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A note for ACAPS

Information gaps in multiple needs assessments in disaster and conflict areas

*With guidelines for their measurement,
using the Nepal 2015 earthquake assessment registry*

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Tables and Figures

Abbreviations and acronyms

ACAPS	Assessment Capacity Project
DFID	United Kingdom Department for International Development
EMAS	Emergency Mine Action Survey
EVD	Ebola Viral Disease
GIS	Geographic Information System
IDP	Internally displaced person
IPC	Integrated Food Security Phase Classification
JRC	European Union Joint Research Center
LGA	Local Government Area
MIRA	Multi-Sector Initial Rapid Assessment
MSNA	Syria Multi-Sectoral Needs Assessment
NATF	Needs Assessment Task Force
NFI	Non-food items
NGO	Non-governmental organization
OCHA	United Nation Office for the Coordination of Humanitarian Affairs
OSOCC	On-Site Operations Coordination Center
SNAP	Syria Needs Analysis Project
UNDAC	United Nations Disaster Assessment and Coordination
UNOCHA	United Nations Office for Coordination of Humanitarian Affairs
VBA	Visual Basic for Applications
VDC	Village Development Committee
WASH	The water, sanitation and hygiene sector

Summary

Monitoring information gaps

Assessment registries, formerly known as "surveys of surveys", are databases about the flow of needs assessments in a crisis or disaster zone. Their purpose is twofold:

1. The registries are archives of shared humanitarian intelligence.
2. They help monitor the distribution of the assessment effort, revealing coverage by areas, social groups and sectors, as well as open and emerging gaps.

This note addresses the second function. It discusses concepts of information value and information gaps as well as key lessons from analyzing collections of assessment reports in four recent crisis contexts. It presents a database template for future registries, supplied in a companion Excel workbook. For greater authenticity, the template is filled with registry data from the response to the Nepal earthquakes in 2015. The note is a continuation of an earlier technical note (Tatham 2011) and comes shortly after a 10-year review of assessment reporting trends and methods (Tax and Noumri 2016).

Assessment resources are in short supply vis-à-vis urgent or difficult information demands. To the extent that agencies share their reports, a coordination body such as UNOCHA can map the progress and quality of the combined effort. Plausibly, only one or two information management or assessment experts will be tasked to read and record the flow of reports on a daily basis. The experts will rarely be able to evaluate the reliability of the underlying data or the validity of the measures that the assessment teams pursued. But they can follow coverage as well as timeliness and shelf-life. They can also form a summary judgment about the degree of detail and the implied ability to prioritize.

Precedents

It is along these modest lines that we investigate the definition and dynamics of information gaps. Also we review past efforts of tracking assessments in four crisis contexts and enumerate lessons learned from each of them:

- **Syria:** ACAPS' involvement in the "Syria Needs Assessment Project (SNAP)" led to the conclusion that the *"ability to support solid judgments on the priority needs and to quantify needs on a sectoral level"* was a reasonable and necessary standard in evaluating the usability and value of assessments. Moreover, in situations of frequent lack of access and patchy indicators, both the severity of situations and the quality of the assessment information were best measured on simple ordinal scales. Assessment gaps and priorities could be established by comparing the values of governorates, districts, etc. on these scales.
- **Ebola:** ACAPS monitored the progress of sectoral assessments during the Ebola viral disease (EVD) in West Africa, particularly in Sierra Leone and Liberia. One of the lessons was that assessment performance varied considerably across the sub-sectors within a given sector. For example, paradoxically, within the health sector in Sierra Leone, the ability to prioritize was better in assessments that addressed the availability of health care services than in those primarily concerned with disease

surveillance. Then and now the humanitarian community did not have a standardized list of sub-sectors; nevertheless, the ability to elucidate differences in severity and priority between sub-sectors make assessments more valuable.

- **Nigeria:** ACAPS reviewed a year's worth of assessment reports about the region embroiled in the conflict with Boko Haram. In a novel database format, the analysts created a record for each combination of report and covered Local Government Area. They rated the quality of the information for each of 15 sectors and functional areas. This enabled a simple form of information *value* estimate. Our secondary analysis shows that the humanitarian community effectively concentrated assessment efforts on the most severely affected accessible areas – a gratifying conclusion.

