system, World Bank and European Commission, in support of governments, in furtherance of a series of institutional agreements on post-crisis cooperation.

PDNA's[33] encompass two perspectives: (i) the valuation of physical damages and economic losses; and (ii) the identification of human recovery needs based on information obtained from the affected population. These perspectives are integrated into a single assessment process to support the identification and selection of response options covering recovery interventions from early- to long-term recovery in a Recovery Framework. The PDNA is comprised of Damage and Loss Assessment (DALA), a Human Recovery Needs Assessment (HRNA) and a Recovery Framework (FR). They are also the base document for discussions to determine international development assistance in cases requiring external assistance including leveraging of targeted or additional assistance from the World Bank and other traditional donors.

[33] http://www.recoveryplatform.org/pdna/

PDNA's are focused on the collection and analysis framework and have no standard database system. Recently, the use of DesInventar was explored by the UN for this purpose. An "extended" version of DesInventar was built as a reference implementation for the output of a PDNA. The results of the past PDNA are usually incorporated in national DesInventar databases, if the latter are available. Recently, then DesInventar disaster loss database system was implemented[34] as an internal UNDP data management tool to support the conduct of the PDNA[35] in Myanmar, following the Cyclone Nargis in 2008 [43]. In case of 2010 Haiti earthquake a built in template accommodated the extremely comprehensive results of an ECLAC Damage and Loss Assessment, as a proof of concept.

At national scale, large events typically trigger detailed studies on what happened and what went wrong in the management of the disaster. Structural earthquake engineering studies are standard practice for large earthquakes (e.g. [41], [42], [53]). Reviews of the management of the emergency by internal or external evaluators are becoming more common (e.g [40] and Pitt Review [54] after UK floods[36]). These studies create a wealth of data that are worth recording in a comparable manner to other disasters. There are no widely accepted standards for now.

4.5 International standardization processes

The scientific/technical community addressing loss data has worked towards establishing standardized concepts and definitions for disaster loss database. Recent efforts, improvements and lessons learned in this field are documented in:

- EM-DAT's new hazard classification,2008 [51],
- UNDP, Disaster Database Standards, 2011 [45],
- Guidelines and Lessons for Establishing and Institutionalizing Disaster Loss Databases, 2009 [44].

The objectives are to have better definition of data fields for loss indicators, definitions of minimum sets of mandatory loss data fields, hazard classification that enables the traceability of cascading events with unique hazard event identifier still to be adopted and successful implementation scenarios.

Documentations of good initiatives and existing methodologies for loss estimation are available from:

- ECLAC Handbook for estimating the socio-economic and environmental effects of disasters [18],
- The Impacts of Natural Disasters: A Framework for Loss Estimation. National Research Council (U. S.) and National Research Council. March 1999 [38], and
- HAZUS Natural hazard loss estimation methodology [29].

The Disaster Loss Data (DATA) Working Group of the Integrated Research on Disaster Risk (IRDR, an ICSU/UNISDR initiative) is studying issues related to the collection, storage and dissemination

[34] www.desinventar.net/DesInventar/download/Myanmar_IM_Process.doc
[35] http://www.recoveryplatform.org/pdna/about_the_pdna
[36] http://www.environment-agency.gov.uk/research/library/publications/33889.aspx

of disaster loss data. The Co-Chairs of the Disaster Loss Data Working Group are the University of South Carolina, USA, Munich RE, Germany.

Among other objectives, the Working Group aims at providing better definitions of loss and related terms and creating a standard methodology for assessing it, at sub-national geographies.

Summary: The current landscape of systematic collection of loss data is varied, with actors from academic, private and governmental institutions. Know-how and expertise on loss data and its collection has been developed over many years in distinct communities. In general, there is a distinction in approach, purpose, scale and scope between global databases (EM-DAT, NatCatSERVICE, Sigma CatNet) and national databases (e.g. DesInventar). There is also a difference in methods used in data-rich countries (e.g. SHELDUS) and data-poor countries (mostly DesInventar). Less systematic loss collection occurs in hazard databases that include a loss component (e.g. Dartmouth Flood Observatory), and during dedicated but ad-hoc loss assessments for large disasters (PDNA's). There is also systematic loss accounting that is part of internal government procedures and that is not publicly shared (e.g. Slovenia). Some international working groups (including IRDR DATA) discuss progress and standardization in loss accounting.

5 OPPORTUNITIES AND LIMITATIONS IN A EU CONTEXT

The culture of archiving data in European Union Member states is rich. Monitoring inventories, environmental parameters and statistical surveys are often endorsed by Eurostat legislation, international and national research institutions or governmental institutions. For loss data, this will be no different. The European Union institutions have a complex structure and different Member States have a wide range of available capacity. An EU approach for a harmonized information system for recording losses will need to be developed based on existing international experiences and existing EU legislation. The aim of this report is to provide a framework to balance the principles of our conceptual model (Section 3.1) with enough freedom for Member States to decide on specific implementation.

In the EU the ideal is to collect loss data at fine scale (asset/municipality) and to manage loss data at international scope (Figure 6) to satisfy the needs of all three application areas: loss accounting, disaster forensics and risk modelling. Note that to achieve interoperability with other international databases requirements can be less stringent. A global scope of managing and regional/national scale of recording loss data would be sufficient if the loss data should satisfy the loss accounting purposes only (Figure 10).

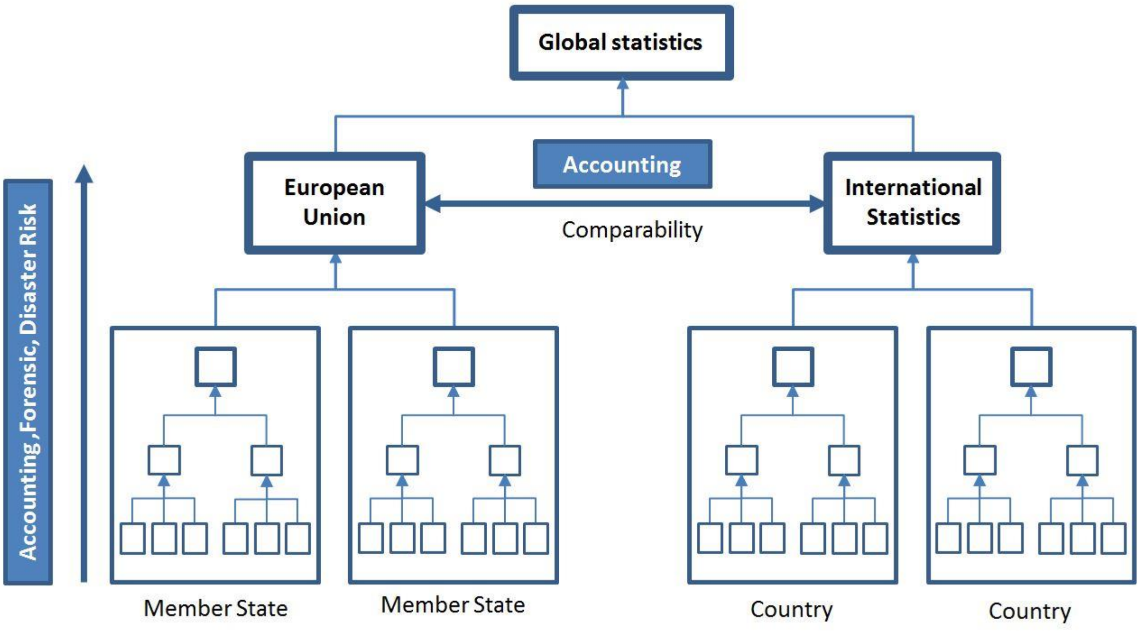

Figure 10: Interoperability of EU loss databases.

An EU methodology will have to be standardized at local (asset/municipality) scale. None of the existing initiatives fits the requirements for EU approach. ECLAC [18] provides a thorough methodology for direct and indirect loss estimation at sectorial level. The United States National Research Council [38] provides a better understanding of issues that are important in making decisions about allocating resources for DRR. Important issues addressed include: who bears the loss, what are the main types of damage in different disasters and spatial resolution of losses. The HAZUS [29] methodology covers many issues of disaster forensics and risk modelling application area.

Our analysis of existing databases indicates that DesInventar provides fields and definitions as well as a methodology that is spelled out more precisely than other databases. DesInventar was therefore considered for an analysis of weakness and strength (Appendix 12.1.4) regarding the requirement for a European Union loss data standards. Our aim is to take the minimum standard available and built upon it to satisfy the identified requirements.

The implementation of future loss data recording will be supported by EU legislation. Three are being revised this year:

- EU Civil Protection Legislation [10],
- EU Solidarity Fund Regulation [15],
- INSPIRE legislation for Natural Risk Zone [32].

The EU Civil Protection mechanism [10] establishes procedures and guidelines for coordination among national civil protection agencies. Because of the involvement of civil protection actors in all disasters (even small scale), they are well positioned to accurately record losses at the local level, even if the responsibility for institutionalizing the disaster loss database may be mandated to other institutions[37].

The EU Solidarity Fund Regulation [15] establishes the rules and principles relating to EUSF intervention to compensate public damage for damage suffered. In particular, it defines the conditions for applying for assistance from the EUSF, as well as the procedure to be followed.

The INSPIRE legislation [11] provides a basis for interoperability and comparability of individual Member State databases. Member States may have slightly different ways to collect data but the reporting should then be standardized based on the technical specifications.

These legal frameworks provide boundaries to what can be done by the European Commission, but also opportunities to establish loss databases across all the EU Member States.

Summary: A European approach needs to be developed by taking stock of existing international experiences and existing EU laws. A number of policy documents have been analysed. Technical and institutional recommendation should provide:

- Requirements for an EU approach that aim for the principles of conceptual model.
- A framework for an EU methodology that should to be standardized at local level.
- Guidance to Member States in their choice of implementation.

[37] Countries where National Platforms (NP) for Disaster Risk Reduction have been established can coordinate roles and responsibilities on data collection within the NP.

6 TECHNICAL REQUIREMENTS FOR RECORDING LOSS DATA AT NATIONAL LEVEL IN THE EU

6.1 Introduction

A lot of work has been done on recording losses. From the existing standards, classifications and successful examples we have tried to focus on those that would be with some adaptation the most suitable for realizing of the conceptual model. These include: EMDAT and MunichRe [51], ECLAC/DALA [18], the US Framework [38], HAZUS [29], the UNDP Data Standard [24], EUROSTAT [22] and INSPIRE [32].

Because the standardization is more difficult and more encompassing at asset scale, and standards that are covering that scale will also be applicable at larger scale, the EU methodology should start from the asset scale, where definitions, units, collection methods and uncertainty estimates are most concrete. This might be beyond the mandate of the EU disaster prevention framework [6], but it is crucial to build on sound and properly defined requirements to fulfil the goals of aggregation at EU level (global scope).

The technical requirements described in the following sections are outlining the principles, but leave freedom for Member States to decide on specific implementation. Using interviews with national experts, several existing contexts of Member States have been considered to develop a few scenarios for implementing loss databases in a country. The implementation issues will be discussed in detail in Section 7.

It is important to understand that the technical requirements for the data model are distinct from user interfaces in a software application. The data model must be able to capture subtle information, while the user interface must try to hide complexity and show only relevant choices. Typically, a good software application will be able to compile many data fields from the context (e.g. those related to uncertainty, time of data entry and geographic location). Other data or metadata can be captured using icons, drop-down lists, map interfaces, etc.

This section deals with the technical requirements for the data model. It does not deal with technical requirements for the user interface. The purpose is to capture all data needs and recommend an approach that can handle the associated complexity.

6.2 Three entities: hazard, affected element and loss

The proposed loss data model is divided into three distinct entities (Table 1) encapsulating specific data related to disaster consequences and managing procedures together.

- Hazard event identification,
- Affected elements,
- Loss indicators describing damage/loss of affected elements.

Depending on the application area (accounting, forensics and modelling), some entities need more emphasis than others, and technical requirements should be adapted accordingly.

6.2.1 Hazard event identification

Hazard event identification provides data to characterize the event causing the impact and locate the event in geographical and temporal space. It is not feasible to record all hazard data in the loss database, in particular for events with a lot of observation and modelling data. Rather, the loss database should contain enough data on the hazard to (1) uniquely identify it and allow an unambiguous link to more detailed hazard databases and (2) provide useful search, filtering and grouping functions.

