COBACORE

Community Based Comprehensive Recovery

Grant Agreement Nº 313308

D2.1 Data Identification

WP 2 Information Framework

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SEVENTH FRAMEWORK PROGRAMME

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Deliverable Title D2.1 Data identification

Deliverable Number D2.1

Keywords: Information framework, disaster recovery, data processing

Executive Summary

The collation, effective management and timely transfer of robust and credible data impact all activities and transcend all phases of the disaster cycle. All actors involved in recovery and reconstruction are dependent upon specific datasets in order to inform decision making, prioritise and mobilise resources as well as to measure the impact of interventions and response strategies. However in spite of the recognised importance of data in terms of resilience, preparedness and responsiveness to a disaster it is apparent that the efficiency of disaster intervention and planning continues to be undermined by ineffective collaboration and constraints on information sharing between the various actors that constitute the responder community. The UNFPA (2010) report entitled 'Guidelines on Data issues in Humanitarian Crisis Situations' suggests that because of the universal importance and cross-cutting nature of disaster response data no specific agency or response cluster, sub-cluster or even working group has thus far been foreseen within the responder community to focus specifically on data issues. The UNFPA report goes on to conclude that the relative absence of defined responsibility has resulted in confusion as to the most reliable sources of data and which approaches to adopt to avail such data.

There are many sources of data and a multitude of estimation methods of related information relevant to disaster related incidents, nonetheless the tendency has been for responders and relief agencies to go for the most available information without appropriate concern as to its reliability, timeliness or indeed its capacity to most effectively address information needs cross different phases of the disaster cycle (UNFPA, 2010). Consequentially, the key 'information vacuum' within the confines of disaster recovery and reconstruction does not always pertain to the unavailability of data but to the lack of harmonisation (between structured and unstructured datasets) as well as limitations around the interoperability of prevailing but often disparate data frameworks. The proof of concept information platform that the COBACORE project is developing is not intended to adversely impact existing data frameworks. Rather the intention is to complement and bolster existing data repositories through enhanced harmonisation and integration of disparate data sources and to bolster decision making capacity by identifying data gaps.

Additionally, the COBACORE information platform aspires to more effectively harness communities affected by or deemed 'at risk' to crisis incidents. This will not only bolster resilience and preparedness capacity at community level but will serve to generate potentially rich and timely data collation across the various stages of the disaster cycle. Thematic overviews of the recovery and reconstruction literature highlight that information transfer between the affected community and the responder community is increasingly considered a two-way flow with advances in ICT enabling effective cascading affected communities to the role of timely and insightful information rather than merely information recipients. Nonetheless, it is apparent that whilst advances in ICT over the last ten years have contributed significantly to the efficiency and coordination of crisis response more needs to done to champion the pivotal role of data within the recovery and reconstruction process as well as addressing the challenges and barriers that serve as inhibitors to stakeholder collaboration and data sharing. Consequentially, and in order to contribute in a positive and meaningful way to the recovery and reconstruction process the COBACORE information framework must give due consideration a number of key dynamics.

Firstly, and in order to add value the COBACORE Information Framework ***must be linked to and in a position to inform decision making****. This can be achieved through the development of a robust and credible evidence base and by addressing existing deficiencies in data composition pertaining to the recovery and reconstruction process. The COBACORE Information framework needs to encompass all phases and the disaster cycle and there needs to be recognition that specific data needs will evolve over time with peaks and troughs experienced at different points in the cycle. There also needs to be recognition that different stakeholders will enter and exit the recovery and reconstruction phase so there needs to be 'seamless' data transfer between actors. Additionally in a world of increasing accountability (particularly on the part of relief agencies to sponsors) the COBACORE platform could play a crucial role in not just informing response planning but in the monitoring and evaluation of intervention measures. To date, the process of intervention evaluation has tended to be labour intensive and expensive – often detracting from an already scare resource pool.*

Interoperability *must be the cornerstone of the COBACORE framework design. The COBACORE platform needs to collate, manage and transfer disparate structured and unstructured data sources as well as interfacing with existing frameworks in a complimentary manner in order to enhance 'picture building' and inform decision making. Economies of scale need to be 'exploited' in terms of data pooling and the effectiveness and efficiency of the data transfer process.*

Scalability and transferability *are further key dynamics of the information platform design. Scalability refers to the size and impact of the crisis whereas transferability is concerned with the type of crisis event. Many of the underpinning datasets required to respond to different types of crisis remains consistent. Moreover, event severity will have implications for the volumes and duration of data requirements as well as resource allocations, nonetheless from a data perspective many of the key indicators remain relevant irrespective of severity. The COBACORE platform must have the capacity to deal with 'less severe' crisis events as well as having the potential to be 'scaled up' in the advent of an extreme event. This is an important consideration within the confines of the COBACORE concept and will have a major determinant on application capacity.*

Transferability, scalability and interoperability will determine the 'end-user market' for the COBACORE platform. In order to deliver added value, the COBACORE platform needs to be integrated into the wider decision making framework informing crisis response – this will bolster familiarity and showcase concept potential in a 'normal' environment in order to install user confidence and 'ease of use'. COBACORE if it is to deliver on its vision cannot become 'pigeon holed' as an emergency response platform which is only rolled out in the advent of a crisis. Platforms such as the UN 'One Response' already exist in this capacity. What makes COBACORE distinct is the ***Community Focus - harnessing and sustaining localised data views and community capacity building*** *– something that existing platforms have failed to capture in a systematic manner. The technical dynamics and issues pertaining to the 'community view' will be the source of detailed exploration in D2.2 and D2.3.*

Note on this deliverable

This document represents the COBACORE consortium's view on the key aspects of Deliverable 2.1. Deliverable 2.1 (D2.1) is defined in the Description of Work as follows:

> ***D2.1) Data identification: This report will contain a comprehensive overview of the key data relating to damage and post-crisis needs assessment for reconstruction and recovery. It will include a detailed analysis of availability, accessibility, format and source of relevant data and meta-information. [month 6]***

During the creation of this deliverable, the consortium concluded that the initial aim of D2.1 could not be fully be realised at the time of submission because of the ongoing discussions on scope and focus of the project. The final project scope, key end user groups and prime use-cases will be determined as part of Task 1.1 in Work package 1, and will be established in D1.1, due in Month 12. Decisions on project delineation have a profound impact on the relevance of potential data sources, and thus directly affect D2.1. Because of the ongoing scoping and focussing activities in WP1, D2.1 focusses on the context of data and its general position in disaster recovery, rather than on the identification of data to be used in the context of the eventual information framework.

The reader is advised to regard D2.1 in this perspective. As soon as the consortium agrees on scope and focus of the project, work will commence to complement D2.1 with identified data sets that are relevant in the context of the information framework development (D2.2, D2.3) and the evaluation session preparations (WP5).

1 Introduction

The increased frequency and intensity of disasters over the course of the last decade has heightened political awareness of the necessity for disaster preparedness strategies as well as highlighting the benefits derived from bolstering resilience within areas deemed vulnerable to incidents of disaster. Figures compiled by the Centre for Research on the Epidemiology of Disasters (CRED)[1] confirm that 357 natural disaster events occurred globally in 2012. Pertinently the 2012 figure was 9.3% below the annual average disaster occurrence for the 10yr period 2002-2011(394). In terms of disaster trends CRED cautions on the need to contextualise the disaster data and to remain objective when making inference on the increased frequency and intensity of disasters given the complex of climate and weather related disasters. Nonetheless interpretation of the statistics would infer a marked increase in both the number and associated impacts of natural disasters over the course of the 10yr period to the end of 2012 relative to the period 1992-2001 for example (Figure 1).

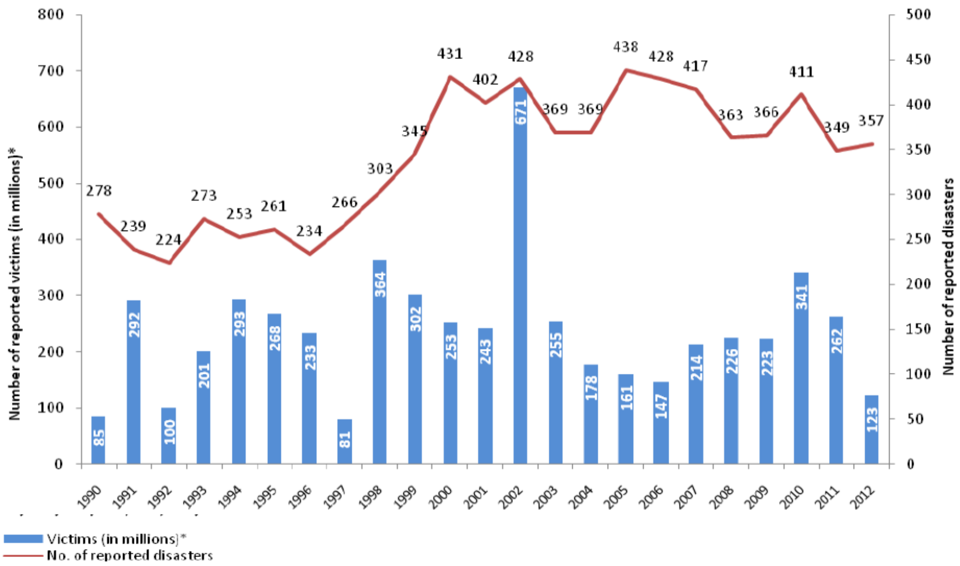

Figure 1: Trends in Natural Disaster Occurrence and Victims (source: Centre for Research on the Epidemiology of Disasters (CRED)

The escalation in reported disasters post-1995 can in part be attributed to better reporting structures as well as more active data collection efforts on the part of institutions such as CRED. However, in spite of concerted efforts to improve data availability and accessibility on disaster

[1]CRED has been active for more than 35 years in the fields of international disaster and conflict health studies, with research and training activities linking relief, rehabilitation and development. In 1980, CRED became a World Health Organization (WHO) collaborating centre as part of WHO's Global Program for Emergency Preparedness and Response.

related events, a lack of robust and credible evidence based practice continues to inhibit the efficiency and coordination of recovery and reconstruction processes. Existing data repositories have limitations in terms of their capacity to deal with the harmonisation of different forms of data (structured and unstructured) as well as the integration of new sources and formats of data as a consequence of technological advancement. Concerns persist around the regularity of data updates as well as the comprehensiveness of data capture which in the absence of key data variables affords only partially informed decision making. Murray (2011) highlights practitioner concerns in respect of the relative absence of robust and credible baseline data in many areas affected by disaster including the lack of data standardisation which has culminated in data inconsistencies and incomparable baseline information. Depending on the disaster context, data can be ad hoc, fragmented and too superficial for real time decision making and action. These limitations create significant problems in developing best evidence based practice guidance for disaster and crisis management.

Paradoxically, many sources of data relevant to damage and post-crisis needs assessment for reconstruction and recovery planning exist, the prevailing challenge is to identify and determine the relevance/significance of these disparate data sources before harnessing them into a usable, manageable and consistent data framework.

Work Package 2 will develop a best practice response, recovery and reconstruction data framework that provides a platform to bolster collaboration and promote data sharing amongst key stakeholders. It is intended that the data framework encapsulates the 'COBACORE ideology', complimenting existing data 'frameworks' and adhering to the overriding premise of enhancing the effectiveness and efficiency of the recovery and reconstruction process.

Advances in the quality of data provision, more robust analytical processes as well as increased multi-disciplinary focus have all served to enhance the proficiency of the recovery and reconstruction process over the course of the last decade. However, in spite of such evolution, key stakeholders have been forthright in their views that more can and needs to be done to enhance the timeliness, credibility and interoperability of data. Moreover, there is a need to transcend the 'silo' mentality (Mays et al, 2013) which so often characterises major recovery and reconstruction efforts as well as a pertinent need to more effectively harness the as yet largely 'untapped' data resources that are affected communities within the disaster locale. It is widely recognised that affected communities are more responsive and collaborative to recovery and reconstruction plans if their insights and ideologies are encompassed within the recovery and reconstruction master-plan. Evaluations of disaster incidents over the course of the last decade have highlighted the need to more effectively mobilise and embrace the competencies and skills sets that exist within communities deemed vulnerable to recurring disaster incidents as a means of bolstering resilience.