- **Nepal:** During four months following the April 25, 2015 earthquake, a designated assessment cell in Kathmandu recorded incoming assessment reports by the level of administrative units. Already by the second week did the vast majority of reports detail their findings at the lowest gazetteered level – the Village Development Committee -, a measure of rapid penetration of the affected terrain. Yet, over the course of the observation period, almost a fifth of all assessments were not that specific. This echoes the "multi-resolution problem" known from remote sensing; it makes it difficult to evaluate information gaps at the lower level. A second challenge arose from the obsolescence of information in the rapidly changing recovery situation. Although the assessment effort achieved good coverage within the first month, two months later much of the information was outdated. The humanitarian community ramped assessments up again, in tune with preparations for the next funding cycle. Multi-resolution in space and decay over time thus are factors that have to be modeled in information gap estimates.

Practicalities

After the review of lessons learned, we turn to the practicalities of information gap management in future humanitarian actions. We provide an Excel workbook template that translates the assessment registry information into a quick look-up facility, into useful estimates of the gaps across the entire theater as well as into lists of units of interest by weighted assessment gaps:

- The **quick look-up** facility answers whether a unit of interest – a combination of administrative area and sector, for example – has been covered by any recent assessment. It screens out those that have exceeded their shelf-life or fall short on a scale of useful information on which the registry team rates every report.

- The **statistical overview** depicts the extent of information gaps over time, against user-selected sectors, shelf-lives and information standards. The gaps are weighted by how severe the assumed impacts are in the various units of interest (the severity score, formed from preliminary indicators such as the rough number of destroyed buildings in a sub-district). A gap in a more severely affected unit matters more than one in a slightly affected unit. As more and more assessments are completed, providing a clearer operational picture, the severity scores must be updated, and the overall coverage view will adjust. Figure 1 depicts the dynamics of information gaps for 200 days from the crisis

onset, calculated at three levels of resolution, in a simulated scenario with severity beliefs about each local area and an information usability rating for each area-sector combination in the assessment reports.

Figure 1: Visualization of the information gap dynamic
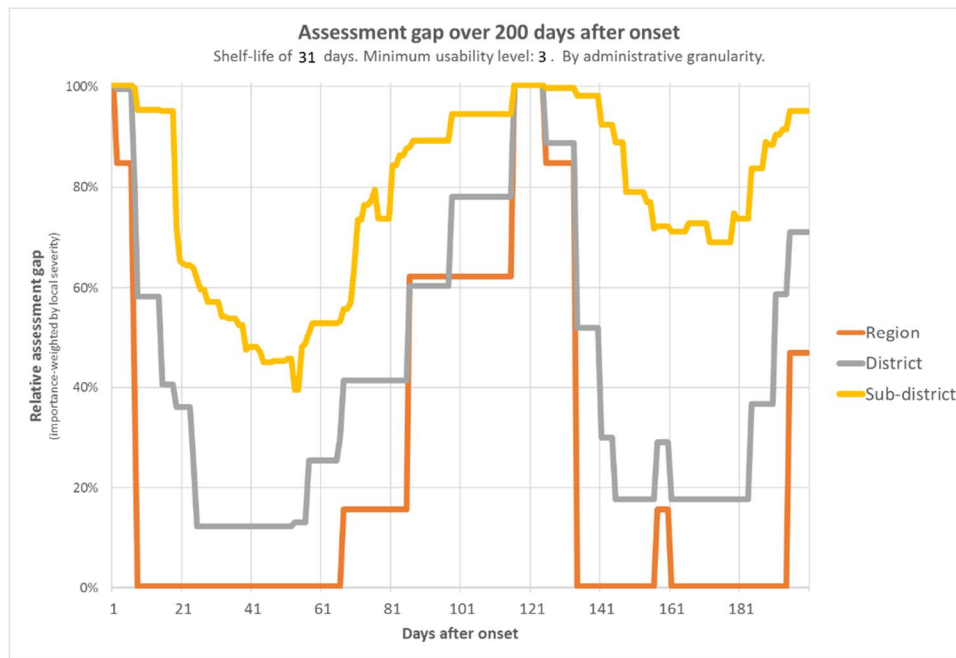
- The workbook produces shortlists of the regions, district, sub-districts with the most highly weighted information gaps. The lists update automatically when the user changes a parameter.