Table 1: Loss database structure

Data element		Standards or best practices to be considered
Hazard event identification	geographical information	Country code (ISO 3166-1 alpha-3 specification) Minimal spatial unit (NUTS classification - LAU2 level) Coordinates (latitude, longitude) of point or polygon
	temporal information	Event date and time: UTC time (h) Period: start date (dd/mm/yyyy) - end date (dd/mm/yyyy)
	hazard event classification	INSPIRE - HazardCategoryValue EM-DAT disaster classification
	event type specific attributes	Small set of severity indicators (e.g. like in GDACS) for search purposes
	hazard event identification number	Modified GLIDE number, used to link to more detailed hazard databases
Affected elements	georeferenced exposed element	Country code (ISO 3166-1 alpha-3 specification) Minimal spatial unit (LAU2) Coordinates (latitude, longitude)
	Characteristics (see Table 3)	General Hazard dependent
Loss indicators describing damage/loss of exposed elements	Name of data field	See Table 4
	Value of data field	Value Physical unit
	Time stamps	Date (dd/mm/yyyy) of entry and update Date of measurement and validity options for time dependent fields
	Source and source type	Types: Official emergency management agency, Official sectorial institutions, Academic and Scientific files maintained by research institutions, Media releases
	Uncertainty	Methodology to describe uncertainty (statistical, interval, estimate, etc.) Reliability of sources (different priorities, different information)

For the hazard classification the EM-DAT/MunichRe proposal [51] (the result of an international working group) or existing classifications in INSPIRE [32] (the result of EU Member State consultation) can be considered. The hazard classification must allow for new entries in order to accommodate emerging perils and local particular conditions as well as to enable the traceability of cascading events. The main type of hazard event should be characterized based on a severity scale. For earthquakes it may be a magnitude scale, for cyclones it may by the Saffir Simpson scale[38] and for floods the DFO magnitude scale[39]. Similar severity scales will have to be adopted

[38] http://www.nhc.noaa.gov/aboutsshws.php
[39] http://floodobservatory.colorado.edu/Archives/ArchiveNotes.html

for other types of hazards (one possible approach is used in the Global Disaster Alert and Coordination System[40]).

When many losses are caused by a large wide-scale event, it must be possible to group them (e.g. total losses for 2004 Indonesia tsunami). A hazard event identification number similar to GLIDE number should be adopted. It would allow for an unambiguous linking of loss records associated to the same disaster event and enable interoperability among different loss databases. The Global Disaster Identifier Number (GLIDE)[41] is a project initiated and maintained by the Asian Disaster Reduction Center (ADRC). The project defines a procedure to generate a GLIDE number for all disaster events. GLIDE numbers can deal with cascading events (using prefixes) and with hierarchical spatial units (countries, provinces, districts; using suffixes). However, the GLIDE number has several disadvantages that make it impractical to use in a European approach: (1) it is created centrally at ADRC creating a dependence on an external entity, (2) it must be requested manually making it impossible to automate its creation and (3) it is not optimized for small scale events. A similar European disaster identification number should be created.

6.2.2 Affected elements

Affected elements define the elements (e.g., people, property, and environment) present in the area affected by a hazard event and thereby subject to damages/losses. Affected elements are identified with location (geo-referencing) and pre-disaster characteristics dependent on the type of the affected elements. A set of the affected elements is a proper subset of all exposed elements (elements at risk) located in the affected area.

Georeferencing of the affected elements is essential for risk modelling and forensics. The more precise (e.g. geographic coordinates), the better the application can make use of it. In most cases, sufficient geo-referencing accuracy can be achieved with definition of minimal spatial unit. The existing NUTS[42] classification, defined by Eurostat, provides spatial units small enough (LAU2 – municipality level) to satisfy the needs of the EU requirements.

As there is currently no widely used list or classification of types of exposed elements Table 3 is provided to facilitate data interoperability. It is a compilation of different existing models taken from ECLAC [18], INSPIRE [32], SHELDUS [38], HAZUS [29], and Eurostat [22]. The list of the characteristics is open for discussion, but eventually it should allow for aggregation (by spatial unit, sector, types of element, and who bears the loss), serve as a proper reference for monetary evaluation of damage and provide the vulnerability level of elements useful for disaster forensics. Therefore the characteristics of structures are divided between general and hazard dependent. Hazard dependent characteristics will group structures with similar performance mechanism (e.g. force resisting) and resulting damages.

[40] http://www.gdacs.org
[41] http://www.glidenumber.net/glide/public/about.jsp
[42] NUTS is a Nomenclature of territorial units for statistics (NUTS 1,2,3 and Local Administrative Unit LAU 1, 2) as a single coherent system for dividing up the EU's territory in order to produce regional statistics for the Community and entered into force in 2003.

6.2.3 Loss indicators

Loss indicators describe the level of damage/loss on individual assets or on a number of damaged/destroyed assets covering several dimensions to thoroughly record the effect of the disasters. The degree of detail of damage depends on the availability of quantitative information in the area affected. Therefore the loss indicator is not only a name of data field with the value and the physical unit but it is also accompanied with metadata including the time of recording/updating, the source and uncertainty. The unit should be standardized, and Table 2 shows the suggested unit for different damage/loss categories. For example, the unit for affected population should be people. Data in other units (families, households) should be converted to number of people, with an associated uncertainty estimate.

Uncertainty refers to the methodology of estimating the data (field counting, remote sensing, application of census data, up-to-date or not, derived from another data field), discrepancy or agreement among the sources, prior knowledge of value distributions, etc. In the case of historical data, values are expected to have higher uncertainty and lack to possibility for verification. Uncertainty should also be estimated for data on hazards and affected elements. In some cases, this may be implicitly done: uncertainty of geographical and temporal identification of hazard event would result in larger spatial unit and wider time range approximation.

For some loss indicators (e.g., killed, missing homeless, evacuated, relocated) there should be an option for time dependent fields to be able to record also temporal stages of disasters, i.e., recovery and response. This would allow the use of loss databases also during emergencies and/or for operational purposes.

6.3 Damage/loss categories

The terminology of the effects of the disasters is as complex as terminology used to qualify them. This section aims to clarify the definitions used in this document. In general, the UNISDR DRR terminology [48] is adhered to, but in some cases more specific definitions are required to avoid ambiguity. The terms loss, damage or impact are similar and often used interchangeably but here we will make a clear distinction among them following the description in [38]:

- The **impacts** of a disaster are the broadest term, including positive and negative effects of the disasters though the impacts of disasters are predominantly undesirable. Furthermore it includes market-based impacts (destruction of property and a reduction in income) and non-market effects (environmental consequences and psychological effects suffered by individuals).
- The **losses** of a disaster represent market-based negative economic impact. These consist of direct losses that result from the physical destruction of buildings, crops, and natural resources and indirect costs that represent the consequences of that destruction, such as business interruption.
- The **damages** caused by natural events refer to physical destruction, measured by physical indicators, such as number of killed, number of buildings in a given damage class. When valued in monetary unit, damages become direct losses.

For the sake of transparency, damages to assets should initially be quantified in physical units (number of pieces, kilometres of roads by class, hectares of crops, tons of agricultural products). Such data is undisputable, while the associated monetary losses depend on the method for estimation. Physical damage can be converted to monetary loss using an economic valuation, while the other way around is not possible. There may be different methods to evaluate monetary loss, e.g. taking into account inflation, purchasing parity, insured losses, etc. In the EU, it would be important to use a standard, unique methodology for economic valuation.

Table 2: Damage/loss categories, most of it adopted from ECLAC

Loss/Damage categories	Tangible		Intangible
Direct damage to exposed elements	Physical damage to property	People directly affected	Cultural heritage Natural environment
Indirect loss/damage	Loss of flow	People indirectly affected	Loss of future usage (agriculture, forestry, tourism, ...)
Total loss/damage	Economic loss	Affected people	Economic loss/number-size of assets
Common denominator	**monetary value**	**Number of persons**	-

Based on the ECLAC nomenclature [18] a disaster affects:

- The exposed elements (**direct damages**). This category consists of damage to assets that occurred right at the time of the actual disaster.
- The flow for the production of goods and services (**indirect losses**). Indirect losses result from the consequences of physical destruction and are more difficult to identify then direct damages and they become apparent at different times after the disaster.
- The performances of the main economic variables of the country/region (**macroeconomic effects**). Macroeconomic effects quantification is usually done for the national economy as a whole. In the EU the Solidarity Fund has a category of regional disasters where the economic stability of region is also considered.

Once physical damage to property (**direct damages**) is converted in monetary value they become **direct losses**. Then the first two types of effects, direct loss and indirect loss, can be added together with monetary value as a common denominator. Macroeconomic imbalances arising from the event can be detected after following the functioning of the economy for a longer time, i.e., a few years, and cannot be added to the other two categories of losses because that would involve double accounting [18]. Therefore macroeconomic effects are not planned to be the subject of this disaster loss standard.

Certain direct or indirect impacts cannot be converted into monetary value simply because the lost item cannot be bought or repaired for money (killed, injured, cultural heritage, extinction of species). People related impacts can be measured in number of persons. Other non-market impacts are difficult to measure and are called **intangible damages**. Furthermore intangible damages are catch-all term for even more unrefined effects, that are impossible to quantify or are even difficult to identify like loss of memorabilia, human suffering, impact on national security and many other similar factors related to well-being and quality of life. A loss database may try to cover some of them, which can be reasonably well quantified like number of persons in the case of affected population.

Sometimes intangible direct damages cause tangible indirect losses (loss of future crops due to soil erosion, loss of tourist attraction due to destroyed cultural heritage). For example, the 2010 eruptions of the Eyjafjallajökull volcano in Iceland created an ash cloud and caused enormous disruption to air travel across western and northern Europe. There were only minor direct damages, but it created large economic losses in the transport sector, which can be recorded as indirect loss.

While the advantages of recording damage is that losses can be derived using different economic models, the disadvantage is that – for accounting – aggregating damage over space and time is not straightforward. Damage for collections of assets (e.g. hospitals in a neighbourhood or municipality) should be recorded using statistical distributions of values (e.g. average damage level). Further aggregation at damage level is not practical, and instead the damage should be converted to monetary losses before the data is aggregated by sector or spatial unit.

6.4 Affected elements

Recording enough data about the affected element is necessary for studying economic impacts by sector, but also to study physical damage models (e.g. in earthquake engineering). Depending on the scientific discipline, buildings are described with many properties. It is not feasible to foresee all possible properties in the loss data standard. Instead, we recommend recording a minimum set of properties useful for all application areas and allowing the record extended data using discipline-related standards (e.g. Syner-G or HAZUS).

Affected elements cover people, structures (buildings or civil works) and two other categories (movable objects and environment). Table 3 shows the key characteristics for each type of affected element, as well as recommended classifications and standards to define them.

Only for property we can define tangible damage, the owner and who bears the loss. Types of owners considered are individual, business, government, and non-governmental organizations, while the losses can be absorbed by insurers, individuals, business, governments, and non-governmental organizations. People and natural environment are treated separately.

For the environment [38] we can distinguish between impacts on human-made landscape environment and on the natural environment (air, water, soil, biotic). Only landscape environment is considered as a property where we can define the tangible damages dependent on different land use[43] (like clean-up costs and repair costs).

Of Table 3, the most relevant elements are related to the socio-economic impact of the disaster. These are people, structures and products/stock/crops.

[43] Land use is the human use of land. Land use involves the management and modification of natural environment or wilderness into built environment such as fields, pastures, and settlements. It also has been defined as "the arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it" (FAO, 1997a; FAO/UNEP, 1999)

Table 3: Affected elements and their characteristics to be recorded. Shaded elements are most relevant for socio-economic assessment.