A key dynamic in tackling the dual challenge of enhancing responder collaboration and mobilise community participation is through the development of a more integrated and utilisable data framework. Through the development of the COBACORE data framework WP2 will serve to improve data transparency and accountability, maximize data capture pre- and post-crisis and bolster the operational capacity and efficiency of the data transfer process - a process considered a two-way flow between the affected community and the responder community.

Within the confines of the COBACORE project, WP2 contributes to the fulfilling of the overall conceptualisation through a number of inter-linked objectives:

- To establish common best practice baseline indicators and meta-information relevant to response, recovery and reconstruction which can be consistently applied across Europe and potentially globally.
- To identify the data required to underpin the common best practice baseline indicators (including source, format and possible limitations).
- To establish secure communication channels for acquisition, storage/management and sharing of data.
- To acquire the available data and develop processes for augmenting this data to enhance its utility and address data gaps.
- To develop a common best practice response, recovery and reconstruction data framework that facilitates the data acquisition methodology and helps direct the platform architecture, whilst ensuring that the data is compliant with EU Directives (such as INSPIRE), including the production of compliant meta-data.
- Provide a mechanism whereby the data framework can provide the structure upon which the community, situation and needs models (developed further in WP3) are analysed.

Work Package 2 does not exist in isolation; rather it forms an integral component of the 'operational dynamic' of the COBACORE concept (Figure 2). Indeed, the data and information framework being developed within WP2 will serve as the 'underpinning' of the COBACORE platform informing and facilitating data flow to support the management, visualisation, mining and model development being undertaken in WP3 and WP4. Whilst some methodologies hypothecate the composition of multi-facetted data repositories, at present no information framework affords the depth and range of baseline data advocated by COBACORE nor is there propensity for the levels of collaboration or inter-operability.

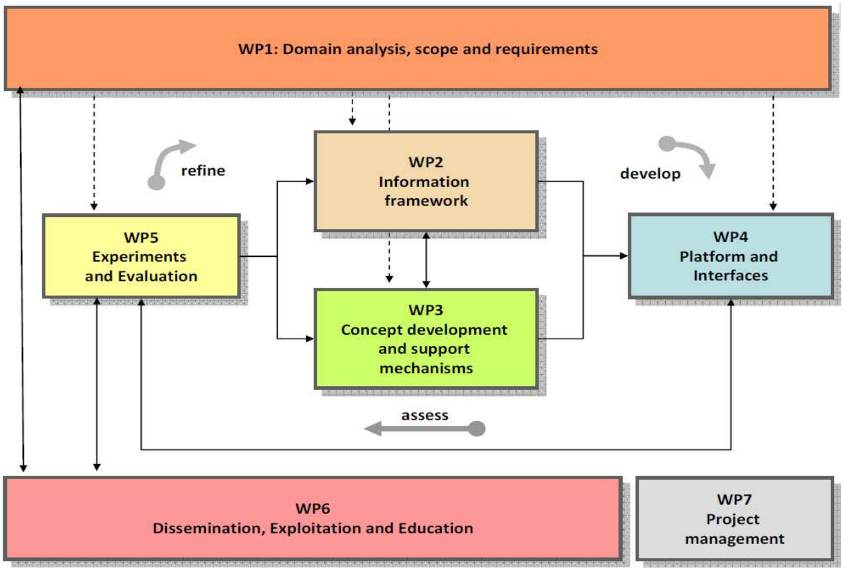

Figure 2: Position of WP2 within the COBACORE Project

The data framework may serve as the fulcrum for WP2 in terms of anticipated outcomes. The composition of that framework and data sources that will ultimately populate the framework form a critical strand of the 'scoping' exercise. The structure of the information framework drives the development of the project forward, as it provides the underpinning for the various dynamics that place inside the proposed platform, and steers the development of the various interfaces to the platform. Moreover, the selected structure of the information framework helps to obtain a greater understanding of data and information needs in various stages of a disaster.

Specifically, D2.1 will focus on the identification and categorisation of data sources considered pivotal to informing and guiding all phases of the recovery and reconstruction process. Importantly, D2.1 will outline the scope of the information framework (across the various stages of the disaster cycle), the structural composition and categorisation of data sources as well as affording due consideration to the operational context and stakeholder application. The remainder of the report is presented in a series of sections. Section 2 examines the role of data across the various phases of the crisis recovery and reconstruction process. Section 3 details the challenges and barriers to effective data utilisation within the confines of a dynamic crisis environment. The role of data within the COBACORE platform is discussed in section 4. Section 5 presents an overview of how COBACORE could be applied in a crisis context. Conclusions and plans detailing the way forward are presented in section 6.

2 The Role of Data in Disaster Management

Disasters both natural and man-made create a dire need to rapidly collate, comprehensive and reliable data on the nature, extent and actual consequences of an event. Gathering and communicating data to stakeholders is the lifeline of any disaster response. It is critical for all parties involved to understand the situation and its expected evolution. This comprehension is needed to implement an effective and efficient recovery plan and bring relief to those affected who need it. The capacity to effectively acquire, collate and share data is essential to this comprehension, and is the primary enabler for coordination between stakeholder parties.

When looking at the role of data in disaster management, it is important to understand how stakeholders use data throughout the various phases of a disaster, and what the objectives are to which data contribute. For this, first a further look is taken at the concept of data itself, and then the use of data is examined in the different phases of a disaster, with a specific focus on needs assessments.

2.1 On data and information in disaster management

The word 'data' stems from Latin, as is the plural of 'datum', meaning 'things given or granted". In common use, the word data usually refers to the outcome of measurements, and hence usually has the form of numbers, words or images (being structured sets of numerical values). Broadly speaking, data usually represent facts. In that sense, data itself has little meaning. In the hands of a human receiver or a data-analysis system, meaning may be given to data, turning it into information. Data that captures the state of a building after an earthquake is just a factual description (i.e. 'collapsed'). Interpretation of that fact and the realisation of its consequences lead to *information* (i.e. 'uninhabitable'), and may lead to a decision (i.e. 'we need to rebuild that house, and provide temporary shelter'). In practice, the words data and information are often used interchangeably, but for the purpose of this report, it is important to keep that distinction in mind.

In order to be meaningful towards decisions, data needs to be processed. In information theory, the term *data processing* refers to the process of collecting and manipulating items of data to produce meaningful information. The term *Information processing* refers to the act of transforming information into other representation, so it becomes valuable to multiple parties. Obviously, data processors and information processors are those parties or systems that perform the processing tasks.

We can further differentiate data by looking at two aspects: the nature of data and the acquisition form. There are two main types of data: *quantitative and qualitative data.* Quantitative data is data that can be expressed as a number, or can be quantified into a number. Examples of quantitative data are scores on surveys, counts, weights, number of occurrences of a certain events. Such data can be represented by ordinal, interval or ratio and are suitable to mathematical or statistical operations. *Qualitative* data cannot be expressed as a number, such as subjective observations ('high', 'low'), personal preferences, narrative descriptions ('wet', 'poor', 'good'), and other non-numerical measures. Both types of data are valid types of measurements and can be acquired by empirical acquisition efforts. Obviously, quantitative data is the more preferable type if said data needs to be further processed or combined with other data.

Another important aspect is the distinction between *primary and secondary data*. *Primary data* is data that is gathered by direct observation, e.g. first-hand accounts, measurements by sensor systems, or field observations. *Secondary data* is data that has been collected and compiled by another party than the eventual user. For instance data that is acquired from census, cadastral registries, survey reports, and existing maps is considered to be of a secondary nature.

Table 1 gives several examples of disaster-related data, using the above two dimensions.

Table 1: Examples of disaster recovery related data

	primary	secondary
qualitative	Field observations, survey data, interview transcripts.	Impact assessment reports, situation reports, background data on the environment and the disaster
quantitative	Sensor measurements, population counts, measured environmental data.	National statistics, census data, maps,

2.1.1 Data and information in disaster management

Now, why is it important to scrutinise data in this manner? As stated before, the availability of data forms the foundation of disaster management. Data is the fuel that drives the machinery of post-disaster recovery. Therefore, it is crucial to examine where data stems from, how it is used and what its role is in shaping the recovery process. By examining the sources of data in use throughout the recovery continuum and understanding how data is utilised, we can identify possible causes of misjudgements, recognise data deficiencies and have a better comprehension of how the COBACORE platform could play a valuable role in disaster recovery.

In short, it is essential to understand and answer these questions:

- What data is typically available and needed in the various phases of recovery?
- What sources can that data be drawn from?
- Who are the primary data providers, and how can they be accessed?
- Who is responsible for collating data into actionable *information*?
- How does information relate to the various objectives of the parties involved?

2.2 On disaster management phases

Studies and debates on the various phases of disasters go back as far as the 1930s. Both scholars and practitioners within the field of disaster management have used these categories relating to the various stages of disaster to better understand their field of study as well as improve their response to disaster events (Coetzee, 2009). Typically, there are four main stages of a disaster that can be discerned: the Preparedness Stage, the Response stage, the Recovery stage and the Mitigation stage (Figure 3).These four stages are usually considered to be part of a cyclic process – a disaster management process where experiences and lessons learnt from a disaster give way to new risk reduction measures. This cycle is usually referred to as the *disaster management cycle*.

Figure 3: The disaster management cycle

Each disaster stage has a different focal point and, consequently, has different data needs depending on the primary objective of the relief or preparatory efforts. For COBACORE purposes, a slightly amended version of the classical disaster management cycle is adopted, and that consists of the following phases:

- The Preparedness phase
- The Response phase
- Early Recovery
- Late Recovery

There are a number of important implications to the disaster management cycle. First of all, the recovery process after a disaster event essentially constitutes a transition from *relief to development*. In the early stages, the emphasis is on providing relief and providing safety and security to those affected. In later stages the primary objectives shifts towards redevelopment, where the emphasis lies on restoring livelihood. Data and information needs will follow suit, and go from information about the vital aspects of the disaster and the affected communities in the early stage of disaster response to livelihood and community needs in latter stages.

Secondly, and in relation to the first point made, there is a shift in ownership of the process. In the early stages of a major disaster, the response and recovery process will typically be in the hands of national authorities and capable humanitarian organisations. In later phases, when the situation has been stabilised, the primary control will be brought back to regional and local authorities and locally active support organisations. Consequently, data and information needs will be more fine-grained and community-generated in latter stages than in early stages.

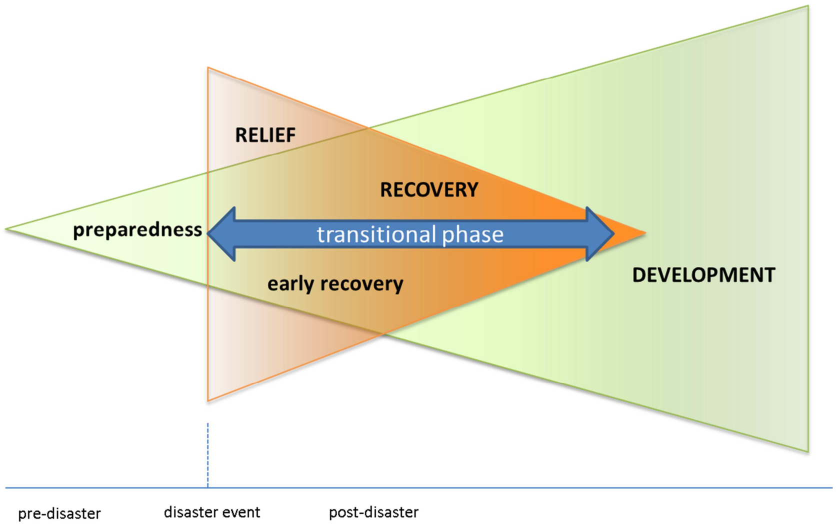

Figure 4: The transition from relief to development in disaster recovery (after: UN-OCHA, Guidance note on Early Recovery).