The template has not been tested in the field, but it has been run with the registry database from the response to the earthquakes in Nepal in 2015. It consistently produced the three outputs when we changed the parameters in its user interface. We have confidence that the template can provide assessment registry teams with the core mechanisms that will facilitate the rapid creation of an appropriate database in their specific circumstances. It is built deliberately from basic Excel features, without resorting to macros or user-defined functions, thus lessening the need for outside expert support.

[Sidebar:] What constitutes gaps, and how do we measure them?

We present the nutshell of a process model as well as a measurement model for information gaps. Describing the detailed transformations from registry entries to values on the gap measure defies brief summary; they can be inspected in the Excel template.

Process model

Information gaps are perceived shortfalls of received information against expected information. Gaps can arise for any of the units of interest that are the object of needs assessments, such as for households, villages, sub-districts, etc. Our template works with

three hierarchical administrative levels, but this can be generalized to more or fewer levels, or to units other than administrative ones, such as IDP groups in camps, in host households, etc. In multi-sectoral contexts, selecting the sectors in which assessments are expected to measure unmet humanitarian needs is necessary in order to define "expected information"; the template lets users make selections of sectors of concern.

Subscripting expected values with the letter E, the information gap G in unit of interest i at time t (in days since the crisis onset) arrives from

$$G_{it} = 1 - \left\{ \sum_{sector} [\mathbf{I}(U_i \geq U_{minE}) * \mathbf{I}(t - t_{published} \leq t_{maxE})] / [\text{count}(sectors_E) * (1 + F)] \right\}$$

where

U is the observed sector-wise usability of the information, and U_{minE} the expected minimum usability

$t_{published}$ = the publication (or end of data collection) date

t_{maxE} = the shelf life in days

$\mathbf{I}$ is the indicator function, which takes the value 1 if the condition is true, else 0

$\sum_{sector}$ is the sum over all sectors of the bracketed expression [..] before /

count$(sectors_E)$ is the number of sectors on which recent and usable information was expected, and

F is a function of friction (due to incomparable categories, disparate samples across reports, or other sources of ambiguity in synthesizing, as well as due to the impact of having to collect and evaluate multiple reports), across all sectors and reports concerning unit i in the interval [$t-t_{maxE}$, t].

In other words, we consider the user-defined set of sectors of interest. In it, we count the **number of sectors** for which the assessment information on **unit of interest i** at **time t** is both **usable** (by the set standard) and **recent** (not obsolete; shelf life not yet expired). We compare that to (= divide by) the number of sectors of interest. We further adjust this value for the level of friction and subtract it from one.

Further, information gaps in more seriously impacted units of interest are considered more serious, in proportion to severity.

Measurement model

The usability ratings are assigned by registry analysts (on criteria detailed in the main section); the user can set the minimum expected level globally, i.e., gaps can be evaluated for different minimum levels, but only one at the time.

The shelf life, t_{maxE}, is also set globally. This is fine for comparisons at a given point in time. It is unrealistic in longitudinal views; assessment information perishes early in the early phase, and afterwards tends to remain useful for progressively longer times. At present, the user can visualize the gap timeline graph only for a given shelf life throughout.

Those measurement components are easy to handle, if somewhat inconvenient. The more serious challenges are posed by the friction and by aggregation.

Friction: We make two stringent assumptions:

1. We have **zero friction** if, for the given unit of interest, there is *at least one recent report* **that covers** *all sectors* **of interest** with usable information. As a result, the information **gap is zero**.

2. Conversely, **if no recent report covers all sectors** in that way, **the friction is insurmountable** (tends to infinity), and the **gap value is one (= 100%).** This is regardless of whether all sectors might be covered by contributions from among several recent usable reports, or not.

The second assumption implies that the coordination center is not able to synthesize reports to the point that enables prioritization, either because of reporting overload or data incompatibility. This is unrealistic and causes gaps to be exaggerated. Practically the bias happens only if the unit of interest was the object of several recent assessments, such as by specialized agencies who reported separately.

The alternative – no friction ever; it doesn't matter from how many different assessments the information is gathered – produces fewer gaps. For completeness, the template does compute this measure, but it is similarly unrealistic; in real-life knowledge management there is friction. A compromise ("Assume some friction") is impractical for lack of a plausible evidence fusion mechanism when usability ratings differ across sectors.