Affected elements			Characteristics	Available classifications
	Property **		owner	individual, business, government, and NGO [38]
			who bears the loss	insurers, individuals, business, governments, and NGO [38]
People			age	ECLAC based ECLAC defines also high risk categories (children under five, nursing and pregnant mothers, disabled, aged, ...)
			gender	
			marital status	
			education	
			employment	
Property	Immovable property	Buildings	occupancy classification	Eurostat CC
			height/no. of stories	
			useful area	
			materials used in construction	
			year of construction	
			hazard dependent classification	Syner-G or HAZUS (earthquake), HAZUS (flood), HAZUS (wind)
		Civil work	type classification	HAZUS
			size/length	
			hazard dependent classification	
			source of pollutants	Natech* classification
	Movable property	Content/ Equipment	depends on the occupancy classification	
		Vehicles	type classification	
		Products/ Stock/ Crop	type classification	Eurostat, UN
Environment	Immovable property	Human-made landscape environment	Land Cover/Land Use classification	CORINE Land Cover European database/Land Use classes, LUCAS
			area	
		Natural environment	type of ecosystem	wetland, floodplain, …
			type of resources	air, water, soil
			biotic capital	flora, fauna

* Natech accident is defined as a technological accident caused by a natural hazard/disaster
** Property assets (movable/immovable) are always accompanied by two extra fields: owner and who bears the loss

6.4.1 Property losses and their aggregation to larger scales

While for forensics and risk modelling the small scales are more important, the main purpose of loss accounting is to aggregate losses over time and space, grouped by economic sector, or by loss owner.

A sectorial approach, as used in DALA and the Solidarity Fund, is useful for:

- EU Solidarity fund to compensate damage in public sector,
- deducing indirect losses with the loss of the flow of the goods inside sectors, and
- providing a comprehensive picture of impairment of the society.

Aggregation of direct physical damage (Table 5) and losses (Table 4) enables to extract the total reconstruction costs. If direct physical damage is recorded, an economic model can be used to transform the data to direct losses. Disaggregation by the loss owner (or who bears the loss) enables to extract the insured cost out of total loss, or to distinguish between public and private losses. Indirect loss can be derived too with sector-specific models for calculation indirect costs as a function of direct costs and damage (Table 4). Note that indirect losses are not related to (groups of) exposed elements, but rather to sectors.

Table 4: Conversion from physical damage to total monetary losses disaggregated by sector, element or loss owner

Direct tangible losses		
Municipality/regional/national level		
Sectorial (based on ECLAC and Solidarity Fund art.3)	**Affected elements**	**Who bears the loss** (based on USA framework) [monetary value]
Residential education/research culture/recreation health sector public administration	building content/equipment vehicles landscape	insurer individual business government
Energy drinking water and sanitation transport communications	building/civil work content landscape	
agriculture, forestry trade and industry tourism	building content/equipment stock/crop vehicles landscape	
clean-up cost emergency relief costs		

Indirect losses	
Municipality/regional/national level	
Sectorial (based on ECLAC)	**Who bears the loss** (based on USA framework) [monetary value]
residential education/research culture/recreation health sector public administration	insurer individual business government
energy drinking water and sanitation transport communications	
agriculture, forestry trade and industry tourism	

For aggregation of losses in a sectorial approach, it is important to understand the occupancy and type classification of buildings and civil works respectively. This classification is sector-specific. There are extensive existing classifications of buildings and structures which can be applied in loss databases. These classifications define hierarchical classes that allow classifying a building in great detail or in broader classes, depending on the purpose. Eurostat [22] divides structures into building (structures with roof) and civil works. Eurostat's classification (based on the purpose of the structure) is most suitable for buildings while for civil works the HAZUS classification [29] of lifeline utilities, transport and communication facilities is more comprehensive. The occupancy class [22] defines also typical content/equipment of the building; crop/stock classification is covered by Eurostat as well.

As mentioned before, at local scale, physical damage may be recorded, either at asset level (like it is the case in Slovenia) or at municipal level (mostly used in DesInventar). In the first case, characteristics of a single building may be recorded. In the latter case, the average properties of the assets must be estimated (e.g. average useful area, average year of construction) as well as average loss characteristics (e.g. average damage class). Alternatively, statistical distributions of parameters may be recorded. Table 5 illustrates the difference between asset level and municipal level. The municipal level may be obtained by aggregating damage recorded at asset level, or it may be assessed directly.

It must be clear that the scale of recording losses influences directly the uncertainty of aggregated losses. Collecting data at asset level will decrease the uncertainty of loss indicators and increases the transparency of total economic loss caused by hazard event.

Table 5. Scales of recording direct tangible physical damage data

Asset level
exposed elements: individual assets [physical units]
buildings (non/residential) content/equipment products/stock/inventory civil work landscape

<table>
<tr><th colspan="4">Municipality level</th></tr>
<tr><td></td><td>Sectorial
(based on ECLAC)</td><td>affected elements
[No/size of assets]</td><td>Sectorial
(based on Solidarity Fund art.3)</td></tr>
<tr><td>social sector</td><td>residential
education/ research
culture/ recreation
health sector
public administration</td><td>building
content/ equipment
vehicles
landscape</td><td rowspan="4">A) for immediate restoration to working conditions:
(1) energy
(2) water and waste water
(3) telecoms
(4) transport
(5) health
(6) education

B)
(1) temporary accommodation
(2) rescue services

C)
(1) preventive infrastructures,
(2) immediate protection of cultural heritage

D) Immediate cleaning up of disaster stricken area/natural zones.</td></tr>
<tr><td>infrastructure</td><td>energy
drinking water and sanitation
transport
communications</td><td>building/civil work
content</td></tr>
<tr><td>economic sectors</td><td>agriculture, forestry
trade and industry
tourism</td><td>building
content/ equipment
stock/crop
vehicles
landscape</td></tr>
<tr><td>other</td><td>clean-up cost
emergency relief costs</td><td></td></tr>
</table>

6.4.2 Affected population and natural environment

Impact on population and natural environment is dealt with differently. Based on the UNDP proposed database standard [45] we propose indicators for quantifying the affected population. We distinguish directly and indirectly affected population. The definitions of [45] are currently being revised by UNISDR. The EU approach should follow the UNDP/UNISDR standard to avoid ambiguity and overlapping (e.g. mutually exclusive fields). Table 6 summarizes the hierarchical definitions.

Table 6. Loss Indicators for Population Affected (number of persons)

<table>
<tr><td rowspan="7">directly</td><td>killed</td><td rowspan="2">fatalities</td><td rowspan="7">affected</td><td rowspan="8">total</td></tr>
<tr><td>missing</td></tr>
<tr><td colspan="2">injured</td></tr>
<tr><td>evacuated</td><td rowspan="2">relocated</td></tr>
<tr><td>displaced</td></tr>
<tr><td colspan="2">homeless</td></tr>
<tr><td colspan="2">victims</td></tr>
<tr><td>indirectly</td><td colspan="3">indirectly affected</td></tr>
</table>

Loss indicators are always defined with the quantitative value expressed as the number of persons. The UNDP standard suggests ways to translate other quantitative measured (e.g. households, families, villages) in terms of people, with an associated uncertainty. While this is useful to code historical data, it should be avoided for new events to measure affected population in any other unit that number of persons.

Table 7: Natural Environment Loss Indicators.

Exposed elements of specific ecosystem			Natural Environment Loss Indicators **[Qualitative description]**
Ecosystem	natural resources	water, air, soil	quality (pollution, noise)
			amenities (changes in aesthetic views, physical structure)
	biotic capital	fauna, flora	change in number of species
			change in abundance of species

Loss indicators of natural environment are ecosystem and hazard dependent. The damages and losses to natural environment are difficult to quantify due to complexity of the ecosystems and the impacts of hazard event, which are not always negative. Often they may manifest themselves months or years later and are often not readily apparent. In general damage to natural environment considers quality (e.g., pollution) and other amenities (aesthetic view, physical destruction) in case of natural resources (air, water, soil), or changed number/abundance of species in case of biotic assets (flora, fauna). These loss indicators do not provide comprehensive overview of the impact but have potential application to the assessment of post-disaster impact. At the moment a qualitative descriptive format is recommended to inherit the diversity of possible outcomes.

Summary: Technical requirements for an EU approach are derived from the needs in three application areas (explained in the conceptual model) and are built on existing practices whenever they fit the purpose. The EU methodology should be standardized at local level, and the data model encompasses three entities:

- hazard event identification,
- affected elements, and
- loss indicators describing damage/loss of affected elements.

Affected elements are people, property and natural environment. Damage to property is attributed by owner and loss owner.

There are two possible levels for recording damages at local level: by asset and at municipality level. The asset level accommodates disaster forensics and risk modelling as well as a monetary evaluation process. The municipality level follows a sectorial approach. Conversion from asset to sector level is based on hierarchical classification of affected elements.

For the sake of transparency, damages to assets should initially be quantified in physical units. Such data is undisputable, while the associated monetary losses depend on the method for estimation. Physical damage can be converted to monetary loss using an economic valuation, while the other way around is not possible. In the EU, it would be important to use a standard, unique methodology for economic valuation.

When damage to property is valued in monetary unit, damages become direct losses. Direct losses and indirect losses together present total loss which can be broken down by sectors and loss owner, and can be aggregated at municipality, regional or national level.

7 SCENARIOS FOR IMPLEMENTATION

7.1 Introduction

The practical feasibility of recording loss data to a certain level of detail depends largely on how existing approaches can be adapted or how much a country wants to invest in establishing new systems. This section describes a few scenarios for implementing loss databases in a country, analyses the costs, benefits and appropriateness for various policies. The purpose is to offer guidance to Member States in their choice of implementation.

The scenarios are based on selected interviews with experts from several Member States, but do not completely describe the situation in a particular Member State. The main difference is in the organisation that will be mandated to collect the data:

- Scenario 1: Local civil protection,
- Scenario 2: National / Regional loss assessment centres,
- Scenario 3: Hazard specific or sectorial national authorities.

Table 8: Scenarios for implementation.

	Scenario 1	Scenario 2	Scenario 3
Mandated organisation	Local civil protection	National / Regional loss assessment centres	Hazard specific or sectorial national authorities
Strengths	Real time, Local, Citizens involved	Consistency, Complex assessments	Consistency, Hazard data / sector data
Weaknesses	Change of procedures	Not complete data, New centres needed, Citizens not involved	Training for loss, Bias towards hazard / sector, Citizens not involved
Cost	Low	Medium	Medium
Benefit	High	Medium	High
Loss accounting	High	Medium	High
Forensics	Medium	Medium	Low
Risk modelling	High	Low	High

7.2 Scenarios

7.2.1 Scenario 1a: New implementation at level of local civil protection

7.2.1.1 Scenario description

Local civil protection agents in municipalities are mandated to record events, their impact and measures taken through a web application hosted by the national civil protection. The web reporting is the last phase of an operation and is part of the standard operating procedures. Dedicated Apps allow data entry from the field using standard mobile technology.

As soon as the local civil protection has entered the event in the system, **citizens** can consult the list of disasters and impact information on the public part of the web application. The disaster archive is geo-referenced on an interactive map and can be searched and filtered by several criteria (time, hazard type, impact size, etc.).

At the **national civil protection** the web application is developed and maintained, progressively adding other modules relevant to civil protection. A validation protocol is set up to identify coding errors and systematic reporting errors.

Statistics and trends can be consulted at municipality level, but also at provincial, regional or national level. Aggregate statistics are publicly shared through a web service providing data in an INSPIRE compliant European Loss Data Standard.

Historical loss data, with incomplete hazard and loss attributes, are added in a one-time effort from scientific and archive sources. The historical data record can be modified, completed, validated and managed by the local authorities.

7.2.1.2 SWOT Analysis

- **Strengths:** data is recorded in near real-time by professionally trained and mandated agents; the process is transparent and citizens are involved; cost-effectiveness of central database
- **Weaknesses:** requires changing existing practices; a minimum training of local civil protection agents must be provided by the national civil protection (may be online training); local civil protection may not have record of previous losses or time to validate and enter the data; no data recorded if local authorities are incapacitated by the disaster
- **Opportunities:** the system may be expanded to incorporate other aspects like communication with citizens, risk communication, hazard assessment, etc.
- **Threats:** political motivations may encourage underreporting or over-reporting of losses.[44]

7.2.1.3 Cost Benefit Analysis: Low cost, High Benefit

Individual municipalities are expected to deal with a maximum of 100 events per year. Reporting time for a typical event would be between 5 and 30 minutes, depending on the losses and complexity of the event. No additional staff is required at municipal level.