2.2.1 The Preparedness Phase

Table 2: Characteristics of the Preparedness phase

Preparedness stage	
Also known as	The mitigation & preparation stage, pre-crisis stage
Timeframe	Pre-crisis
General description	Activities in this stage are geared towards reducing the risk and extent of damage of possible disasters, and make societies aware of the risks they run
Primary objective of activities	Strengthen the overall capacity and capability of a society to manage possible emergencies and ensure an efficient and effective disaster recovery process
Typical activities	• conduct vulnerability and capability assessments • conduct disaster risk assessments • implement disaster risk reduction and mitigation measures • implement community disaster awareness and preparation measures
Typical parties involved	National governmental agencies, professional analyst groups

Typical data and information need	• Baseline data and information about the target environment as to assess vulnerabilities to various possible disasters, and to plan prevention and preparation measures.
Primary data types	Secondary data (quantitative, qualitative)
Example data sources	• Baseline data from national or local registries (census data, cadastral data, national statistics reports). • Data and information from key organisations in relevant sectors • Data on vital infrastructures • Information about national and local disaster management governance

In most developed countries, national governments undertake disaster risk reduction activities and vulnerability analyses in order to be well-prepared in case a disaster strikes. Such efforts go by different names, such as the 'national risk assessment', 'Vulnerability and Capacity Assessment (VCA)', 'disaster risk reduction efforts', and other similar titles. These efforts are usually government-led because of their society-wide implications and the investment needed to take up recommendations that follow such assessments. These activities typically include:

- The assessment of possible and likely disasters and the consequences on society
- The initiation of response plans to the identified risks
- The identification and implementation of risk-reduction activities to prevent or lessen the effects of expected hazards, risks and vulnerabilities.

To achieve comprehensive disaster preparedness, a great deal of information must be gathered and maintained in advance of an event. Most humanitarian crisis and disaster scenarios are unexpected but some can be detected through Early Warning Systems (EWSs) which can be introduced to scan the physical and social environment for evidence of natural or man-made disasters. This serves to underline the need for contingency and preparedness planning to enhance the level of preparedness pre-disaster in order to mitigate risks and levels of impact during an event (UNFPA, 2010). Fundamental therefore to disaster preparedness is the collation of a number of key baseline datasets to enable area profiling and to assist and inform decision making following the onset of a crisis. These key baseline datasets typically include:

- Disposition of the population, including residential areas, demography, vulnerability of population groups and social capital
- Critical sectors, including utility and transportation facilities, financial services, public order and safety
- Cultural heritage and social facilities
- Cadastral information and other related administrative sources concerning the build environment

It is advantageous where possible to include responders, emergency planners and other key stakeholders in the assembly of key baseline datasets as this determines information needs from the various stakeholder perspectives and facilitates the development of a 'holistic' and necessary data composition. It is not uncommon to also involve civilians into the vulnerability assessments, as to have a better understanding of the local priorities and to be able to identify local capacities to assist in certain disaster scenarios. Especially in less-developed societies with weak or under-equipped national governments, vulnerability and capacity assessments tend to yield to most value when performed at the local community level. In such circumstances, humanitarian organisations often take over the coordination of such assessments efforts.

2.2.2 Response stage

Table 3: Characteristics of the Response stage

Response stage	
Also known as	the Acute Stage, the Relief phase, the Rescue stage
Timeframe	Immediately following a disaster event
General description	Immediate relief efforts in response to a disaster event
Primary objective of activities	• Fulfil the basic humanitarian needs of the affected population • Safe lives and protect vital infrastructures
Typical activities	• Planning, preparation and implementation of humanitarian relief responses • Estimation of the damage by collating reports and comparing pre- and post-disaster states • Conception of a common situational picture • Providing information to the wider public
Typical parties involved	Local and national governments, professional disaster management services, humanitarian relief organisation, virtual and technical online communities. In case of major disasters: international communities
Typical data and information need	• Data and information about the state of the environment (e.g. damage reports, population health reports) • Data and information about response capabilities by relief organisations and professionals • Data and information about the evolution of the disaster • Accounts of acute needs by affected community members • Baseline information about the pre-disaster state of the environment
Main data types	Primary data (qualitative, quantitative), secondary data
Example data sources	• Community-generated damage-, needs- and response

	reports • Measurements from sensor systems (including vital infrastructure status reports, environmental sensors, and other relevant measurements) • Baseline datasets to interpret field observations • Relief capacity reports of response organisations

Following the onset of a disaster, the immediate concern for disaster managers and responders is maximising the effectiveness of humanitarian actions. This is achieved by identifying target groups and their specific needs as well as the political, physical, cultural and social barriers that prevent access to services. The collection and analysis of data and precise knowledge of the working environment are prerequisites for the proper evaluation of needs and the determination of priority targets. Moreover, given the urgency with which information necessary for decision-making is expected, an Initial Rapid Assessment (IRA) is the most appropriate data compilation technique following a disaster event. The IRA is implemented to furnish the needed baseline data for decision making, determine capacities and available resources within the affected community while assessing needs, vulnerabilities and gaps in essential services. It seeks to respond to the following key questions:

- What happened? Does an emergency situation exist? If so, what are its main characteristics?
- To what extent has the population been affected by this crisis? Who is likely to be more vulnerable and why? How many persons have been affected and where are they?
- Are any specific interventions needed to avoid further harm, accidents or loss of life? If so, what are the priorities in terms of humanitarian assistance?
- What are the persistent or likely threats that could worsen the emergency situation?
- What resources and capacity are available on the spot (e.g., infrastructure, institutions, etc.) to assist in humanitarian response? What capacity gaps have been identified?
- What pertinent information is lacking that could be obtained through follow-up surveys or qualitative studies?

There are no standard methods for conducting IRAs rather the approach is tapered to the type of humanitarian crisis, the specific information needs of responder/stakeholders, the degree of accuracy expected and the resources available in terms of both pre-assembled data and field gathering capacity (UNFAP, 2010). However, whilst the implications of disaster events vary significantly dependant on factors such as the nature of the event, the intensity and duration, the location affected and the levels of community preparedness and resilience the underpinning data needs exhibit high level of consistency.

Pertinently, two important trends are emerging in the disaster management field that for all intention purposes are dependent upon the effective collation and timely distribution of data. Firstly, international cooperation within the confines of disaster response is expanding leading to increased information exchange between organisations. Secondly, a greater volume of publicly or 'grass root' generated information has created challenges in managing the sheer amount of information available but also ensuring its validity and usability. As the UN OCHA (2012) concludes – 'For information to have value, it must inform'. These two important trends are now considered in turn from both a sociology and technical perspective.

2.2.3 Early recovery stage

Table 4: Characteristics of the Early recovery stage

Early recovery stage	
Also known as	The Post-Acute Phase, the Chronic Phase
Timeframe	Shortly after the immediate relief phase of a disaster, usually starting after a few days.
General description	A transition phase from immediate relief efforts to longer-term recovery. The early recovery phase aims to recover the vital services to the affected communities and lay down the foundation for long-term recovery.
Primary objective of activities	• Planning and preparation towards sustained recovery • Monitoring of ongoing relief efforts • Establish basic rehabilitation of services to affected communities • Establish the foundation for longer-term recovery and formulation of a desired end-state
Typical activities	• Formulate recovery and redevelopment plans • Provisionally recover the most crucial vital services • Mobilise and enable communities to participate in recovery efforts • Establish coordination groups to oversee the recovery effort • Perform needs assessments on livelihood aspects
Typical parties involved	Local governmental agencies, local communities, locally operating humanitarian NGOs
Typical data and information need	• Primary data obtained from the affected environment, e.g. field surveys and observations by relief workers, community-generated data • Baseline information about the pre-disaster state, and information about the desired end-state.
Main data types	Primary data (qualitative , quantitative), secondary data
Example data sources	• Community surveys, field observations • Baseline information about the pre-crisis state of the environment • Key information about the state of vital services

The Early Recovery phase is a transitional phase – from humanitarian relief to redevelopment. During the Early Recovery phase the immediate threat of the disaster has passed. The population is just beginning to see the results of the disaster and its effect on their community. It is during this time that governmental agencies and NGOs will begin their evaluation of the disaster area to assess the damage and plan the magnitude of response. The purpose of the early recovery approach is to reduce the need for future humanitarian interventions – or in the first instance, reduce the scale – and ensure that by having a development voice in the humanitarian arena, the essential work of humanitarians will also help to attain development goals.

This early recovery phase predominantly focuses on recovery of the most concrete part of the 'fabric' of the community, being the vital services that make life sustainable in the affected areas, such a critical infrastructures (water supply, roads, energy services, health services, sustained food supply). Recovery of the critical sectors, enables the community to return to 'normal life' and to fully participate in the recovery process.

Early recovery helps to improve coordination between humanitarian and development actors and helps saving lives, money, and protects development achievements and opportunities. It addresses the divide between relief and development activities; while stressing the importance of local communities, as well as national and local authorities. In this sense, early recovery augments humanitarian assistance operations; supports spontaneous recovery initiatives by affected communities; and establishes the foundations for resilience and longer-term recovery as soon as possible after a disaster or crisis.

Early recovery activities should commence as soon as possible, whenever the circumstances allow. Typical early recovery activities include:

- Support rehabilitation of local businesses via financial injections and other supportive measures to revive the economic climate of the affected area
- Restore vital infrastructures and public services
- Restore governance structures and capacities needed for both relief activities and recovery planning
- Support community restoration and resettlement of displaced persons
- Infrastructure rehabilitation, to improve access to basic services as well as revitalize the local economy
- Improve livelihood by cleaning debris, easy access to public facilities and provide information on recovery planning to the affected society

2.2.4 Late recovery stage

Table 5: Characteristics of the Late recovery stage

Late recovery stage	
Also known as	Post-crisis phase, reconstruction phase
Timeframe	Months to years after a disaster
General description	A period of recovery, resettlement and reconstruction that re-establishes livelihood to an affected society. This phase is more akin urban planning and development than relief, and is grounded in the ambition to restore livelihood and long-term safety to the affected society.
Primary objective of activities	• Re-establish the livelihood of affected communities • Bring the affected society and environment towards the previously stated desired end-state
Typical activities	• Implement development plans on affected sectors • Engage communities in the recovery process
Typical parties involved	Local and regional governments, local NGO's
Typical data and information need	• Longer term needs derived from the difference between desired end-state and the actual situation • Data on the state of services and facilities to the affected communities • Information about groupings that take on specific recovery ambitions.
Main data types	Primary data (quantitative and qualitative), secondary data and information
Example data sources	• Specified livelihood needs from community members • Local development plans and recovery efforts • Contact information of groups that partake in the recovery effort.

The late recovery phase is a natural progression from the Early Recovery phase. During the Early Recovery phase, the focus is still very much at re-establishing the foundation for proper recovery. As soon as vital services have been rehabilitated and the basic needs of the population have been met, the focus will go towards sustained development of the affected environment. The Late recovery phase is still very much guided by national and local disaster coordination mechanisms, but is aimed at bringing the recovery efforts back into the hands of local communities, such as local governmental agencies, locally operating services and NGO's and the affected communities themselves.

As time progresses, the desired end-state should be more elaborate and should be developed in consent with the affected community itself. As Nakagawa & Shaw (2004) put it: "*Disaster recovery is not only about building houses but the reconstruction of the whole community as a safer place*." A good example is the recovery after the 2011 earthquake in Christchurch, New Zealand. In interaction with the affected community and based on more than 100.000 submitted suggestions a vision on the future for central Christchurch was developed, consisting of five key themes (Christchurch, 2013): *green city; stronger built identity; a compact city core; live, work, play, learn and visit*; *accessible city*. Throughout the recovery process, citizens have been invited to contribute to realising the five key aspirations for Christchurch. The recovery of the district Roombeek after the explosion of a fireworks storage in 2000 (Enschede, The Netherlands) shows a similar pattern (Roombeek, 2013).