Large events, like severe earthquakes affecting many municipalities with emergency operations lasting days or weeks, likely overwhelm the local civil protection, making loss reporting a low-priority issue. Nevertheless, after the emergency ends, the losses can be assessed and entered routinely in the system by existing staff. In case the local civil protection is incapacitated, data may be entered by regional or national civil protection staff.

On-line training tools, frequent use of the system and an easy user interface must ensure a minimum learning curve and minimum training need.

[44] This may be mitigated by establishing a body at European level to validate data. This may be a mandate of OLAF, with technical assistance of JRC. JRC could also play a role in case Member States want to delegate the development and maintenance of the national database, e.g. in the initial phase.

At **national level**, the implementation of the web application system is a one-year project based on a standard open source implementation of the EU Loss Data Standard. Extensions may lengthen the implementation time of the project, but they are optional or may be added in a phased approach. At national level, the operation of the system requires system administration, maintenance of the software and the database, and routine validation of the data according to a data validation protocol.

The **benefits at municipal level** are related to disaster risk reduction. Transparent communication of historical losses allows for better urban planning (avoiding hazard-prone zones), continuous dialogue with citizens on risk, increasing awareness of risk with citizens. Loss records also allow prioritization of risk reduction efforts.

The **benefits at regional level** are that loss statistics are available for supporting claims to the Solidarity Fund.

The **benefits at national level** are the near real-time availability of accurate loss statistics in a standard format, compliant with European and global reporting requirements.

7.2.1.4 Fitness for use

- **Loss accounting.** The database has a very low threshold and is therefore complete. Trends cover all losses and are relevant for local, regional, national and international reporting.
- **Forensics.** High detail in loss recording allows forensic analysis. However, a local interpretation of the respective weight of vulnerability, coping capacity and preparedness measures may be biased towards non-manageable factors (hazard).
- **Hazard modelling.** The fine granularity of the data is optimal for hazard modeling. Inclusion of small events with low or zero losses are important for model calibration.

7.2.2 Variations and extensions of Scenario 1a

7.2.2.1 Community focus: risk communication with citizens

The web application available at municipal level can be expanded with additional functionality. Modules can be developed to enhance risk communications with citizens. Taking advantage of increased availability of smart phones and social media, the local civil protection can engage in a dialogue around risk, impact and losses.

Not only can authorities inform citizens, but citizens can also provide loss data. Crowd sourced data might not me the best way of data collection but certainly they deserve mention and a bit of analysis in their strength (capillarity, redundancy, timeliness) and weaknesses (non-homogeneity, low quality, difficult to screen). They can also be a secondary source to validate or direct proper collection, or they can be mainstreamed through prepared crowd sourcing projects (such as volunteering system).

Example: As soon as the local civil protection has entered the event in the system, citizens can **consult the list of disasters and impact information** on the public part of the web application.

The disaster archive is geo-referenced on an interactive map and can be searched and filtered by several criteria (time, hazard type, impact size, etc.). For recent or current events citizens are encouraged to **submit photos and testimonies** about events through the web application. This is supported by a public App, but also by integration with social media sites. This creates a participatory approach and a sense of ownership at community level.

7.2.2.2 Integration with risk assessment

Risk assessment is a statistical process whereby hazards, exposure, vulnerability and coping capacity are modeled to estimate the foreseeable losses. Loss databases are often used to calibrate and validate risk models.

Example: A municipality has an **existing risk assessment system** in its urban planning sector. The loss data, collected by the civil protection sector, is available in interoperable formats (e.g. Google Earth KML) and is integrated seamlessly in the hazard assessment system. Losses, risk and urban planning zones can be **visualized together on a map**.

7.2.2.3 Integration with emergency operations

Emergency response operations cover the period just before and during an event. Information management is a key component of effective emergency management. The loss data assessment may be integrated in this information management system. Additional attributes useful for emergency management may be recorded, including transient data on evacuations, displaced people, partial damage data, etc. Time-dependent data recorded during an emergency are extremely useful for forensic analysis.

7.2.3 Scenario 1b: Adaptation of existing system at local civil protection

7.2.3.1 Scenario description

A country has developed a **system to manage information related to disaster events, emergency operations and risk management**. Part of the system covers the systematic recording of impacts and losses for small and large events. For small events, data are recorded by the **local civil protection** and validated by the mayor. For large events, **dedicated loss assessment teams** are dispatched to the affected area to compile a comprehensive multi-sectorial impact report, which is filed within a predefined deadline. All data are available in a non-public web application.

To exchange data with the EU or with neighboring countries, the country **adapted the system to export data in the EU Loss Data Standard**. This exported data is available through an INSPIRE compliant geospatial data portal.

7.2.3.2 SWOT Analysis

- **Strengths:** use of existing well-established data infrastructure and reporting processes; data is recorded in near real-time by professionally trained and mandated agents; the process is transparent; cost-effectiveness of central database

- **Weaknesses:** may require modifications to core system (e.g. additional data fields); may require translation of information from local language to English
- **Opportunities:** the existing system may be an example for other Member States, either by sharing the software or best practices.
- **Threats:** too large a gap between the existing data structure and the proposed EU Loss Data Standard may lead to partial compliance

7.2.3.3 Cost Benefit Analysis: Low Cost, High Benefit

Because this scenario requires only minor changes to an existing system, the costs are very low. The changes may be included in the routine change and upgrade cycle of the system. The main effort is to develop an export functionality supporting the EU Loss Data Standard.

Since the system is already in place, most of the benefits are already understood by local, regional and national organizations (see scenario 1). The additional benefit is to be compliant with the EU standard and being able to share data automatically with the EU and neighboring countries.

7.2.3.4 Fitness for use

- **Loss accounting.** The database has a very low threshold and is therefore complete. Trends cover all losses and are relevant for local, regional, national and international reporting.
- **Forensics.** High detail in loss recording allows forensic analysis. Use of specialized teams for larger disasters avoids bias towards non-manageable factors (hazard).
- **Hazard modelling.** The fine granularity of the data is optimal for hazard modeling. Inclusion of small events with low or zero losses are important for model calibration.

7.2.4 Scenario 2: National / regional loss assessment authorities

7.2.4.1 Scenario description

A country chooses to report **only major losses**, i.e. exceeding the threshold for the Solidarity Fund (0.3% of national GDP or 1.5% of regional GDP). **Specialized centres** are established at national or regional level to perform loss assessment in the area of competence, with teams being deployed in the affected area.

The **assessment methodology** is comprehensive, complex and covers multiple sectors (e.g. human impact, physical damage, agriculture losses, business continuity losses, indirect losses, earthquake engineering structural assessment). However, the assessment also includes data according to the EU Loss Data Standard, which can be exported and shared in a standard format.

Historical losses are compiled from scientific sources and archives. This is done gradually in times when no loss assessment campaigns are active.

7.2.4.2 SWOT analysis

- **Strengths:** consistency of recording can be ensured through training of a small number of experts; loss data is recorded as part of a wider, multi-sectorial assessment
- **Weaknesses:** no involvement of affected community; no complete inventory of losses (only major losses are reported); need for establishment of specialized centers with capacity to deploy to disaster-affected areas
- **Opportunities:** specialized centres may be mandated with other disaster risk reduction tasks (e.g. hazard assessment)
- **Threats:** cost of specialized centres may be unrealistic in conditions of austerity.

7.2.4.3 Cost Benefit Analysis: Medium cost / Medium benefit

The creation of specialized agencies requires new dedicated resources. The required resources depend on the threshold for disasters and the complexity of the assessment methodology. It may vary from a single staff per office (covering only events with large impact affecting multiple municipalities or regions) to a larger team (to cover smaller events affecting single municipalities).

Since the database only covers part of the events (only larger events) the database will cover only part of the losses, and not be useful for all policy or operational questions. Frequent, low-impact events (like landslides, local storms or minor floods) are omitted, and may bias the trends and statistics on disaster impact.

7.2.4.4 Fitness for use

- **Loss accounting.** The database has a high threshold and covers only major losses. Aggregate losses cover an unknown part (less than 50%?) of the real losses. Major losses are recorded in a systematic way.
- **Forensics.** Complete and comprehensive analyses allow detailed forensic conclusions on major events.
- **Hazard modeling.** Only extreme events can be modeled, leaving large uncertainty on small events just under the threshold.

7.2.5 Scenario 3a: Hazard specific national authorities

7.2.5.1 Scenario description

A country has **existing practices in managing information for specific hazards**. These include procedures to record new events, and their consequences in terms of human and physical losses. Assessments are performed by experts in the field, recording specifics about the hazard event, but also complete information on the impacts. All data are stored in a national level database covering one or more hazard types.

The EU Loss Data Standard is implemented by exporting existing data in the new standard, potentially adapting the original database to accommodate mandatory or recommended loss data fields. **Assessment procedures are adapted** accordingly. The exported data is either made available with INSPIRE compliant methods or imported in a national multi-hazard loss database.

7.2.5.2 SWOT Analysis

- **Strengths:** use of existing well-established data infrastructure and reporting processes; strong emphasis on complete hazard information (good for risk modeling); dedicated staff for loss assessment
- **Weaknesses:** no/little involvement of affected community; potential bias towards hazard data instead of loss data.
- **Opportunities:** standardizing loss data in hazard-specific organizations can harmonize risk assessment procedures
- **Threats:** coordination for loss assessment among hazard-specific communities and

7.2.5.3 Cost Benefit Analysis: Medium Cost, High Benefit

Because this scenario requires changes to an existing system, the costs are relatively low. Nevertheless, recording losses requires a different expertise than recording hazard information. This may require additional resources with appropriate expertise or training existing staff to record losses. Changes to the existing IT system are likely required. Another effort is to develop an export functionality supporting the EU Loss Data Standard.

The benefits are that the hazard specific institution will have data allowing for hazard-specific risk modelling, in particular for developing better loss vulnerability curves. In addition, data can be shared and integrated with other hazard-specific institutes to foster a multi-hazard risk assessment framework. The additional benefit is to be compliant with the EU standard and being able to share data automatically with the EU and neighbouring countries.

7.2.5.4 Fitness for use

- **Loss accounting.** The database has a low to medium threshold and covers most losses. Losses are recorded by trained staff in a systematic way (likely with very accurate hazard description).
- **Forensics.** Unless specific expert groups are developed, complete and comprehensive forensic analyses will not be available.
- **Hazard modelling.** Accurate hazard-specific information is recorded and allows detailed hazard modelling.

7.2.6 Scenario 3b: Sectorial national authorities

One of the alternatives to scenario 3a is that mandated organizations are sectorial agencies. They already govern the databases of the specific exposed elements (e.g. agriculture). In the case of major disasters they can utilize specialized regularly trained assessment teams. For example, the ministry for agriculture covers losses in agricultural sector, ministry for transport in transport infrastructure, ministry for trade and industry in economic sector, etc.

Summary: Different scenarios for implementing loss database in a country are described in detail. They are provided with cost-benefit analysis and appropriateness for different policies. Specific implementation will depend on the flexibility of existing systems, how much a Member State plans to invest in establishing new systems and which application areas are of their interest.

8 RECOMMENDATIONS FOR DEVELOPMENT OF EU LOSS DATA GUIDELINES

8.1 EU Loss Data Standard

This study provides an analysis of the uses of loss data, and the technical requirements needed for database design. We proposed different levels at which a standard can be developed, and the consequences in terms of its applicability. We also analysed scenarios of how a potential standard can be implemented in Member States, taking account of existing legislation and existing institutions. However, this document is the result of a 3 months study based on literature review, interviews and meetings with selected professionals. The document is a preliminary step that will be followed by the engagement and the active involvement of EU Member States.

The actual development of an EU Loss Data Standard is both a technical issue and a political issue. It would need to be agreed among Member States and the Commission for which application areas a standard needs to be developed. This may be restricted to collecting data for major disasters at EU level (e.g. using the data collected under the Solidarity Fund) and then sharing it in the Hyogo Framework of Action. But it can also encompass lower levels (eventually up to municipality and asset level), which, if implemented, will provide robust evidence for future risk modelling and disaster forensics, coherent among Member States.

It is recommended that a formal discussion forum would be created where a consensus can be built among stakeholders on the scope and the technical definition of the standard. In order to prepare such a forum and establish a mandate, an informal process can be started between the Commission and volunteering Member States to study the feasibility, scope and technical definition of a potential EU Loss Data Standard. Member States would be invited to study in detail their institutions, existing practices, policies that can benefit from better loss data, and estimate the cost of different scenarios.

In parallel, the analysis presented in this document can support working towards a coherent approach for handling loss data at international level. In particular, harmonisation between the US and the EU should be considered given they are both data-rich areas. At the asset level, this analysis has been based as much as possible on existing practices (mainly of the USA), adapted to the EU context. For higher aggregation levels, a global loss standard would be welcome to support global loss accounting in the Hyogo Framework, global disaster risk reduction monitoring, and for supporting global risk modelling efforts. Close collaboration with international efforts, including the LOSS DATA group of IRDR, the DesInventar-based efforts of UNISDR, and the regional work of UNDP is essential. A European Loss Data Standard is expected to be a contribution to this international effort.

Table 9: Aggregation at EU level: example of reporting sheet (all in monetary value). Such sheets can be created at municipality, regional, national or international level.

Direct loss to affected elements (€)						
Sector	affected elements	Loss owner				
		insurer	individual	business	NGO	government
residential	building					
	content/equipment					
	vehicles					
	landscape					
education research	building					
	content/equipment					
	vehicles					
	landscape					
culture recreation	building					
	content/equipment					
	vehicles					
	landscape					
health sector	building					
	content/equipment					
	vehicles					
public administration	building					
	content/equipment					
	vehicles					
energy	building/civil work					
	content/equipment					
	landscape					
drinking water and sanitation	building/civil work					
	content					
transport	building/civil work					
	content					
	landscape					
comm	building/civil work					
	content					
agriculture forestry	building					
	content/equipment					
	stock/crop					
	vehicles					
	landscape					
trade and industry	building					
	content/equipment					
	stock/crop					
	vehicles					
	landscape					
tourism	building					
	content					
	landscape					

Indirect loss (€)					
sectors	Loss owner				
	insurer	individual	business	NGO	government
residential					
education research					
culture recreation					
health sector					
public administration					
energy					
drinking water and sanitation					
transport					
comm					
agriculture forestry					
trade and industry					
tourism					

Total loss (€)					
sectors	Loss owner				
	insurer	individual	business	NGO	government
residential					
education research					
culture recreation					
health sector					
public administration					
energy					
drinking water and sanitation					
transport					
comm					
agriculture forestry					
trade and industry					
tourism					

8.2 Data sharing mechanisms and expected reporting needs

Loss databases are expected to be implemented at national level in Member States. Where data is needed at European or cross border or global levels, this would be in the form of aggregated data from the Member States. This is a well-established process in other policy areas, and is facilitated by the INSPIRE legislation. The technical recommendations in this work are fully compliant with INSPIRE processes and procedures.

The European Commission does not need loss data at asset or municipal level. Instead, its core needs are aggregate data on human and monetary losses on an annual basis per geographic area. The exact requirements would need to be agreed between the Commission and Member States. The figure below shows a potential summary table of losses, which may be provided at any geographical level (municipal, provincial, regional, national). It can be disaggregated by sector, by loss-bearer and/or by other dimensions, as appropriate.

8.3 Quality assurance

When loss data are shared with international organizations in aggregate form, a quality assurance mechanism must be established to catch errors and potential bias.

Quality assurance can be supported by technical analyses, including techniques to estimate the total exposure based on satellite technology. This is common practice in insurance industry, where losses due to floods are validated with high resolution data of flooded area. Statistical techniques to detect outliers are also powerful tools that are commonly applied in other areas.

Quality assurance may be ensured at EU level, or be included in a wider peer review process among Member States[45].

Summary: The development of the EU Loss Data Standard guidelines is a technical and a political issue. Loss database are expected to be implemented at national level in Member States while the European Commission will need only an access to aggregated data from MS. Data sharing mechanism and reporting can be governed by INSPIRE legislation, quality assurance mechanism may be ensured at EU level or through peer-review process among MS.

[45] For instance the peer reviews of the national HFA implementation. See 2013 United Kingdom Peer Review - Building resilience to disasters: Implementation of the Hyogo Framework for Action (2005-2015), UNISDR, EC, OECD. http://www.unisdr.org/we/inform/publications/32996

9 OVERVIEW OF RECOMMENDATIONS

Loss data accounting is now in demand at all levels from national, to super-national and international. Loss data includes human, physical and economic losses. Many countries and institutions record loss data but there is no authoritative loss database that can provide a trend at European or global level. Due to the diversity of purposes and data collection procedure available databases cannot be combined without encountering methodological problems.

Loss databases need to be developed to monitor societal resilience and to implement disaster risk reduction measures. There are at least three linked application areas that require overlapping loss information: accounting, forensics and risk modelling. The three areas differ in scale (precision) and scope (coverage) requirements. A theoretical model allows to evaluate existing databases for fitness for use for particular applications, or to understand the scale and scope – and the related investment – to develop new databases. The key is to engage actors at local level to establish loss databases for operational use, which can then be aggregated at national and global level for strategic and policy making purposes.

The current landscape of systematic collection of loss data is varied, with actors from academic, private and governmental institutions. Know-how and expertise on loss data and its collection has been developed over many years in distinct communities. In general, there is a distinction in approach, purpose, scale and scope between global databases (EM-DAT, NatCatSERVICE, Sigma CatNet) and national databases (e.g. DesInventar). There is also a difference in methods used in data-rich countries (e.g. SHELDUS) and data-poor countries (mostly DesInventar). Less systematic loss collection occurs in hazard databases that include a loss component (e.g. Dartmouth Flood Observatory), and during dedicated but ad-hoc loss assessments for large disasters (PDNA's). There is also systematic loss accounting that is part of internal government procedures and that is not publicly shared (e.g. Slovenia). Some international working groups (including IRDR DATA) discuss progress and standardization in loss accounting.

A European approach should be developed by taking stock of existing international experiences and existing EU laws. A number of policy documents were analysed. Technical and institutional recommendation should provide:

- Requirements for an EU approach that aim for the principles of conceptual model.
- Framework for EU methodology that should to be standardized at local level
- Guidance to Member States in their choice of implementation.

Technical requirements for an EU approach are derived from the needs in three application areas (explained in the conceptual model) and are built on existing practices whenever they fit the purpose. If all three application need to be considered, the EU methodology should be standardized at local level, and the data model encompasses three entities:

- hazard event identification,
- affected elements, and
- loss indicators describing damage/loss of affected elements.

Affected elements are people, property and natural environment. Damage to property is attributed by owner and loss owner. There are two possible levels for recording damages at local level: by asset and at municipality level. The asset level accommodates disaster forensics and risk modelling as well as a monetary evaluation process. The municipality level follows a sectorial approach. Conversion from asset to sector level is based on hierarchical classification of affected elements.

Different scenarios for implementing loss database in a country are described in detail. They are provided with cost-benefit analysis and appropriateness for different policies. Specific implementation will depend on the flexibility of existing systems, how much a Member State plans to invest in establishing new systems and which application areas are of their interest.

The development of the EU Loss Data Standard guidelines is a technical and a political issue. Loss database are expected to be implemented at national level in Member States while the European Commission will need only an access to aggregated data from MS. Data sharing mechanism and reporting would be based on the INSPIRE legislation, quality assurance mechanism may be ensured at EU level or through peer-review process among MS.

10 CONCLUSIONS

The purpose of this study was to formulate recommendations for the development of EU loss database guidelines. Loss data collection systems are one of the key priorities of the Hyogo framework for action as well as Community framework on disaster prevention within EU. In order to promote knowledge based disaster management within EU, loss data accounting is now in demand at all levels from local, regional, national to international.

Recording loss data in data rich environments like Europe has different challenges than the more common system driven by the international community in data poor environments. The users of the loss data are also different, which places more emphasis on the utility of loss data for local disaster risk reduction, disaster forensics and hazard modelling.

The recommendations were developed in a wider context of different uses of loss data. A conceptual model groups the many uses of loss data in three application areas: loss accounting, forensic studies and risk modelling). For each application, the needs in terms of loss data requirements were assessed based on (1) interviews of national experts, (2) a critical review of the existing initiatives and standards for disaster loss databases at international level and at Member States level including existing EU law, and (3) identified requirements of the policies in Europe and international activities that address the loss databases.

This study provides technical requirements for the database design starting from the most detailed scale (individual assets) and spanning coarser scales at municipal, regional, national and global scale. Vertical (local to global) and horizontal (across municipalities or countries) aggregation was considered to cover the variety in scopes (geographical coverage) of databases. The study also looked at different scenarios for implementing loss databases in a country.

The aim of the recommendation is:

- to provide a technical framework addressing the principles of the conceptual model,
- to propose different levels at which a standard can be developed and to explain the consequences of its applicability,
- to give enough freedom to Member States to decide which application areas are of their interest,
- to provide guidance to Member states in their choice of implementation,
- to show the way of harmonisation of the loss data at international level, and
- to suggest the data sharing and quality assurance mechanism.

In order to be applicable for all three application, an EU methodology would have to be developed at local level which triggers both technical issues and political issues. The study covers the most important issues of the EU methodology for collecting data that would fit the requirements of the EU approach. The document is a preliminary step that should be followed by the engagement and the active involvement of EU Member States in the definition of standards.

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12 APPENDICES

12.1 DesInventar and EM-DAT database comparison

This appendix will provide the findings on the comparative exercise conducted by JRC between DesInventar and EM-DAT disaster loss databases, using the inventory for Chile as it was present in both databases (Appendix 12.3). Those two databases were chosen because they have public access, exportable datasets and – using although different methodologies – both cover the human and economic loss of all types of hazard. Both databases have been used by different international research institutions for validating hazard risk models (e.g. UNEP and JRC) and for measuring achievement of different disaster risk reduction programs worldwide (e.g. the Global Assessment Report (GAR) of UNISDR).

The study complements earlier and similar studies including [52]and [46]. Through a detailed comparison of DesInventar and EM-DAT databases, the key features of loss databases will be explained. The weaknesses and strengths of the databases will be revealed in general. Furthermore the comparison will give helpful insight to formulate the requirements for different features that the database set up in European Union should have. These have the double objective to be comparable with existing global databases on one side and to be ambitious enough to fulfil the future needs of EU Disaster risk Reduction (DRR) policy on the other side.

The objectives of this analysis are as follows:

- To compare the structure and the methodology of both databases,
- To study the completeness in terms of data fields and recorded events,
- To find out the degree of complementarity and interoperability between the databases.

Methodology considers the following features:

- the practice of data collection in terms of standard form for collecting information,
- the resolution of data collected and geo-referencing of the location,
- the concepts and definitions of data fields and hazard classification,
- entry criteria for the inclusion of events in the database,
- existence of ID event number.

Here data fields are the indicators of disaster loss that build up the data sheet in the database. Data fields can be qualitative or quantitative, and in the latter case it is composed of the value and the unit. We distinguish indicators for the definition of the hazard event from those defining human loss, physical damage and economic loss. Examples of human loss indicators[46] are number of killed, missing, injured, evacuated or relocated persons.

[46] In the main document the term “affected population loss indicators” is used instead of the “human loss indicators”. Here the latter term is preserved because it is used in the described loss databases.

Table 10: Comparison of basic characteristics: EM-DAT vs. DesInventar.

EM-DAT	Name of database	DesInventar
CRED	**Owner**	National Governments
19,000	**Number of entries**	depends on the country
1900 - present	**Period covered**	depends on the country
global	**Spatial range**	national
national level	**Spatial unit**	subnational, local level
Natural and technological disasters	**Disaster Type**	Natural and technological disasters
No	**Georeferenced data**	Yes
human loss economic loss	**Loss indicators**	human loss physical damage economic loss
killed, injured, homeless, affected	**Human loss indicators**	deaths, missing, injured or sick, evacuated, relocated, victims, affected
UN agencies, US Government agencies, official governmental sources, IFRC, research centres, Lloyd's, Reinsurance sources, press	**Main sources**	government agencies, NGOs, and research institutes; News and media
UN agencies	**Priority source**	News media
10 or More people killed or 100 or more people affected or declaration of a state of emergency or call for international assistance	**Entry criteria**	no minimum threshold - any event that may have had any effect on life, properties or infrastructures
country, disaster group, disaster type, or time period	**Search engine**	geographic unit, GLIDE number, disaster type, cause, time range, variable range
public, on-line	**Access**	(mostly) public, on-line; some restricted
http://www.emdat.be	**Web address**	http://www.desinventar.net

12.1.1 Structure and methodology

The main difference between EM-DAT and DesInventar lies in the practice of collecting and **the resolution** of loss data. In EM-DAT data are recorded at country level, while in DesInventar the spatial unit for recording loss is sub-national breaking down into states then provinces and municipalities. This finer scale is essential to capture local disaster impact and gain new insight into risk. Recurrence of losses caused by fine scale events within the same spatial unit can accumulate to large losses. Furthermore, small spatial units automatically produce a geo-referencing of the collected loss data in situations when geographical longitude and latitude are not provided. However, DesInventar software allows aggregation of loss data through different levels to the national levels.