In late recovery, primary, community-generated data becomes more important. This is not only due to the additional emphasis on community engagement, but also due to the particular focal points of late recovery. Late recovery activities will usually focus on livelihood-related themes, such as social wellbeing, cultural fulfilment and personal sense of security and wellbeing. Data and Information relevant to these themes are highly subjective in nature so they will need to be obtained from those who are affected.

3 Challenges to Effective and Efficient Use of Data in Crisis

In spite of the considerable progress that has been made over the course of the last decade to address inefficiencies in the crisis recovery and reconstruction process and to enhance collaboration between key stakeholders, data sharing and the coordination of information (across all stages of the crisis cycle) continues to be considered problematic by those involved in crisis response. A number of research investigations attribute the inability to share and effectively coordinate information to the dynamic and volatile nature of a crisis environment (Kapucu, 2006). Nonetheless the need for stakeholder collaboration within a crisis scenario is undisputed whilst the value derived from a robust and credible data rich evidence base has been shown to contribute to a more effective and efficient response strategy as well as informing a more sustainable recovery and reconstruction process. As such there is an onus on key stakeholders to explore opportunities for greater integration of data resources within the confines of crisis planning and to actively encourage and promote the sharing of information.

Paradoxically, experience of previous crisis incidents suggest that the real barriers to emergency response and crisis management are not necessarily the lack of data but the fact that huge amounts of data is stored in different formats or is held by disparate stakeholder groupings (Donkervoort et al. 2008). Moreover, bottlenecks in data transfer are in most cases attributable to the lack of data standardisation and the lack of interoperability between both organisations and key data sets. Creating synergies across the various phases of the disaster cycle and between the key actors very often necessitates the reshaping of working processes, interactions and interfaces, building common data pools as well as sharing skills, methods, tools and applications. As a consequence the ideology of more efficient and effective data utilisation within the confines of crisis recovery and reconstruction is it not without complexities. The principal challenges are examined within sub-sections 3.1-3.5.

3.1 Data Accessibility and Availability

The unrestricted availability and accessibility of data is essential for the realisation of interdisciplinary understanding and for developing situational awareness of the impacts, ensuing risks and potential cascading consequences of disaster incidents. Invariably the depth and completeness of the data available will vary across different points in the disaster cycle but the availability of data and the capacity to access that data in a timely manner will have a major bearing on capacity to inform decision making premised upon a credible and robust evidence base.

Kohler et al. (2006) highlight that the costs and completeness of data as well as availability and usability differ considerably from one country to the other and according to the purpose for which they have been collected. The underpinning data necessary to inform all stages of the disaster and recovery process are for the most part not held centrally. In many European countries key datasets used to inform reconstruction and recovery are collated by federal, regional or local authorities. Research institutes also have access to rich data repositories whilst various data sets deemed critical to informing the decision making process are held by non-governmental and commercial providers. A further dynamic in terms of data accessibility is Intellectual Property Rights which often act as a barrier to the integration of different data sources to new user oriented information.

The principal barrier to open data sharing is nonetheless the arcane format in which data is collected and presented on government computers and the inability to share this data easily with other actors involved in the recovery and reconstruction process or the wider public. The ability to capitalize on advancements in ICT which advocate data sharing is to a great extent dependent upon both companies and governments improving how they share information. For example, in the US following the aftermath of Hurricane Sandy it was discovered that regulations and policies needed to be amended or altered to allow for certain collaborations with public data. This is often one of the hardest changes to make, but by illustrating the benefits to the State and the citizens, resolutions can be found. While many government agencies and first responder systems may need a certain level of security and firewall to the outside world, speedy and open access, powering the ability of users to share and communicate information, accelerates relief efforts.

3.2 Harmonisation and Interoperability

Di Maio (2008) advocates the view that advances in ICT technologies, especially the internet and related web based applications constitute an ideal pervasive, real time and distributed platform theoretically well suited to optimize data exchange, in order to bolster the flow of information to key decision makers involved across all elements of the recovery and reconstruction process (Di Maio, 2008). However, one of the key challenges facing crisis response managers is the lack of data harmonisation and the interoperability of data sets across different national contexts as well as between key stakeholder groupings. Harmonisation refers to the standardisation of data so that they can be matched with other data and information regardless of the format (Villa et al, 2008). Interoperability is the ability of products, systems or business processes to work together to accomplish a common task (Villa et al. 2008). The major issue in data harmonisation within the confines of crisis response is that currently there is no framework setting common, unifying, data collection and production measures and a proper agreed exchange format between organisations. Meanwhile, different domain vocabularies are often used by different crisis information systems. This presents a challenge to exchanging information efficiently since the semantics of the data can be heterogeneous and not easily assimilated. For example, the word ‘Person’ can have different meanings - a ‘displaced person’, ‘recipient of aid’, or ‘victim’. Within this premise semantic interoperability is a key challenge to the interoperability of Information Sharing Systems (ISS) within the confines of crisis response and recovery.

Shaw et al (2013) highlight that the increased use of information systems and data within crisis management makes the challenges of information sharing and data interoperability increasingly important. The Haiti Earthquake in 2010 is considered a watershed in the application of disparate and remote forms of Information and Communication (ICT) to inform the recovery and reconstruction process (Hattotuwa and Stuffacher, 2010). Nonetheless, the earthquake in Haiti served to highlight a series of deficiencies in the collation, analysis, interpretation and transfer of data within dynamic, highly volatile situations. Communities affected by the earthquake for the large part remained passive recipients of information, having to deal with, amidst significant trauma, competing information on aid delivery and services. Beyond the hype, the majority of those affected by the earthquake were beyond the radar of ICTs (Hattotuwa and Stuffacher, 2010). The Head of the UN OCHA, expressed frustration at the relief effort citing ‘only a few relief clusters have dedicated cluster coordinators, information management focal points and technical support capacity’. Beyond the UN observations, significant concerns were expressed about the coordination and collaboration between civil and military responders and the lack of data and information sharing as consequence of the incompatibility in datasets as well as the capacity to capture (and indeed place trust in) unstructured data being delivered through new forms of media.

Paradoxically, Haiti has been described as a 'technological learning environment' within the confines of a dynamic crisis environment. In the immediate aftermath of the earthquake a series of information platforms were initiated in order to leverage existing web, internet and mobile technologies, including social media platforms to inform relief and response strategies. The **USHAHIDI** platform facilitating the collation of distributed data via SMS, email, or web and visualise it on a map or timeline was deployed in order to ascertain the needs of affected communities in the field. **SAHANA**, a web-based collaboration tool designed to address coordination problems amongst actors involved in the relief effort was also deployed utilising crowd sourced data in discerning the precise coordinates of key infrastructures including medical provisions. USHAHIDI and SAHANA complemented the UN's OneResponse platform which served as the key portal in terms of situational reports, updated contact information and mapping data. Pertinently, almost all relief agencies involved in Haiti including military personnel utilised social media and mobile technologies to coordinate, collaborate and act upon information generated from the affected communities (Hattotuwa and Stuffacher, 2010).

Reviews of crisis incidents over the course of the last decade highlight the increasingly important role of ICT systems in informing the response and recovery process. Moreover, there is increased recognition amongst the responder community that in the prevailing 'network age' (OCHA, 2012) communication and production of data is no longer a 'one way street' – humanitarian organisations and policy makers responsible for the initiation of disaster preparedness strategies and for the coordination of recovery and reconstruction operations are increasingly embracing the benefits of not just disseminating information but having a dialogue and receiving information from affected communities - those who previously were just information recipients. The advancement in ICT to enable two-way communication flow within the advent of a crisis incident is widely considered a positive development within the disaster management literature. Nonetheless, concerns have been raised around the reliability of the information presented by affected communities as well as the capacity of affected communities to understand and act rationally on information from responders within highly volatile situations. In order to be useful, information must be accurate, trusted, and easily understood by both the affected community and the disaster responders.

Whilst the Haiti earthquake for example served to highlight the positive benefits offered by crowd-sourced information there are a number of risks which also stem from this innovative aspect of modern communication technology. Anyone who has access to mobile or online technologies can contribute to ongoing dialogue and preparation of solutions within a crisis period – this has major implications in terms of verifying and validating the data. Data from social media can be especially unsound and requires some form of verification tasks to be carried out in order to determine validity.

Moreover, the potential for a 'tsunami' of information that can result from harnessing social media channels post-disaster, has the potential to overwhelm any envisaged platform. Sorting through the 'noise' of this vast amount of data whilst serving to overcome historic barriers in the form of 'information vacuums' presents new challenges in terms of the capacity and effectiveness of data management systems as well as the ability to integrate and harmonise of both structured and unstructured datasets to inform crisis response. The accuracy of information generated from crowd sourcing platforms is nonetheless often low; sometimes less than a third turned out to be accurate. Moreover, the tendency of citizens to exaggerate under extreme stress should not be underestimated, nor should the potential service that crowd sourcing will serve in future operations as citizens learn how to use social media.

Harnessing the potential benefits to humanitarian efforts of advances in ICT and mitigating the risks that they pose will be a key challenge for crisis response agencies moving forward. Large scale disaster incidents such as the Haiti earthquake are prominent examples of how crisis response efforts are evolving to leverage the efficiencies offered by the internet in the area of real time communication among agents and stakeholders. Nonetheless, OCHA (2012) reports that current practice has not been able to take full advantage of the new technologies and partnerships offered by this 'network age' to share, manage, understand and then act on information in an effective and timely way. Indeed, post-crisis evaluations of crisis responses over the course of the last decade would suggest that whilst the new sources of information available as a result of new technology, these new sources of 'information' are not being effectively harmonised with more traditional and structured data sources. It is apparent that today's information systems used in the field of disaster management are often not as open and extensive as needed to consolidate the complex data sets and the different systems described above for solving tasks and questions based on complex workflows and scenarios. Interoperability as well as application-oriented integration of methods, data and systems must be improved. This could be realised by designing distributed software architectures, which enable and support flexible and interoperable keeping, integration and more effective networking.

The COBACORE platform will need to accept inputs from a host of different actors and then provide information back to the actors in a standardized format. As more actors become involved, and as more people gain access to communications technology, the challenge of managing that process has grown. Moreover, different cultures, a lack of shared standards, the absence of operational protocols and competition for resources often make it difficult for diverse humanitarian agencies to work together (OCHA, 2012). Finding a standardized method of communication between all the actors will be challenging as many of the organizations/actors involved are unlikely to be able, or willing, to adopt a specific standard. However, for common disaster related information that can be collected in a structured way, standards can help to improve the quality and reusability of the data. Adoption of COD (Common Operational Datasets) and FOD (Fundamental Operational Datasets), describe an excellent base layer of information that is structured and can be widely used across humanitarian organizations. For most unstructured sources the method of communication must be on the providers' terms e.g. for retrieving and submitting Twitter data we can only use what Twitter has made available through its open API. The sharing and interrogating of disaster related datasets can be achieved by espousing the principles of 'linked open data'. One such humanitarian linked open data protocol is HXL (humanitarian exchange language). HXL intends to provide a common language that humanitarian actors can use to share information.

3.3 Data Sharing and Integration

Post-disaster evaluations conducted over the course of the last decade highlight deficiencies in data sharing between organisations, levels of incompatibility in work practices, misalignment between needs and recovery actions, as well as short-sighted decisions on funding and the courses of action. Previous poor experiences in information pooling, lack of trust, and resource constraints are some of the features identified which undermine information and knowledge exchange. Reviews of crisis responses initiated over the course of the last decade highlight a shift to the use of multi-faceted methodological approaches in order to better understand information exchange in acknowledgement of the complexity of contemporary decision making and the dynamic environments, diverse social contexts in which crisis responders operate. It is apparent that whilst considered progress has been made in advocating stakeholder collaboration and information sharing, the continued absence of a robust interoperable data framework which can serve as an evidence base to inform strategic decision making within vibrant environments such as those encountered during and in the immediate aftermath of a crisis event has contributed to unnecessary protracted recovery timelines as well as inefficiencies in resource allocation.