In DesInventar the **standard form** for collecting information on site is split into mandatory and customized data fields. Customized field are dependent on the country. Customization and local adaptation are fundamental for implementing a sustainable database that meets the requirements of a particular country’s needs. It also helps to ensure that the database becomes part of government systems and not a standalone one [44]. Mandatory fields are essential for execution of the aggregation process in vertical (local to global) and horizontal level (comparing municipalities).

EM-DAT collects data indicators for human and economic loss, while DesInventar provide also data indicators for physical damage related to homes and to infrastructure (Appendix 12.2). But **definitions of loss data indicators** vary to such extent that this impedes the general comparability of the data fields. Table 11 shows the comparison between the definitions of human loss indicators. In general, the EM-DAT set of definitions is written more in terms of humanitarian assistance needed while the DesInventar set of definitions is more in terms of damage and loss that people suffer. EM-DAT focuses more on the response phase of the disaster management which has to address immediate needs and mobilization of services while DesInventar gives already more insight into Post Disaster Needs Assessment and the recovery phase that comes out of it. Furthermore there are many overlaps in the definition and they are difficult to compare.

Table 11: Comparison of definitions for loss indicators related to people: EM-DAT vs. DesInventar.

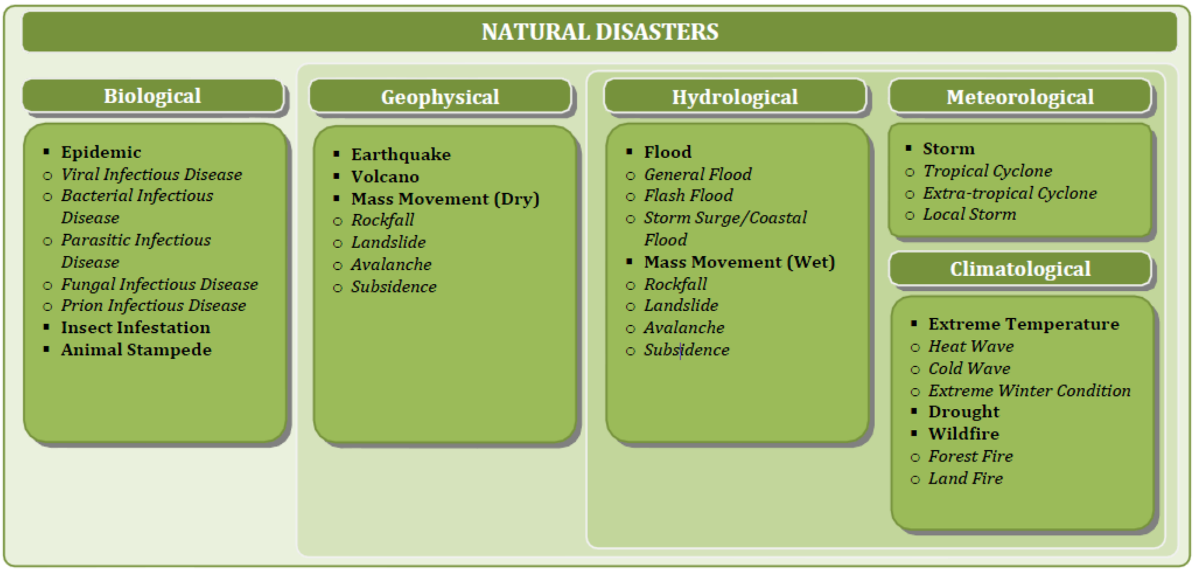
	EM-DAT	DesInventar	
Definition	**Field**	**Field**	**Definition**
Persons confirmed as **dead** and persons **missing** and presumed dead (official figures when available).	**Killed**	**Deaths**	The number of persons whose deaths were directly caused. When final official data is available, this figure should be included with corresponding observations, for example, when there are differences between officially accepted figures and those of other sources.
		Missing	The number of persons whose whereabouts since the disaster is unknown. It includes people who are presumed dead, although there is no physical evidence. **The data on number of deaths and number of missing are mutually exclusive and should not be mixed.**
People suffering from physical injuries, trauma or an illness requiring medical treatment as a direct result of a disaster.	**Injured**	**Injured, sick**	The number of persons whose health or physical integrity is affected as a direct result of the disaster. This figure does not include victims who die. Those who suffer injuries and or illness, if the event is related to a plague or epidemic, should be included here.
People needing immediate assistance for shelter.	**Homeless**	no equivalent data	
People requiring immediate assistance during a period of emergency; it can also include **displaced or evacuated people**.	**Affected**	**Evacuated**	The number of persons temporarily evacuated from their homes, work places, schools, hospitals, etc. If the information refers to families, calculate the number of people according to available indicators.
		Relocated	The number of persons who have been moved permanently from their homes to new sites. If the information refers to families, calculate the number of people according to available indicators.
		Victims	The number of persons whose goods and/or individual or collective services have suffered serious damage, directly associated with the event. For example, partial or total destruction of their homes and goods; loss of crops and/or crops stored in warehouses, etc. If the information refers to families, calculate the number of people according to available indicators.
		Affected	The number of persons who suffer **indirect or secondary effects** related to a disaster. This refers to the number of people, **distinct from victims**, who suffer the impact of secondary effects of disasters for such reasons as deficiencies in public services, commerce, work, or because of isolation. If the information refers to families, calculate the number of people according to available indicators.
Sum of injured, homeless, and affected.	**Total affected**	no equivalent data	
	in terms of help needed	***in terms of damage suffered***	

Even though both databases cover natural and technical disaster the **hazard classification** follows a different approach. DesInventar reports just a simple list (Table 12) of different hazard types while EM-DAT has a new hazard classification (Table 13) of which the hierarchy is based on a triggering hazard logic which is successful in defining cascading events [51]. EM-DAT distinguishes two generic categories for disasters (natural and technological). The natural disaster category is divided into six subgroups: Biological, Geophysical. Climatological, hydrological, Meterological and Extra-Terrestrial disasters. Each subgroup in turn covers 12 main disaster types, identified by DISNO[47], and more than 32 subtypes.

Table 12: Predetermined hazard types in the system of DesInventar.

Accident	Leak	Coastal erosion	Sedimentation
Avalanche	Structural Collapse	Rain	Drought
Alluvion	Explosion	Surge	Storm
Flash-flood	Forest fire	Snowfall	Thunderstorm
Biological Event	Hailstorm	Heat Wave	Tsunami
Pollution	Frost	Cold Wave	Gale/Tornado
Landslide	Hurricanes/Cyclones	Panic	Boat Capsize
Epidemic	Fire	Plague	
Eruption	Flood	Earthquake	

Table 13: Hazard types reported in EM-DAT.



The definition of disaster[48] triggers the next question: what is the scale of the disaster that affected community/society cannot cope? To avoid this ambiguity the **entry criteria**/thresholds are introduced in existing disaster loss databases regulating the scale (small, medium or large) of the disasters to be included. Entry criteria are also a methodology issue.

[47] Unique disaster number for each disaster event (8 digits: 4 digits for the year and 4 digits for the disaster number – for example, 19950324) defined and valid inside EM-DAT database.

[48] UNISDR Terminology [48] on Disaster Risk Reduction defines a disaster as: “A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources. Disasters are often described as a result of the combination of the exposure to a hazard, the conditions of vulnerability that are present and insufficient capacity or measure to reduce or cope with the potential negative consequences. Disaster impacts may include loss of life, injury, disease and other negative effects on human physical, mental and social well-being, together with damage to property, destruction of assets, loss of service, social and economic disruption and environmental degradation.”

In case of the EM-DAT disaster loss database the thresholds are unique regardless of the country's capacity to cope with the disaster; they are considered to be predefined thresholds which bias the selection towards more significant disasters in the terms of human or economic loss. However entry criteria become redundant, like in DesInventar, if the losses are recorded in local/municipality level. First, the mayor would have difficulties to assess the extent of disaster beyond the border of municipality, and, second, small events might have catastrophic outcome for the municipality, especially if repeated frequently, while they can be easily handled at country level. Furthermore, small scale events can be just one in a series of cascading events which cannot be always immediately recognized as a part of a larger hazard event that causes large cumulative losses. In terms of climate change adaptation we should have in mind that small disasters are usually the product of climate variability and climate change [37]. On European level smaller scale event and impacts should be included but the entry criteria are to be discussed in order not to flood the database with insignificant accidents not correlated with any hazard event at all.

Table 14: Difference in death toll for Chile during 1970-2011 in EM-DAT and DesInventar database

Chile for time period 1970-2011		
	EM-DAT (killed)	**DesInventar (death + missed)**
No. of records	94	12599
Death toll	2255	6232

Focusing on Chile again, due to different entry criteria between EM-DAT and DesInventar the disaster death toll in DesInventar is almost 3 times that of EM-DAT for the same time period 1970-2011. The death toll in EM-DAT (based on Table 11) is described with one data field (number of killed), while in DesInventar it is considered as a sum of two data fields (number of death and number of missing).

A simple ratio between the number of deaths and the number of record cards gives a reasonable estimate of the scale of the disaster for the spatial unit considered (Province). Earthquake events in 1971, 1985 and 2010 pop up as the major disaster in Chile in the last 40 years also in EM-DAT. The earthquake in 2010 affected a small area compared to the other two and it was much more detrimental for the affected provinces.

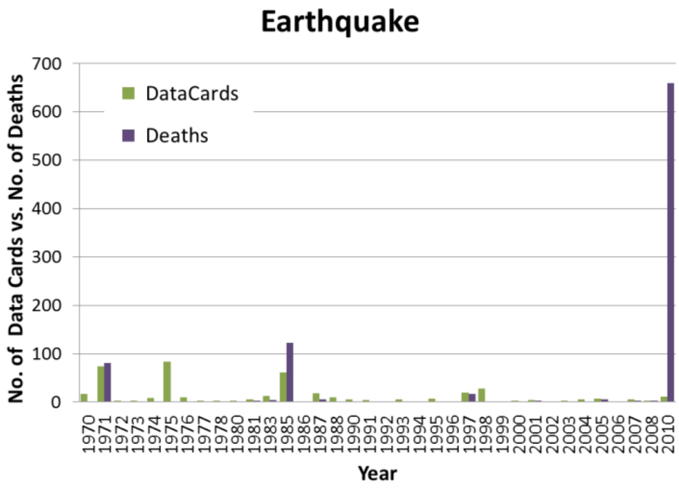


Figure 11: Chart generated form DesInventar database for Chile for earthquakes

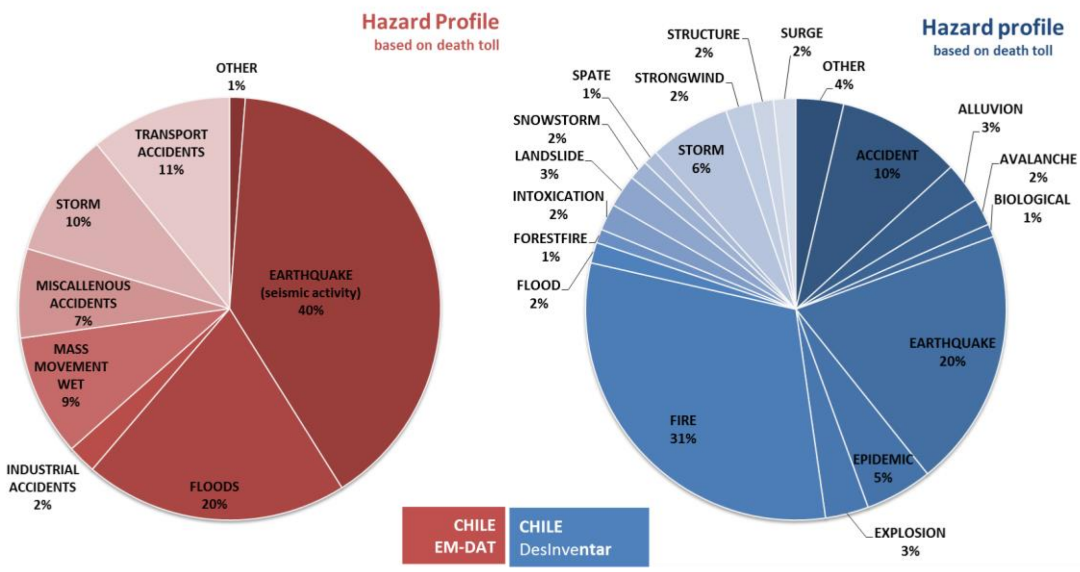


Figure 12: Hazard profile produced from EM-DAT (right) and DesInventar (left) for Chile for time period 1970-2011

Different entry criteria are also a reason for different hazard profiles for Chile (time period considered 1970-2011) produced from two different databases (Figure 12). According to EM-DAT, the prevailing hazard risks in Chile are earthquakes, floods and transport accident, while DesInventar lists fires[49], earthquakes and accidents as the main risks. The average death per card is 2.93 for earthquakes, 2.24 for accidents and only 0.58 for fires. Fire accidents are in general small accidents not detected by EM-DAT due to entry criteria, but eventually they accumulate and become the hazard type with the highest death toll.

In case of the floods the absolute value for death toll is 440 people in EM-DAT while 77 people in DesInventar. Such a huge discrepancy obliges one to carefully consider the reliability of the data.

[49] Fire (DesInventar) - Urban, industrial or rural fires, but not including forest fires. Limited to those induced or highly connected to natural phenomena, such as electrical storms, earthquakes, droughts, etc.

12.1.2 Completeness of data fields and events

The completeness of information refers to the proportion of the records in data fields that are considered mandatory in each database. The empty data fields are recognized as missing values. The zero value should not be used to indicate missing data, but only to indicate a true value of zero.

Four factors contribute to the completeness of disaster loss databases: the information provided by the data source, ambiguous definitions of data fields, un/skilled personal and the minimum entry criteria. The completeness of data fields is an indicator of quality because dis/aggregation of data is possible only when full data fields of disaster loss are provided for the final reporting for disaster risk management.

Figure 13: Completeness of data fields in EM-DAT (right) and DesInventar (left) database for Chile in the records from 1970-2011

The number of data fields where numerical values were expected was 3 in EM-DAT and 30 in DesInventar. The EM-DAT database is less demanding in that perspective. In case of the Chile inventory for 1970-2011 (Figure 13) only 2% of records were completely empty, while in DesInventar there were almost 7% of empty cards. This may indicate that often the record cards were used to record a hazard event even if no loss occurred. In DesInventar on average only 2 data fields out of 30 were filled. We can think of two reasons: first, most historical records are digitized from archives that lack data; second, not all loss indicators are relevant for all hazard types (as shown in Table 15) and the analyst decided not to insert the data.

Therefore, the meaning of zero value of the data field is even more important. There should be a clear distinction among zero value as no loss, a loss without a known value or no information about a loss.

Table 15: Main loss indicators by different hazard types (Adapted from Frederick C. Cunny: Disaster and Development, Oxford University Press, New York, 1983)

Disaster type / ***Impacts***	*Earthquake*	*Cyclone*	*Flood*	*Tsunami*	*Volcanic eruption*	*Fire*	*Drought/ famine*
Short-term migrations			x		x	x	x
Permanent migration							x
Loss of housing	x	x	x	x	x	x	
Loss of industrial production	x	x	x	x		x	
Loss of business production	x	x	x	x		x	
Loss of crops		x	x	x	x	x	x
Damage to infrastructure	x	x	x	x		x	
Disruption of marketing systems	x	x			x		
Disruption of transport systems	x		x				
Disruption of communications	x	x	x	x		x	
Panic						x	
Breakdown of social order	x	x				x	

12.1.3 Complementarity and Interoperability

EM-DAT and DesInventar are originally designed for different users. Therefore differences in structure and methodology are expected. The complementarity and consequently the interoperability is very important, firstly, for the cross-checking of the information (especially if different sources of information are used) and, secondly, if the two databases contain conceptually different information (data fields) their union can provide a more comprehensive overview of the disaster impact. In both cases it is essential for both databases to have records characterized with **event ID numbers** to aggregate and compare loss data related to the same hazard event.

EM-DAT generates its own unique disaster number DISNO for each disaster event compound of 8 digits, 4 for the year and 4 for the disaster number, while DesInventar has a data field for GLIDE[50] number. Unfortunately it is often left blank. The problem is that GLIDE is not strictly issued for every event, and for sure not for small scale events.

[50] Global identifier number is a globally common unique number assigned to disaster event by the Asian Disaster Reduction Center (ADRC) - http://www.glidenumber.net/glide/public/about.jsp

Box 1: The 2010 Chile earthquake case study – GLIDE number EQ-2010-000034-CHL

On 27 February 2010 an earthquake occurred off the coast of central Chile having a magnitude of 8.8 on the moment magnitude scale with intense shaking for about three minutes. It ranks as the sixth largest earthquake ever to be recorded by a seismograph. It was felt strongly in six Chilean regions (from Valparaíso in the north to Araucanía in the south), that together make up about 80 percent of the country's population. The earthquake triggered a tsunami which devastated several coastal towns in south-central Chile and damaged the port at Talcahuano. An aftershock of 6.2 was recorded 20 minutes after the initial quake. Two more aftershocks of magnitudes 5.4 and 5.6 followed within an hour of the initial quake. This earthquake was characterized by a thrust-faulting focal mechanism, caused by the subduction of the Nazca plate beneath the South American Tectonic Plates.

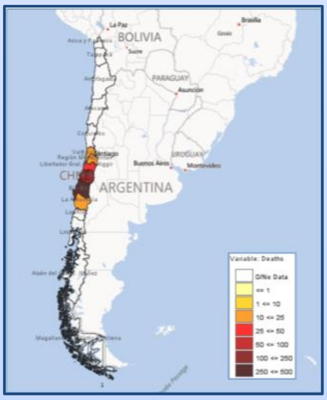


Figure 14: Number of deaths in 2010 Chile earthquake (DesInventar map)

Table 16: Comparison of 2010 Chile earthquake disaster loss data in EM-DATA and DesInventar database

EM-DAT		DesInventar		
Disaster Type	2010 Earthquake Chile	2010 Earthquake Chile		Disaster Type
Disaster Number	2010-0091	11 Cards: from 2010-00035 to 2010-00049		Serial
Data field	Data	Data		Data field
Killed	562	989	660	Deaths
			329	Missing
Injured	10334	117		Injured, sick
Homeless	800000	no equivalent data		
Affected	1861222	579		Evacuated
		631		Relocated
		2159799		Victims
		100		Affected
Total affected	2671556	no equivalent data		

Due to the different practice of data collection, in EM-DAT disasters are entered by event per country while in DesInventar disasters are entered by event per region/provincial/municipality. Therefore the DesInventar loss data above are the sum of the values on all the cards which belong to the same event (disaster type) aggregated by the date.

The names of the affected regions, provinces and districts provided in DesInventar can provide complementary information to increase the resolution of EM-DAT's national level figures. The databases could complement each other also for human loss data (when information is compiled in one database and is lacking in the other), for number of homeless (not recorded in DesInventar), for number of relocated and evacuated (not recorded in EM-DAT) and in number of total affected (not recorded in DesInventar).

However, an overall mismatch of the values of the common data fields, mainly due to the discrepancies in the data field's definitions and different source of information, squanders the credibility of any interoperable activities between the two disaster loss databases.

12.1.4 Weaknesses and strengths of DesInventar

Among existing loss databases DesInventar provides a methodology and data fields that corresponds the most to the technical requirements for recording loss data in the EU. Based on Table 17 it seems possible that EU standards can be built in DesInventar and make the two of them compatible. This does not mean that EU countries should implement DesInventar. More likely, EU countries will modify their existing systems to implement the standard. Nevertheless, in case no systems are in place, DesInventar may be a valuable solution.

Table 17: Weaknesses and strengths of DesInventar.

Weaknesses	Strengths
• Serial number of record cards is not helpful for aggregation by event and follows different standards among the countries • Too many qualitative units that should be replaced by classes when exact value is unknown • Does not consider time dependency of some data fields • Hazard classification does not allow traceability of cascading events • Definitions of data fields should avoid overlapping and ambiguity • Monetary value as the unit for loss is not transparent	• Model for minimum spatial units (i.e. region/province/commune) provides adequate resolution and observation level • Dis/aggregation through spatial units and other searching options is possible • Data field for GLIDE number • Provides geo-referenced inventory • The idea of record cards • Division on common and customized data fields • Provides human loss, physical damage and economic loss indicators • Covers natural and technological disasters • Can handle small scale events

12.2 An overview of different loss databases

Table 18: Comparison of basic assets of existing loss databases

Name of database	DesInventar	EM-DAT	NatCatSERVICE	Sigma CatNet	Canadian Disaster Database (CDD)	SHELDUS	Emergency Management Australia Disasters Database
Owner	La Red	CRED	Munich RE	Swiss RE	Public Safety Canada	HVRI	Australian Government
Number of entries	depends on the country	19000	30000 (cca 800 per year)	9000 (300 per year)	9000	600000	
Period covered	depends on the country	1900	1980 (even from 79AD) onwards	1970	1900	1960 onwards	1622
Spatial range	Caribbean, Asia, Africa	global	global	global	Canadian affected at home and abroad	USA	Australians affected at home and abroad
Spatial unit	National, subnational, local level	National level	National level		Coordinates/province/territory	County level	Coordinates/region
Disaster Type	Natural and technological disasters	Natural and technological disasters	Natural hazards	Natural and technological disasters	Natural and technological disasters, incidents	Natural hazards	Natural and non-natural disasters
Georeferenced data	Yes	No	Yes	Yes	Yes	Yes	Yes
Loss indicators	Human loss Physical damage Economic loss	Human loss Economic loss	Human loss Physical damage Economic loss	Human loss Economic loss	Human loss Economic loss	Human loss Economic loss	Human loss Physical damage Economic loss
Loss indicators related to people	Deaths, missing, injured, affected, victims, evacuated, relocated	Killed, injured, homeless, affected, total affected	Death toll, injured, missing, evacuated, displaced, affected, diseases	Dead, missing, victims, injured, homeless	Fatalities, injured, infected, evacuees	Fatalities, injuries	Deaths, injuries
Main sources	Government agencies, NGOs, and research institutes	UN agencies, US Governmen tagencies, official governmental sources, IFRC, research centres, Lloyd's, Reinsurance sources, press, private	Munich RE branchoffices; Insurance Associations;Insurance press; Scientific sources; Weatherservices; Governmentalandnon-governmentalorganisations	National disasters co-ordination bodies' publicly released information, press, industry reports, aid agencies reports, as well as internal primary research carried out by Swiss Re underwriting and claims assessors	Federal institutions, provincial/territorial governments, non-governmental organizations and media sources	National Climatic Data Center's monthly Storm Data publications, NGDC's Tsunami Event Database, USGS (earthquakes)	Bureau of Meterology, Geoscience Australia, Royal Commission and coroners reports, Governement Departments, Disaster Assist and the Insurance Council of Australia
Priority source	News media	UN agencies	Munich RE branchoffices; Insurance Associations				
Entry criteria	No minimum threshold - any event that may have had any effect on life, properties or infrastructures	10 or More people killed or 100 or more people affected or declaration of a state of emergency or call for international assistance	Entry if any property damage and/or any person sincerely affected (injured, dead), before 1970 only major events	20 or more deaths and/or missing, and/or 50 or more injured, and/or 2000 or more homeless, and/or insured losses (in 2011US$) >US$18 million (Marine), >US$35.9 million (Aviation), >US$44.6 million (all other losses), and/or total losses in excess of US$89.2 million	10 or more people killed or 100 or more people affected/injured/infected/evacuated or homeless or an appeal for national/international assistance or historical significance or significant damage/interruption of normal processes such that the community affected cannot recover on its own	1976-1995:minimum of $50,000 in damage or at least one death, 1960-1975 and 1995 onward: no thresholds	3 or more deaths, 20 injuries or illnesses, significant damage to property, infrastructure, agriculture or the environment; or disruption to essential services, commerce or industry; or trauma or dislocation of the community at an estimated total cost of A$10 million or more at the time the event occurred.
Search engine	Geographic unit, Glide number, disaster type, cause, time range, variable range	Country,disaster group, disaster type, or time period			Province/Territory, event type, time period, range of fatalities, injered, infectec, evacuees and estimated total cost, consumer price index normalization	Hazard type, location, and date/Major disasters/Presidential Disaster Declarations Number/GLIDE number	Disaster type, location, number of injuries, number of fatalities, insurance cost and date range. You can also search for a specific event using the free text field
Access	public, on-line	public, on-line	limited access	limited access	public, on-line	public, on-line	public, on-line
Web adress	http://www.desinventar.net/	www.emdat.be	www.munichre.com/geo		http://www.publicsafety.gc.ca/prg/em/cdd/index-eng.aspx	http://webra.cas.sc.edu/hvriapps/sheldus_setup/sheldus_login.aspx	http://www.emknowledge.gov.au/disaster-information/