Research presented at ISCRAM (Neef, 2013) infers that the lack of cohesion between disaster response professionals and the thus far inability to effectively embrace local communities in terms of both data provision and to mobilise local capacity can be attributed to '*collaboration gaps'*. A collaboration gap refers to the disparity between the actual and the ideal collaboration between mission-critical parties. These gaps may be caused by a number of causes:

- organisational causes (ineffective organisational structures, lack of organisation awareness, opposing beliefs, backgrounds or work practices)
- knowledge-related causes (insufficient means to obtain critical information, lack of contextual knowledge about the environment, conflicting views of the situation)
- contextual causes (the social, political, economic situation under which a recovery process takes place)
- other causes that have a detrimental effect on the effectiveness of the undertaking

Within the disaster-recovery domain three types of collaboration gaps have been identified (Figure 5). The potential for a 'collaboration gap' between the local and higher level of operations can in part at least be attributed to the different perspectives and aspirations in terms of the necessitated response. This has the potential to undermine operationally accountability and in extreme cases result in ineffectual implementation of what could have been reasonably constructed as an appropriate response strategy. Secondly, as had been shown in the recent disaster response evaluation reports potential exists for a collaboration gap between organizations active across different phases of recovery or even in more extreme cases amongst stakeholders involved in the same phase of the recovery process. This tends to be most pronounced when activities by local relief organisations are not properly coordinated and interfere with each other, and consequently jeopardise the wider recovery plan.

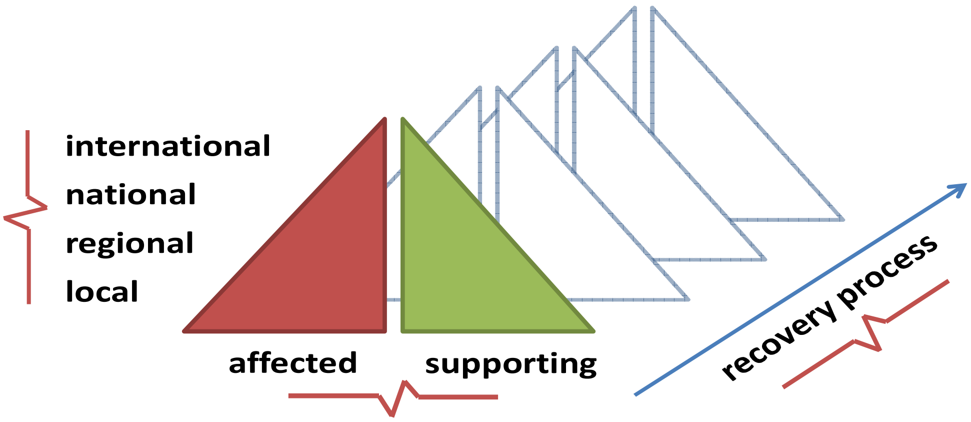

Figure 5: Collaboration gaps in the disaster recovery process (Neef, 2013)

There is a plethora of governmental, non-governmental and charitable organisations involved in the recovery and reconstruction process and each will have different constitutional remits, resources, response rates and capabilities. Moreover each will have its own information resource with varying degrees of appropriateness to a given crisis and location. In many ways this replicates the classic arguments for the allocation of resources – either through the market (in an unplanned manner) or in a more managed framework (organised by government or a lead organization, such as the United Nations). In the context of a crisis event all humanitarian or physical support bodies may respond individually and there may be a lack of co-ordinated working, confusion, over-lap or under-lap of engagement, and wasted effort and resources. This may be characterised as a non-strategic response agenda. The alternative is for a more managed approach which seeks to provide a more holistic response through strategic thinking and co-ordinated actions (Mays et al. 2013).

There is a general issue relating to the wide and diverse organizations with potential to respond to a crisis and a specific question relating to the harmonisation of data and information. First, there is an organizational agenda required to ensure that the composition of bodies involved in the recovery and reconstruction process are integrated in such a way as to provide an efficient and effective response. There is an extensive literature base delineating the debates and ideologies of data integration premised around the ideologies of addressing inherent institutional and administrative inefficiencies. In crisis response contexts enhanced sharing of data is considered the mantra to facilitating integrated working of the various bodies within crisis and recovery decision making. In practical terms: it may require the implementation of non-traditional arrangements such as *contractualism* or '*concertation'* that have been advocated whereby formalised agreements are put into place to secure desired outcomes (Vincent-Jones, 2000; Pichierri, 2002). In the opinion of Lloyd (2008) such collaboration and information sharing arrangements depict a rethinking of the ways in which more effective integrated actions can be achieved.

An extensive body of literature exists concerning the creation of information, its management and its interpretation and use (Gerlak et al. 2011). There is a complex of data characteristics, user dimensions and system design aspects; and relational dynamics between them. Additionally, it is important to recognise that not all the recovery response and planning bodies may be physically involved in the specific response (maybe not having the appropriate skills or competencies for that specific crisis) but can make available their information resource to support the response programme. There are nonetheless challenges relating to the technical and organizational aspects of information management and decision making; there is a need to understand information-seeking behaviours and knowledge construction; and a need to better appreciate and understand ways of facilitating information sharing and knowledge exchange across an increasing diverse range of mediums/sources.

It is clear from the existing literature base that there is a need for the deliberate coordination of data and information, and for information sharing, in order to support strategic decision making and improve the efficiency and effectiveness of disaster response strategies. There are a number of theories to analyse and explain information seeking and retrieval behaviours, yet there is no accepted methodology which prescribes how an information and ideas exchange might operate; this is contingent on the particular context and conditions involved.

Finally, but perhaps most tellingly there is propensity for a 'collaboration gap' between the affected community and the supporting community – particularly in situations when the 'voice' of the affected community is disregarded - or considered to have been disregarded. Pertinently, failure of collaboration between the local community and the response community is likely to culminate in the misinterpretation of needs resulting in a misguided and in all probability unsustainable recovery process.

Evaluation reports of recent disaster incidents highlight two pertinent and perhaps more importantly, recurring issues that have served to hamper the proficiency of recovery processes. Central amongst the failings of intervention measures have been the levels of disconnect between relief organizations and local communities. This has in essence served to disregard not only a potentially rich and valuable data source to inform the recovery an reconstruction operation but has also served to mobilise and harness the capacity and skills set that reside within affected communities in order to bolster their resilience levels. The ultimate goal of disaster recovery is to regain a sustainable state of well-being and functionality for affected communities. As quality of life and well-being are subjective matters, community members from the affected area need to be involved. It is important to recognise however that community engagement will only be effective if aid recipients believe that they are being listened to and that their questions, concerns and problems are being addressed. This necessitates that aid agencies create a system to collect community feedback and have staff responsible for verifying, analysing and responding to it.

The inclusion of representatives from affected communities enables community-needs to be correctly defined, as communities have an excellent understanding of their own particular needs and priorities. Conversely, what can and cannot be done in terms of recovery activities depends on the capabilities of part taking relief organizations, funding opportunities and environmental, social and legal constraints. These pieces of knowledge need to be disseminated properly throughout the community and become a foundation for recovery planning. Failures on this part may lead to misconceptions about the recovery process and the harbouring of unrealistic expectations on the part of the affected community. In disaster recovery, it is crucial to develop community-wide collaborations. The word 'community-wide' not just refers to the affected communities and locally deployed relief organizations, but to all groups that have a stake in the disaster recovery process. This also includes regional and national organizations, local companies, supporting volunteer and technical communities, financial institutions and other groups that contribute directly or indirectly to the relief effort. In this sense, community-wide collaboration building refers to the effort of creating suitable information and cooperation agreements between essential stakeholder parties, so that the right collaborations take place at the right time, at the right location and in the right form.

The aspiration of crisis response managers is to develop a comprehensive needs picture across the different phases of the recovery effort in order to initiate a sustainable recovery and reconstruction programme. The development of matrices of community needs, recovery activities, and their corresponding acting parties support the identification of duplication and missing efforts and priorities. This requires information sharing from whole of community sources and interoperability in multiple ways. A comprehensive picture of community needs is built up by community members and is grounded in their short and long-term needs for sustainable well-being. Accountability of recovery efforts can be supported by making explicit relations between identified community needs, recovery activities and involved organisations explicit. A comprehensive community needs picture could consist of information about:

- drivers of the crisis,
- scope of the crisis,
- profiles of affected community,
- the needs of community members in the affected area,
- local and regional capacities for recovery and reconstruction,
- capacities outside the area
- coverage of community needs and gaps,
- strategic priorities.

As time progresses, the focus of recovery will shift from short to long-term and the community needs and action plans will need to shift accordingly. By maintaining explicit relationships between these pieces of information, recovery objectives can be formulated that can be monitored through time as identified needs are met and new ones emerge. This approach facilitates progress monitoring, improves accountability, and stimulates unity of effort because the baseline picture is made through a collaborative effort of all involved parties.

Evaluation of crisis response has highlighted the inability to integrate and capture data availability as one of the more pertinent issues within modern disaster management. The earthquake in L'Aquila, Italy in 2009 highlighted some important difficulties which can arise if information is conveyed in a manner which could be open to interpretation. Prior to the earthquake, conflicting reports on the levels of danger posed to certain regions have been described. A gap in expertise and decision making capacity was reported in relation to the early warning system – scientific information provided by experts on levels of risk were not well understood by local authorities who were unsure about how and when to act (Fearnley, 2012). In addition, local actors did not advise scientists on the local conditions which could provide more certainty on the levels of risk posed to certain communities (for example, many buildings in L'Aquila were not structurally sound). Consequently, a number of areas did not act at all and suffered huge damages from the earthquake as a result. The ability to combine scientific knowledge (forecasting, risk assessment etc.) with local knowledge (social, economic, political and cultural factors specific to the at risk population) to inform decision making is critically important (Fearnley, 2012). Thus, enhancing open and transparent networks of communication among decision makers is a key challenge within disaster management.

To help alleviate 'collaboration gaps' between the affected community and the responder community and to bolster collaboration across responder and relief agencies and other actors initiating/supporting, there needs to be a clear understanding about the needs of the affected communities, their remaining capabilities and their recovery ambitions. This requires suitable information channels between the affected community and the response community. Mutual awareness and trust need to be cultivated and an appropriate division tasks and responsibilities assigned. The development of conceptual frameworks for understanding information behaviours within crisis situations is evolving, but extremely revealing in terms of how antecedent dimensions, such as individual demographic profiles (e.g. gender, age, education); personal experience (e.g. organisational setting, information feedback loops); salience (perception of how relevant information is to a specific problem or task); and beliefs (ability, personal costs, organizational cultural alignment) inform the way individuals and organizations involved in disaster relief engage with and utilise information in order to inform decision making. As such it is imperative that the COBACORE information platform encompass the organizational - as well as technical - dimensions of data sharing and information exchange in order to foster key stakeholder integration across the crisis response cycle as well as developing appreciation of the data needs of different communities (affected and responder) involved in the recovery and reconstruction process.