Table 19: Data fields/ loss indicators in different loss databases

	DesInventar	EM-DAT	NatCatSERVICE Munich RE	Sigma CatNat Swiss RE	The Canadian Disaster Database	SHELDUS	Emergency Management Australia Disasters Database	Disaster Database Standard (2011) (core / comprehensive fields)
Related to location and event	Serial	Disaster number DISNO	MR-Number	Latitude	Disaster Type	Beginning date	Latitude	Serial
	DataCards	Country	Geographical information	Longitude	Date of Event	Location (county and state)	Longitude	DataCards
	Event	Disaster group	Generic group	Description of the event	Specific Location		Disaster category	Event
	Code Región	Disaster sub-gropus	Disaster group	Event date	Description of Event		Date of event (start and end)	Code Región
	Región	Disaster main type	Disaster main type and sub-type	Event date to	Latitude & Longitude		Region	Región
	Code Provincia	Disaster sub-type	Date (start and end)	Peril	Province/Territory		Description	Code Provincia
	Provincia	Date (start and end)	Description of the event (severity)	Country	Magnitude		Information sources	Provincia
	Code Comuna			Location				Code Comuna
	Comuna							Comuna
	Location							Location
	Date (YMD)							Date (YMD)
	Comments							Comments
	Cause							Cause
	Description of Cause							Description of Cause
	Source							Source
	Magnitude							Magnitude
	GLIDEnumber							GLIDEnumber
	Duration (d)							Duration (d)
	fichas.latitude							fichas.latitude
	fichas.longitude							fichas.longitude
Related to people (number of persons)	Deaths	Killed	Death toll	Dead	Fatalities	Fatalities	Deaths	**Killed**
	Missing	Injured	Injured	Missing	Injured/Infected	Injuries	Injuries	**Missing**
	Injured, sick	Homeless	Missing	Victims	Evacuees			**Injured**
	Affected	Affected	Evacuated	Injured				**Fatalities**
	Victims	Total affected	Displaced	Homeless				**Homeless**
	Evacuated		Affected					**Relocated**
	Relocated		Diseases					**Displaced**
								Evacuated
								Affected
								Victims
								Indirectly affected
								Total affected
Related to housing (usually quantitative)	Houses Damaged		Housing damaged	Description			Homes destroyed	**Houses Destroyed**
	Houses destroyed		Housing dam/destr.				Homes damaged	**Houses Damaged**
	Crops and woods (Hectares)		Housing destroyed				Buildings destroyed	**Description**
	Livestock		Boats				Buildings damaged	No. Of Livestock lost
	Educational centres		Cars				Buissiness damaged	Ha. Crops affected/destroyed
	Hospitals		Health centers				Vehicles	Number of Schools affected/destroyed
	Roads affected (Mts.)		Public buildings					Number of Health facilities affected/destroyed
	Other losses							Number of Religious buildings affected/destroyed
								Number of Government buildings affected/destrooyed
								Number of KM of roads affected/destroyed
Economic loss	Loss value local	Estimated Loss USD	Overall loss USD/EUR	Total loss USD	Estimated Total Cost	Property losses USD	Estimated cost	Total Value of economic loss USD/local
	Loss value USD		Insured loss USD/EUR	Insured loss USD	DFAA Payments	Crop losses USD	Government assistance	Direct Value of economic loss USD/local
			Munich Re share USD/EUR		Insurance Payments		Insurance cost	Indirect Value of economic loss USD/local
					Provincial/Territorial Costs/Payments			Insured Value of economic loss USD/local
					Utility Costs/Losses			Reconstruction Value of economic loss USD/local
					Other Federal Institution Costs			
Related to infrastructure and other sectors (qualitative)	Transport sector		Roads/railways/bridges	Description				
	Communications		Water supply					
	Aid organisation installations		Electricity/Communication					
	Agriculture and fishing		Infrastructere damage					
	Water supply		Business interuption					
	Sewerage		Industry					
	Education		Construciotn sites					
	Power/Energy		Agriculture					
	Industry		Fishery/aquaculture					
	Health Sector		Marine/Offshore					
	Other							
	Comments							

12.3 Multi-hazard national disaster loss databases

Two main references are used for links of available national disaster loss databases in the world: the Disaster Database portal DisDAT[51] and DesInventar website[52]. For the population data Wikipedia was used as a source[53].

Table 20: Existing multi-hazard national disaster loss databases

Database Name		Coverage	Country	Continent	Tool	Population
1	Desinventar Database for Djibouti	National	Djibouti	Africa	DesInventar	818,159
2	Egypt disaster database	National	Egypt	Africa	DesInventar	83,661,000
3	Desinventar Database for Ethiopia	National	Ethiopia	Africa	DesInventar	84,320,987
4	Desinventar Database for Kenyia	National	Kenyia	Africa	DesInventar	38,610,097
5	Mali disaster database	National	Mali	Africa	DesInventar	14,528,662
6	Morocco disaster database	National	Morocco	Africa	DesInventar	32,883,200
7	National Disaster Loss Database of Mozambique	National	Mozambique	Africa	DesInventar	23,700,715
8	Desinventar Database for Uganda	National	Uganda	Africa	DesInventar	34,131,400
9	Desinventar Database for Costa Rica	National	Costa Rica	America Central	DesInventar	4,667,096
10	Dominican Republic disaster database	National	Dominican Republic	America Central	DesInventar	9,445,281
11	Desinventar Database for El Salvador	National	El Salvador	America Central	DesInventar	6,183,000
12	Desinventar Database for Guatemala	National	Guatemala	America Central	DesInventar	15,438,384
13	Desinventar Database for Honduras	National	Honduras	America Central	DesInventar	8,385,072
14	Desinventar Database for Jamaica	National	Jamaica	America Central	DesInventar	2,709,300
15	Mexico disaster database	National	Mexico	America Central	DesInventar	112,336,538
16	Nicaragua historical database	National	Nicaragua	America Central	DesInventar	6,071,045
17	Desinventar Database for Panama	National	Panama	America Central	DesInventar	3,405,813
18	Trinidad and Tobago - Historic Inventory	National	Trinidad - Tobago	America Central	DesInventar	1,328,019
19	Canadian Disaster Database	National	Canada	America North	-	35,056,064
20	SHELDUS (Spatial Hazard Event and Losses Database for the US)	National	United States	America North	-	315,724,000
21	Desinventar Database for Argentina	National	Argentina	America South	DesInventar	40,117,096
22	Desinventar Database for Bolivia	National	Bolivia	America South	DesInventar	10,389,913
23	Desinventar Database for Chile	National	Chile	America South	DesInventar	16,634,603
24	Desinventar Database for Colombia	National	Colombia	America South	DesInventar	47,018,000
25	Desinventar Database for Ecuador	National	Ecuador	America South	DesInventar	15,471,200
26	Desinventar Database for Guyana	National	Guyana	America South	DesInventar	784,894
27	Peru disaster database	National	Peru	America South	DesInventar	30,475,144
28	Desinventar Database for Uruguay	National	Uruguay	America South	DesInventar	3,286,314
29	Disasters inventory of Venezuela	National	Venezuela	America South	DesInventar	28,946,101
30	Disaster Incidence Database (DIDB) of Bangladesh	National	Bangladesh	Asia	-	152,518,015
31	Timor East disaster database	National	East Timor	Asia	DesInventar	1,066,409
32	Desinventar Database for India - Mizoran	Province / State	India - Mizoran	Asia	DesInventar	1,091,014
33	Desinventar Database for India - Orissa	Province / State	India - Orissa	Asia	DesInventar	41,947,358
34	Desinventar Database for India - Tamil Nadu	Province / State	India - Tamil Nadu	Asia	DesInventar	72,138,958
35	Desinventar Database for India - Uttar Pradesh	Province / State	India - Uttar Pradesh	Asia	DesInventar	199,581,477
36	Indonesian Disaster Information and Data (DIBI)	National	Indonesia	Asia	DesInventar	237,641,326
37	Iran Disaster Database	National	Iran	Asia	DesInventar	77,354,000
38	Jordan Disaster Database	National	Jordan	Asia	DesInventar	6,286,200
39	National Disaster Loss Database of Laos	National	Laos	Asia	DesInventar	6,580,800
40	Desinventar Database for Lebanon	National	Lebanon	Asia	DesInventar	4,324,000
41	Maldives Disaster Database	National	Maldives	Asia	DesInventar	328,536
42	Desinventar Database for Nepal	National	Nepal	Asia	DesInventar	26,494,504
43	Calamidat Disaster Event Database of Philippines	National	Philippines	Asia	-	92,337,852
44	Desinventar Database for Sri Lanka	National	Sri Lanka	Asia	DesInventar	20,277,597
45	Desinventar Database for Syrian Arab Republic	National	Syrian Arab Republic	Asia	DesInventar	22,066,000
46	Damage and Needs Assessment system (DANA) of Vietnam	National	Vietnam	Asia	DesInventar	88,780,000
47	Desinventar Database for Yemen	National	Yemen	Asia	DesInventar	24,527,000
48	Emergency Management Australia Disasters Database	National	Australia	Oceania	-	22,973,506
49	Solomon Islands Database	National	Solomon Islands	Oceania	DesInventar	515,870
50	Desinventar Database for Vanuatu	National	Vanuatu	Oceania	DesInventar	285,213

[51] http://www.gripweb.org/gripweb/?q=disaster-database - DisDAT is the result of the collaboration between the Centre for research in Epidemiology of Disasters (CRED) and Global Risk Identification Program (GRIP), with the financial support of United States Agency for International Development (USAID)
[52] http://www.desinventar.net/
[53] http://en.wikipedia.org/wiki/List_of_countries_by_population and related links on 03/05/2013

European Commission
EUR 26111 EN – Joint Research Centre – Institute for the Protection and the Security of the Citizen

Title: Recording Disaster Losses: Recommendations for a European approach

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Abstract
In a study commissioned by Directorate General Humanitarian Aid and Civil Protection of the European Commission, the Joint Research Centre formulates technical recommendations for a European approach to standardize loss databases. Loss data are useful for the implementation of disaster risk reduction strategies in Europe (from local to national scales) and to help understand disaster loss trends at global level.

Taking stock of existing work, the study defines a conceptual framework for the utility of loss data which allows a cost-benefit analysis of implementation scenarios. The framework considered loss accounting, disaster forensics and risk modelling. Depending on the scale (detail of recording) and scope (geographic coverage), technical requirements will be more or less stringent, and costs of implementation will vary accordingly.

The technical requirements proposed in this study rely as much as possible on existing standards, best practices and approaches found in literature, international and national organisations and academic institutions. The requirements cover very detailed recording (at asset level) as well as coarse scale recording. Limitations and opportunities of existing EU legislation are considered as the EU context.

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As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle. Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new methods, tools and standards, and sharing its know-how with the Member States, the scientific community and international partners.

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