3.4 Key Stakeholder Uptake and Initiatives to Enhance Data Provision

The need for enhanced integration of data sources and for sharing of information between actors involved in the crisis recovery and reconstruction process is not contested. Deliberations do prevail however around the means by which this can be most effectively achieved. Additionally, evaluations and observations recorded from crisis events over the course of the last decade, highlight data provision and the capacity to transfer and communicate data in a manner which is both timely and conducive to informing decision making in the area of the recovery and reconstruction process. This offers the greatest scope for enhancing the proficiency and efficiency of relief efforts. Perhaps, because data collation and information flow transcends all phases of the recovery and reconstruction process, or because it cascades all 'response clusters' it has not been afforded the depth of exploration or developed understanding other areas of the crisis cycle. More needs to be done to champion the role of data and information sharing in terms of the contribution to the response, recovery and reconstruction process. At present, the quality of data provision, the transferability and interoperability of data is not recognised with the levels of acclaim or afforded the same recognition as other facets of the response, recovery and reconstruction process. Even though in many instances it was the availability of the data which dictated the response strategy and intervention measures, the true value of timely, credible data - it would seem - only materialises within the confines of an 'information vacuum'. Notwithstanding the barriers, considerable progress has been made in recent years pertaining to the accessibility and interoperability of data – much of which forms a critical underpinning data repository for informing crisis recovery and reconstruction. In the Seventh Framework Programme for Research (FP7) 2007-2013, the European Commission, in partnership with the European Space Agency, set the foundation for the development of the **Global Monitoring for Environment and Security (GMES)**. The GMES initiative included a budget of €1.2 billion for the development of services that would support both the environment and security, with particular focus on the atmosphere, emergency response, land, ocean and security. In a security context, the benefits of this research agenda were designed to enhance the quality of life in Europe through utilising earth observation satellites and ground based systems to better understand security preparedness and response capacity. It was designed to improve prediction monitoring and assessment capabilities of member states of Europe, through providing a platform to be better prepared for security issues such as man-made and natural disasters and respond more effectively and efficiently in emergency situations.

GMES also supports the implementation of an EU Directive, **INSPIRE**, through developing the needed spatial data infrastructures for ensuring consistency in data collection across Europe. The main aim of INSPIRE has been the creation of a cross boundary, pan-European Union Spatial Data Infrastructure (SDI) to facilitate the sharing of GI among all spectrums of government and improving accessibility of GI to European citizens (Local Government Group, 2010). Under INSPIRE, the 27 nations of the EU are required to undertake a number of changes to their current data capturing methodology to ensure consistency, accountability and comparability of approach (Local Government Group, 2010). These requirements include:

A. Make available and interoperable, metadata that detail the underpinning elements of spatial datasets and services so that they can be shared

B. Implement network services to facilitate an enhancement of awareness, access and use of spatially enabled data

C. The removal of barriers that have in the past prevented the sharing of GI between different public sector bodies

The SDI developed in each jurisdiction for the sharing of spatially enabled data through INSPIRE will be fundamental to the effectiveness and efficiency of the baseline model of the COBACORE project. Many aspects of the data themes of INSPIRE will be essential for building up the 'before' picture in post-crisis environments and will facilitate a cross-jurisdictional understanding of where damage has occurred. Indeed, this will be of strategic benefit to the reconstruction and ultimately, recovery components of the post-crisis life cycle and remove any restrictions which may have applied if such commonality didn't exist.

The INSPIRE Directive covers spatial data sets which fulfil the following conditions:

1) They relate to an area where a Member State has and/or exercises jurisdictional rights
2) They are in electronic format
3) They are held by or on behalf of any of the following:
    a. a public authority, having been produced or received by a public authority, or being managed or updated by that authority and falling within the scope of its public tasks
    b. a third party to whom the network has been made available in accordance with Article 12
4) They relate to one or more of the themes listed in Annex I, II or III

4 The Role of Data in COBACORE

4.1 Data and Information Framework Structure in COBACORE

The previous sections have demonstrated that effective and efficient decision making in post-crisis environments is premised upon having the necessary information to inform and support strategic and operational response. Therefore, it is critical that those responsible for making and informing decisions have access to the right information at the right time. This data must be available, in the right format and easily accessible. Failure to deliver on any of these requirements may inhibit the efficiency of the response and the effectiveness of ensuring positive recovery.

Timely and accurate data (coupled with a joined-up data sharing approach) are therefore undoubtedly recognized as being integral to the responsive actions employed by the key decision makers in pre, during and post-crisis situations. Nevertheless, interpretation, sharing and communication of this information is also fundamentally critical in the process and decision informers and makers must be mindful of these components in any planning, response, reconstruction and recovery activities. Despite this, many methodologies do not deliver this complete package, with information presented in previous sections and other deliverables demonstrating the challenges in achieving such an optimal platform for decision informers and makers.

The key objective of the envisioned COBACORE platform is to help bridge this gap by providing mechanisms that enhance the decision informing process. It will do so by making relevant pre-crisis datasets available, by allowing post-crisis damage to be better understood and evidenced, and by providing the ability of the end user to make effective and efficient decisions on the reconstruction and recovery process. Likewise, it decreases the time spent by responders on collecting, harmonising, analysing and visualising information that is coming from many disparate sources and in many formats. This time could and should be spent on ensuring that the response employed will meet the needs of the affected community and ensure that the reconstruction and recovery process will be sustainable and mindful of potential risks that may arise in the future.

As a consequence, the COBACORE project will employ a methodology that will facilitate this process by ensuring that the right information will reach those that require it, at the time in which they need it to make effective decisions. It will do so through the use of a two stage data and information framework approach that will first rationalise the required data and provide a better understanding of how the data would be applied in different crisis situations- this will be known as the 'right information stage'. The second stage is then the development of the analytical and communicative platform that will provide the mechanism to get the information to those that need it in an informative and timely manner- this will be known as the 'right people, at the right time stage'.

Whilst this deliverable is more concerned with providing a knowledge and understanding of the data that would be required to bridge the gaps identified and build upon existing good practice in relation to IT and crisis response and management, it is mindful of the fact that COBACORE needs to ensure that it is providing a mechanism to capture, analyse and communicate information on a plethora of pre, during and post-crisis situations to a diverse audience who need the information quickly and in the right format. This can only be achieved when an understanding is gained on what the needs of the potential users are and how they require the information. Therefore, COBACORE, in line with the scope of the project, has worked in partnership with potential end users and reviewed themes emanating out of the current literature base to develop an understanding of the information framework that needs to be developed.

4.1.1 The COBACORE Information Framework

The role and utility of data is fundamentally structured and communicated through the utilisation of an information framework. This framework, in its broadest sense (and discussed in more detail in later deliverables in this work package), is designed and developed through gaining a knowledge and understanding of good practice identified from both the literature and end user engagement.

From this process, we identified that in order to add value to what has and is currently being employed in crisis planning and management, the information framework needs to have flexibility to not only accept structured and unstructured data from disparate sources, but also communicate outputs to a variety of audiences. This must be facilitated through providing functionality to enable different pre-crisis scenarios/uses to be analysed and understood.

The information framework developed in the COBACORE project will be based on two main workflows. First, an identification of the fundamental datasets required for enhancement of preparedness, response, reconstruction and recovery is made. This captures the information that the end users and literature base identify as being critical to needs assessment and recovery, but not necessarily always commonly available in the one framework when needed. The second workflow is based on the development of the information framework architecture, modelling and communicative processes required for getting the data to the right people at the right time.

Again, from the literature base and consultation with end users it was identified that three main views/models were needed to understand the pre, during and post-crisis environment. In the context of the COBACORE platform, the three views that we believe necessary for ensuring optimal preparedness, reconstruction and recovery are that of a community model, a needs model and a situation model, as set forth in the Description . The rationale behind the selection of these three models is defined by the collection of needs presented by end users after a crisis has occurred in both the literature base and through engagement.

The situation model

At the fulcrum of the COBACORE philosophy is the situation model. This model provides data that can be used as the basis from which decision makers can prepare for different crisis scenarios (preparedness phase) in Europe. Indeed, it can also be used to form the foundations from which a knowledge and understanding of the local area can be achieved during a crisis event (response). This would provide a contemporary picture of the socio-demographic, economic and physical environment (including elements such as critical infrastructure, response infrastructure (location of snow ploughs, water butts and so on) and other important ancillary location based infrastructure. The picture drawn up within the situation model can then be used to realise the impact that the crisis has had on the subject area through an understanding of the damage that has occurred. This will facilitate a more effective and efficient response to reconstruction and recovery and will enable a greater prioritisation of demand, supply and needs to be achieved.

Annex II shows an example instantiation of the situation model, using data from available data repositories in Northern Ireland.

The community model

The community model maintains an overview of known actors within the community surrounding the common needs assessment effort. This includes relevant actors within the affected area, in the surrounding area, in online communities and otherwise related actors. The model represents relevant information about the actors, such as their basic characteristic, their capacity to provide relevant information, their physical location, their role and responsibilities and so on.

The community model includes a view of both the affected community as well as the responding community. In practice, these sets will overlap, as affected civilians might be capable of providing information or contribute to assessment activities. A core component of the COBACORE platform (and in particularly this model) is the spatial overlay of where the key actors within the community are based and which ones can respond safely, efficiently and effectively. The model will provide the functionality to understand the data and allocate/ select key actors accordingly based on damage types/expertise and also accessibility. This type of approach is not evident in the literature, with no specific repositories available for capturing the key actor data.

The needs model

The needs model maintains an overview of actual needs on different levels of abstraction, and provides an outlook on how they will be met. The model also provides means to projected needs. It links lower order needs (local individual and community needs) to higher order strategic demands (flash appeals and strategic information frameworks that stem from humanitarian clusters).

Figure 3 shows the three models that will be employed as a basis for the COBACORE platform.

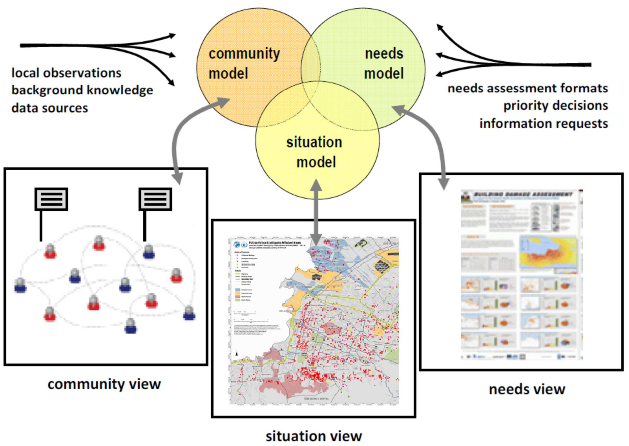

Figure 6: Model view of COBACORE Platform

Where possible, the COBACORE platform will make use of available open data sources and should be easily extendable with new functionalities or data sources. For example: geospatial databases from local governments, satellite imagery, commercial information, information from NGO's (following the IATI standard), and so on. The COBACORE platform will have connectors to data sources that will be automatically processed, pre-analysed and geo-mapped to present a useful and understandable situational awareness picture to the user.

4.2 Data Challenges and Consequences for COBACORE

Given that COBACORE requires an extensive amount of data in order to become operational, effective and efficient, it is therefore of paramount importance that COBACORE gets the buy-in from key stakeholders and data providers in jurisdictions where COBACORE will be applied in a testing and operational environment. The development of the INSPIRE Directive and subsequent requirement to comply will facilitate a Government data stream in jurisdictions that would like to explore the potentiality of the COBACORE platform. Indeed, ancillary data (such as socio-economic and more specialised data such as contingency assets) will more than likely be available; however, access will be critical. This is why D2.1 has explored the potentiality of accessing data for Northern Ireland, a relatively small Country with a well-established mapping agency, Land and Property Services (formerly Ordnance Survey Northern Ireland). Annex II shows a first survey of potentially relevant datasets, in the context of the situation model of the COBACORE information framework. This was done in order to understand the complexities involved in data availability and accessibility and to gain knowledge of what information could potentially be used in the subsequent components of Work Package 2.

5 Conclusions and Way Forward

Evaluations of crisis events which have occurred over the course of the last decade have made pertinently clear the need for greater collaboration and information sharing among disaster response agencies during times of crisis. Moreover, there is a need for greater integration and communication flow between affected communities and response communities. Increasingly affected communities are no longer considered as passive recipients of information but as a crucial data repository for informing the disaster recovery and reconstruction process – although the consensus amongst responders is that the role and capacity of affected communities remains a vastly underutilised resource.

Advances in ICT have served to transform the way in which data is exchanged and information enabling more effective harnessing of 'field data' from affected communities. This has proven to be effective in terms of bolstering response co-ordination. Nonetheless it also presents challenges to data management systems in terms of collation, verifying, analysis, interpretation and ultimately dissemination. Moreover, it is apparent that many of the datasets required to inform a crisis response are disparate (both in terms of source) and lack the levels of harmonisation conducive to enhanced interoperability amongst the responder community and other stakeholders involved in emergency response planning.

The COBACORE information platform is premised around two pathways of innovation which are considered to overcome the inherent inefficiencies and ineffectiveness of data application. Firstly, a comprehensive approach to needs assessment and recovery planning, and secondly the development of community building methods in disaster recovery.

The COBACORE data Framework will be an easy to use system to capture, integrate and analyse large volumes of data from a variety of resources, both structured and unstructured, to provide processed information to support the decision making process in a short period of time. The data framework will not be bound to structured data but will need to embrace and analyse unstructured data including social media, YouTube, Email, XML, RSS feeds etc. The framework will be both scalable and elastic where performance can be optimised in relation to the size of the tasks. This can be achieved using commodity computing components along with software to manage the allocation of resources to provide a scalable hardware infrastructure that can expand or contract with the processing demands and performance needs.

D2.1 has considered the types and forms of data and identified the key underpinning data sets necessary to support the recovery and reconstruction process. Specifically D2.1 has considered the dynamics of data collation and management identifying the source and format of key datasets across the various phases of the crisis cycle. Exploration of international best practice and the thematic contextualisation has enabled the identification of inherent barriers to stakeholder collaboration and data sharing as well as identifying weaknesses and inefficiencies in the prevailing data frameworks that would enable COBACORE to improve the effectives of recovery decision making through the provision of a more robust, credible and comprehensive information framework.

The harnessing of communities as a data provider remains the nexus of the COBACORE concept. The mobilisation, coordination and efficient capture of data from affected communities remain a largely untapped resource. In crisis in which communities played an active role in informing recovery and reconstruction planning this has been deemed highly advantageous although the propensity to integrate different forms of data (harmonisation) as well as different mediums (integration) presents a number of technical as well as societal challenges.

D2.1 will serve as the foundation for WP2 encapsulating the key issues pertaining to the role and composition of data within the recovery and reconstruction process. The next six months of the COBACORE project will see WP2 focussed on defining and developing the technical dynamics of the data framework incorporating the data collection methodologies and detailing the various layers and inter-linkages in datasets across the various phases of the recovery and reconstruction cycle. The design and interface capacity of the information framework will be undertaken in collaboration with WP3 and will reflect input and insight from the responder community and other prospective end-users.

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List of Acronyms and Abbreviations

A

ANSI - An abbreviation for American National Standards Institute. ANSI standards have been established for many elements of computer systems to aid research and development. The existence of standards allows designers to develop general solutions to common problems.

Application Programming Interface (API) - specifies how software components should interact with each other. In practice, most often an API is a document that includes specifications for routines, data structures, object classes, and variables.

B

Base Map - Spatial data sets that provide the background upon which more specific thematic data is overlaid and analysed.

Big Data–a large volume of both structured and unstructured data that is so large it is difficult to process using traditional database and software techniques.

C

Cache – is a place to store something temporarily, when looking at a web-page the requested files are automatically saved on your hard disk in a cache so when you return to the page the browser will get the files from your hard disk rather than the original server.

Cloud –Commonly refers to network-based services which appear to be provided by real server hardware, which in fact are served up by virtual hardware. Such virtual servers do not physically exist and can therefore be moved around and scaled up (or down) on the fly without affecting the end user - arguably, rather like a cloud.

Common Operational Dataset (COD) – are critical datasets that are used to support the work of humanitarian actors across multiple sectors. They are considered the standard for the humanitarian community and should represent the best available datasets for each theme.

Coverage – A data model for storing geographic features, a coverage stores a set of thematically associated data considered to be a unit. Features are stored as both primary features (points, arcs, polygons) and secondary features (ticks, links, annotation).

Creative Commons - is a non-profit organization headquartered in Mountain View, California, United States devoted to expanding the range of creative works available for others to build upon legally and to share.

Crowdsourcing–is a type of participative, normally online, activity in which an individual, institution, company proposes to a group of individuals with a varying knowledge, heterogeneity and number voluntary undertake a task. Often used to subdivide tedious work or to fund-raise start-up companies and charities, this process can occur both online and offline

D

Data Harmonisation – the iterative process of capturing, defining, analysing and reconciling government information requirements, and data standardization as the mapping of this simplified data to international standards.

Dashboard – provides an ‘at a glance’ view of key performance indicators relevant to a particular objective or business process.

Disparate Data–is data from any number of sources, largely unknown and unlimited and in many different formats. Disparate Data are heterogeneous data. They are neither similar nor can be easily integrated with an organisations database management system.

F

Features – The collective term for individual objects shown on map layers in their correct locations. A ‘Feature’ could be a building, an area, a street, a road or postcode etc

Framework (Software) - An information architecture, a reusable software template, or skeleton, from which key enabling and supporting services can be selected, configured and integrated with application code. A Framework is a reusable software platform to develop applications, products and solutions.

Free Open Source Software (FOSS)– is computer software which can be classified as both free software and open source software. Therefore anyone is licensed to use, copy, study and change the software in a way and the source code is openly shared to encourage people to improve the functionality and design of the software.

Fundamental Operational Datasets (FOD) – datasets that are relevant to a humanitarian operation, but are more specific to a particular sector or otherwise do not fit into one of the COD themes.

G

Gazetteer – geographic dictionary used in conjunction with a map or atlas, will typically contain information concerning the geographic makeup, social statistics and physical features of a country, region or continent. Content of the gazetteer can also include the location and dimensions of the subject.

Geo-coding – The process of adding location information to a file or database so its objects can be displayed on a map, for example calculating the x,y location of properties based on their address.

Geographic Information System (GIS) – The entirety of a system used for processing location information including data, hardware, software, people and managed services.

Geography Mark-up Language (GML) – OpenGIS XML-based language for describing and encoding geospatial information. An application of XML, a specification developed by members of the Open GIS Consortium.

Geo server – is an open source software server written in Java that allows users to share and edit geospatial data using OpenGIS standards Web Feature Service (WFS), Web Coverage Service (WCS) and Web Map Service (WMS). Geo server can also publish data from any major spatial data source using open standards.

Geospatial Data – Digital data that represent the geographical location and characteristics of natural or man-made features, phenomena and boundaries of the Earth. Geospatial data represent abstractions of real-world entities, such as roads, buildings, vehicles, lakes, forests and countries. Geospatial data refers to such data in any format, including raster, vector, point, text, video, database records, etc.

GeoWebCache – is a java web application used to cache map tiles coming from a variety of sources such as the OpenGIS standard Web Map Service (WMS) in order to optimise map image delivery. GeoWebCache exists as a standalone application and as a built in extension to Geo server.

H

HTTP - Hypertext Transfer Protocol, the World Wide Web protocol for moving hypertext (HTML) files across the Internet.

Humanitarian eXchange Language (HXL) – an XML schema which allows humanitarian organisations to publish their data in a machine readable format. Once the data has been published in this open format then anyone can have access to it.

Humanitarian Free Open Source Software(H-FOSS) – refers to Free and Open Source Software created to be used in the support of Humanitarian response.

Humanitarian Open Streetmap Team (HOT)– coordinates the creation, production and distribution of free mapping resources to support humanitarian relief efforts in many places around the world. Their main objective is to promote the principles of open source and open data sharing to humanitarian response and support the growth of the OpenStreetMap project.

I

Infrastructure for Spatial Information in the European Community (INSPIRE) – Directive 2007/2/EC of the European Parliament. This seeks to ensure that the spatial data infrastructures of the member states are compatible and useable in an EC and a cross boundary context. INSPIRE will enable the sharing of environmental spatial information among public sector organisations and better facilitate public access to spatial information across Europe.

Internet Map Server (IMS) – server software which allows users to share, view and edit geospatial data via Open Geospatial Consortium (OGC) standards such as WMS, WFS and WCS.

K

Key Mark-up Language (KML) – an XML based language schema for expressing geographic features and visualisation on maps. KML was developed for use with Google Earth, in 2008 KML became an international standard of the **Open Geospatial Consortium**.

L

LIDAR – Light Detection and Ranging is an optical remote sensing technology that can measure the distance to, or other properties of a target.

M

Map - A two-dimensional visual portrayal of geospatial data. A map is not the data itself.

Metadata – refers to data about data and is used in two fundamentally different concepts

- Structured Metadata – design and specification of data structures
- Descriptive Metadata –describes a resource for purposes **Micro tasking** – is the process of breaking a large project into tiny, well defined tasks. The resulting micro tasks can be performed independently, cannot be automated and can be done in a short period of time i.e. less than an hour.

N

NGO - Non-governmental organization

O

Open Data – is the idea that data should be freely available to everyone to use and publish as they wish, without restrictions from copyright, patents or other methods of control. Open Data has gained popularity in recent years with the launch of open-data government initiatives such as Data.gov and Data.gov.uk

Open Geospatial Consortium (OpenGIS)– an international industry consortium of 475 companies, government agencies and universities participating in a consensus process to publicly available interface standards. The standards enable developers to make complex spatial information and services available and useful to all kinds of applications.

Open Source –is computer software with its source code made available where the developer provides users the right to study, change and distribute the software at no cost to anyone for any purpose.

Open Street Map – is an initiative to create and provide free geographic data such as street maps, to anyone.

P

PostGIS – provides spatial objects / Features for the PostgreSQL database, allowing storage and querying of geographic information.

PostgreSQL– Powerful Open-Source Object-Relational DBMS, with a strong emphasis on extensibility and implements the majority of the SQL:2008 standard. PostgreSQL provides spatial extensions, PostGIS, to allow database operations to be performed using geometry as well as tabular data.

Projection – is the transformation of the latitudes and longitudes on a sphere into the locations on a flat plane i.e. a map.

R

Raster – is the method for storing spatial data that involves assigning a value to each dot in a large matrix e.g. Aerial photographs and satellite images

Resource Description Framework (**RDF**) - has come to be used as a general method for conceptual description or modelling of information that is implemented in web resources, using a variety of syntax notations and data serialization format

Relational Data Base - data in such a way that it can be added to, and used independently of, all other data stored in the database. Users can query a relational database without knowing how the information has been organised.

RSS – is a family of web feed formats used to publish frequently updated works such as blogs, news headlines in a standardised format.

S

Short Message Service (**SMS**) - is a text messaging service component of phone, web, or mobile communication systems, using standardized communications protocols that allow the exchange of short text messages between fixed line or mobile phone devices.

Social Media – the means of interactions among people in which they can create, share and exchange information and ideas in virtual communities and networks i.e. Facebook, twitter, YouTube, Flickr, etc.

SPARQL - is an RDF query language, that is, a query language for databases, able to retrieve and manipulate data stored in Resource Description Framework format.

SQL:2008 – is the sixth version of the ISO and ANSI standard for SQL database query language.

Structured Data – refers to data that is organized in a structure, the most common form of structured data is a database where specific information is stored based on methodology of columns and rows.

Structured Query Language (SQL) - is a standard interactive and programming language for getting information from and updating a database.

Styled Layer Descriptor (SLD) – is a WMS user defined XML encoding standard to allow symbolization and colouring of geographic features and coverage data.

T

Thematic Map – a map showing, by colour or pattern, the distribution of a single phenomenon.

U

Unstructured Data – is information that does not have a pre-defined data model or is not organised in a pre-defined manner. Unstructured data is normally predominantly text, but may contain data such as dates, numbers and facts. Conversely, structured data refers to *data that is identifiable* because it is organized in a structure. The most common form of structured data is a database where specific information is stored based on a methodology of columns and rows

W

Web Coverage Service (WCS) – define services on coverage and supports the retrieval of geospatial data as "coverage", the WCS supplies information in forms that are useful for client-side rendering, similar to the WFS.

Web Feature Service (WFS) - refers to the sending and receiving of geospatial data via the internet. An important distinction between WFS and WMS is that the WMS displays the geographic information after it has been rendered as a digital image, whereas WFS sends the "source code" of the map.

Web Mapping - Dynamic query, access, processing, combination and portrayal of different types of spatial information over the Web.

Web Map Service (WMS) – OpenGIS standard protocol for serving geo-referenced map tiles over the internet. Provides a simple HTTP interface for requesting geo-registered map images from one or more distributed geospatial databases. A WMS request defines the geographic layers and area of interest to be processed. The response to the request will be one or more geo-registered map images, returned as a JPEG or PNG that can be displayed in a web browser application. The interface also supports the ability to style the returned images using the Styled Layer Description standard.

Web Services - are self-contained, self-describing, modular applications that can be published, located, and invoked across the Web. Web services perform functions that can be anything from simple requests to complicated business processes. Once a Web service is deployed, other applications (and other Web services) can discover and invoke the deployed service.

Widget–a reusable element of a Graphical User Interface, GUI

X

Extensible Mark-up Language (**XML**) - is a mark-up language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable.

Annex I – Themes encompassed in the INSPIRE directive

Annex 1-3: Themes Encompassed in the INSPIRE Directive

Annex 1

1 Coordinate reference systems	2 Geographical grid systems
3 Geographical names	4 Administrative units
5 Addresses	6 Cadastral parcels
7 Transport networks	8 Hydrography
9 Protected sites	

Annex 2

1 Elevation

2 Land cover

3 Ortho-imagery

4 Geology

Annex 3

1 Statistical units	2 Buildings
3 Soil	4 Land use
5 Human health and safety	6 Utility and Government services
7 Environmental monitoring facilities	8 Production and industrial facilities
9 Agricultural and aquaculture facilities	10 Population distribution – demography
11 Area mgt/regulation & reporting units	12 Natural risk zones
13 Atmospheric conditions	14 Meteorological geographical features
15 Oceanographic geographical features	16 Sea regions
17 Bio-geographical regions	18 Habitats and biotopes
19 Species distribution	20 Energy resources
21 Mineral resources	

Annex II – Example population of the situation model

Situation Model Data

Data Type	*Theme*	*Shelter*	*Format*	*Source*
Road Network (including key nodes)	Transport Infrastructure	X	WMS	https://www.spatialni.gov.uk/wss/service/Road_Service-DLS-I-LIC/WSS
Rail Network (including stations)		X	.miff	Translink
Bus Stations		X	.miff	Translink
Airports		✓	Feature Class	Land and Property Services
Heliports		X	Feature Class	Land and Property Services
Seaports		X	Feature Class	Land and Property Services
Bridges		X	.miff WMS	Translink (rail) Road (https://www.spatialni.gov.uk/wss/service/Roads_Service_Assets-INC-LIC/WSS?request=GetCapabilities&service=WMS&version=1.3.0)
Electricity Network (including power stations and substations)	Utility Infrastructure	X	Feature Class	Northern Ireland Electricity
Water Network (including waste treatment/water treatment/sewers/pumping stations)		X	WMS	https://www.spatialni.gov.uk/geoportal/catalog/search/resource/details.page?uuid=%7B2A49DC40-A24F-46E5-A048-14F5E643EFDA%7D
Public and Private Telecommunication Infrastructure (Fixed,		X	Feature Class	Fixed Networks Operators (British Telecom, Virgin Media, TalkTalk, etc.) Mobile Networks Operators (EE,O2, Vodafone,3, Airwave,etc.) and Satellite Operators

Comment [I1]: Table name and reference?

Comment [WT2]: This table seems to cover the Community Baseline and the Target Situation.

Mobile and Satellite)				(Inmarsat, etc.)
Energy Providers (power stations/gas network/coal providers/oil distribution)		X	Feature Class	All Energy Providers/ Land and Property Services
Fuel Storage	Supply Chain	X	WMS	https://www.spatialni.gov.uk/geoportal/catalog/search/resource/details.page?uuid=%7B590D0F16-E7D5-45CD-81D0-0FF597C3408C%7D
Banks and ATMs		X	Excel	Open Street Map/ Financial Institutions
Supermarkets		X	Excel	OSM/ Retailers
Shelters (type)		✓	Feature Class	https://www.spatialni.gov.uk/wss/service/Councils_Emergency_Support_Centres_WMS_I_LIC/WSS?request=GetCapabilities&service=WMS&version=1.3.0
Water (emergency supplies)	Contingency Assets	X	.miff	Northern Ireland Water
Sand bags		X	Feature Class	Roads Service, Local Government, Northern Ireland Water. Rivers Agency
Potential Water Butts		X	.miff	Northern Ireland Water
Medical Supplies and Staff Locations		X	Excel	To be Sourced
Supplies/Equipment and Snow Ploughs		X	.miff	Roads Service
Gritting Potential		X	.miff	Roads Service
Medical Field Camps		✓	Feature Class	Department of Health, Social Services and Public Safety
Emergency Vehicles (helicopters/boats/snow vehicles/ all -terrain vehicles)		X	Feature Class	Army, Local Government, Police
Land/ Land Use	Land and Property	X	WMS	https://www.spatialni.gov.uk/geoportal/catalog/search/resource/details.page?uuid=%7B41877EA7-00D5-465B-8613-38316FAA0DE6%7D
Property (leisure and recreational/emergency planning room, CCTV)		✓	WMS	https://www.spatialni.gov.uk/geoportal/catalog/search/resource/details.page?uuid=%7B5687659A-F897-451D-BE1A-A4B14C8CC28A%7D

Police Stations and specialist unit locations	Emergency Services	X	WMS/ Excel	https://www.spatialni.gov.uk/wss/service/PoliceStations/WSS
Fire Stations and specialist unit locations		X	Feature Class	Northern Ireland Fire and Rescue Service
Ambulance Stations		X	WMS	https://www.spatialni.gov.uk/geoportal/catalog/search/resource/details.page?uuid=%7BA79CD2BB-E9D4-43F9-96F5-4ABBFBFA818D%7D
Hospitals with Accident/Emergency and Trauma and Surgery functions		✓	WMS	https://www.spatialni.gov.uk/wss/service/HSC_TRUSTS_CLOSED_COMMUNITIES-INC-LIC/WSS?request=GetCapabilities&service=WMS&version=1.3.0
Medical Facilities with Specialist Functions (burns/plastic surgery etc.)		✓	WMS	https://www.spatialni.gov.uk/wss/service/HSC_TRUSTS_CLOSED_COMMUNITIES-INC-LIC/WSS?request=GetCapabilities&service=WMS&version=1.3.0
Army (regular and reserve) locations and assets		X	Feature Class	Ministry of Defence
Search and Rescue Volunteers		X	Excel	Voluntary Organisations
Prisons and Custody Suites		X	Feature Class	https://www.spatialni.gov.uk/wss/service/PoliceStations/WSS
Population by age cohorts	Socio-Demographic	X	Feature Class	Northern Ireland Statistics and Research Agency
Employment and Unemployment Rates		X	Feature Class	Northern Ireland Statistics and Research Agency
Deprivation Data		X	WMS	https://www.spatialni.gov.uk/wss/service/NISRA-DLS-I-LIC/WSS?request=GetCapabilities&service=WMS&version=1.3.0
People on social welfare (specifically disability benefits/health care benefits/pensions)		X	Feature Class	Northern Ireland Statistics and Research Agency
Crèches		X	WMS	https://www.spatialni.gov.uk/geoportal/catalog/search/resource/details.page?uuid=%7BE7F02B73-E141-4D3A-9C1E-FD90006294C8%7D

Nursery Schools	Education Facilities	✓	WMS	https://www.spatialni.gov.uk/geoportal/catalog/search/resource/details.page?uuid=%7BE7F02B73-E141-4D3A-9C1E-FD90006294C8%7D
Primary Schools		✓	WMS	https://www.spatialni.gov.uk/geoportal/catalog/search/resource/details.page?uuid=%7BE7F02B73-E141-4D3A-9C1E-FD90006294C8%7D
Secondary and Grammar Schools		✓	WMS	https://www.spatialni.gov.uk/geoportal/catalog/search/resource/details.page?uuid=%7BE7F02B73-E141-4D3A-9C1E-FD90006294C8%7D
Technical Colleges		✓	WMS	https://www.spatialni.gov.uk/geoportal/catalog/search/resource/details.page?uuid=%7BE7F02B73-E141-4D3A-9C1E-FD90006294C8%7D
Universities		✓	Feature Class	Universities
Premises with Entertainment Licences (and capacity)	Entertainment Premises	✓	Feature Class	Local Government Environmental
Concert Halls		✓	WMS	https://www.spatialni.gov.uk/geoportal/catalog/search/resource/details.page?uuid=%7B8A9665A5-73E7-4025-9550-B0E7F101BFF7%7D
Conference and Exhibition Centres		✓	WMS	https://www.spatialni.gov.uk/geoportal/catalog/search/resource/details.page?uuid=%7B8A9665A5-73E7-4025-9550-B0E7F101BFF7%7D
Sports Stadia		✓	WMS	https://www.spatialni.gov.uk/geoportal/catalog/search/resource/details.page?uuid=%7B8A9665A5-73E7-4025-9550-B0E7F101BFF7%7D
Shopping Centres (above and below ground)	Large Scale Commercial	X	WMS	https://www.spatialni.gov.uk/wss/service/LPS_OSNI_Pointer_Lite-WMS-I-LIC/WSS?request=GetCapabilities&service=WMS
Large Office Premises		✓	WMS	https://www.spatialni.gov.uk/wss/service/LPS_OSNI_Pointer_Lite-WMS-I-LIC/WSS?request=GetCapabilities&service=WMS

Central Business and Retail District		X	WMS	https://www.spatialni.gov.uk/wss/service/LPS_OSNI_Pointer_Lite-WMS-I-LIC/WSS?request=GetCapabilities&service=WMS
Raster/Vector Base Mapping (at different spatial scales)	Core Mapping Data	X	WMS	https://www.spatialni.gov.uk/geoportal/catalog/search/resource/details.page?uuid=%7B5EA8D1CD-3AE8-42E0-9AB3-44F0012460B9%7D
Cadastre including (buildings/lane ways/field boundaries/financial components)		X	WMS	https://www.spatialni.gov.uk/geoportal/catalog/search/resource/details.page?uuid=%7B5EA8D1CD-3AE8-42E0-9AB3-44F0012460B9%7D
Ortho/Oblique/Satellite Imagery		X	WMS	https://www.spatialni.gov.uk/geoportal/catalog/search/resource/details.page?uuid=%7BEBA8DCBE-DD3E-4EE8-A276-7C3471F33140%7D
Geophysical Information Digital Terrain/Elevation Models Flood Pain and Past Flooding Incidents		X	WMS	https://www.spatialni.gov.uk/wss/service/LPS_OSNI_10m_DTM-DLS_I_LIC/WSS http://www.dardni.gov.uk/riversagency/index/strategic-flood-maps.htm
Hazard Maps		X	WMS	https://www.spatialni.gov.uk/geoportal/catalog/search/resource/details.page?uuid=%7B6A971016-876E-4FD5-B0B5-D7B9E61D3ECC%7D
Registered Farms and Types	Agriculture and Animals	X	Feature Class	Department of Agriculture and Rural Development
Dangerous Animals		X	Excel	Local Government, Department of Agriculture and Rural Development
Animal Sanctuaries		X	Excel	Local Government, Department of Agriculture and Rural Development
Veterinary Clinics		X	WMS	Northern Ireland Statistics and Research Agency
Sewage and Waste Water Treatment Works	Chemical and	X	WMS	https://www.spatialni.gov.uk/geoportal/catalog/search/resource/details.page?uuid=%7B2A49DC40-A24F-46E5-A048-14F5E643EFDA%7D
Fireworks and		X	Excel	Local Government, Police

Munitions	Dangerous Storage			
Oil and Gas Refineries		X	Excel	Local Government
Nuclear Facilities		X	Excel	Local Government
Chemicals Storage		X	Feature Class	Local Government
Post-Crisis Damage	Damage	X	Feature Class	Local Government, Responders
Weather	Weather	X	Raster/ Feature Class	Met Office