To mitigate the lack of realism, the user interface provides a table displaying for a given unit of interest which sectors are covered by *any* recent report(s). The table reports for each sector the highest usability rating the all the reports relevant for this unit. This permits a quick, holistic overview although not one condensed into one figure.

Aggregation: We posit that for a unit of interest at a higher level (e.g. a region) the information gap is zero if

1. it is zero due to the information collected about itself, or
2. at least one of the elemental members (e.g., a district or sub-district) has a zero gap.

One has to pause and realize how unrealistic this measurement rule is. Thus a region can appear with a zero gap if only one village in it has been satisfactorily assessed. Its beauty, however, is dynamic – if in each of four regions one village has been visited, nevertheless the four regions can be minimally differentiated by crisis impact or needs. Plus, while the algorithm shows the regions covered, it also shows all their districts, sub-districts, villages outside the four visited ones as uncovered – and to these the attention will now turn – until, iteratively, assessment saturation is reached.

The gap value for all units of interest at a given hierarchical level (e.g., for all districts) is the severity-weighted mean of the units' gap values. The gap timeline graph is drawn on this basis.

This presumes that all units at the lowest level have been assigned a severity score, as the result of remote sensing, recent assessment visits, or imputation of contextual values (e.g., the median severity scores of the assessed villages in the district).

Over time, with more assessments, these scores are likely to be updated, perhaps several times. The information gap algorithm is robust to changes of the severity metric as long as it is ratio-level and the new metrics are the same type for all units. At this point, the measurement challenge is not technical, but organizational. Do the registry analysts have the authority (and credibility) to assign scores, even to units not recently assessed?

Outlook

If and when the template will be used in future crisis responses, users will want to adapt it to new concerns, skills and opportunities. Notably, its outputs will need to be connected to GIS facilities, in order to visualize query and overview results not only in time, but also in space (a key recommendation in Tatham's 2011, op.cit., noted and extensively practiced in Nepal). It can be opened up for wider use and participation in a Web-based application. Those are desirable features; however, until it is tested in hot action, the template, in its current version, strikes a defensible balance of comfort and complexity.

A number of conceptual challenges remain, and we present some of them. A sidebar discusses the different emphases and challenges between information value and information gap models. Some readers may expect needs assessments to be evaluated for their information *value*. The value is the difference between the consequences of knowing and ignoring, minus the cost of acquiring the information. However, humanitarian action does not produce the kinds of commensurable costs and benefits that go into value calculations. The more modest, if less mainstream, *gap* model is more practical. At its simplest, it answers yes/no-questions – whether a unit of interest is covered by a recent assessment, or not. In addition, the evaluative components in the gap model – the rating of reports for usable information and the weighting of gaps by an assumed severity distribution – both are plausible and desirable. These components are new; their practical problems are hard to anticipate until future assessment registries provide a testing ground.

The template can be downloaded from www.acaps.org/img/documents/i-information-gaps-in-multiple-needs-assessment-in-disaster-and-conflict-areas--demo-files-february-2016.xlsx .

Introduction

Monitoring and measuring information gaps

This note is an extension of the earlier technical note "Survey of Surveys" (Tatham 2011). Surveys of surveys in the humanitarian world are registries of needs assessments and of other data collections that were carried out in order to better know the situation of affected populations as well as the actual distribution, use and effect of relief and protection efforts. Historically, the term "survey of surveys" goes back at least to the Humanitarian Information Center that the United Nations operated in Kosovo in 1999, and may be even older. Such surveys became habitual through the work of subsequent Humanitarian Information Centers. By 2002, UNOCHA put them on the same footing with "Who's doing What Where ('3W')" and vulnerability mapping exercises "essential to improve coordination of assistance" (Darcy and Hofmann 2003:54).

While the practice of these "surveys of surveys" has been sustained over the years, the term itself has become somewhat ancient; perhaps because of the very success and permanence, current lingo prefers "assessment registry". This term is imbued with bureaucratic self-importance, but we shall not second-guess it and will use it in the remainder of this note.

The humanitarian community strives to form a picture of crisis conditions and essential needs as complete, accurate and rapid as possible. Increasingly it monitors its own information collection and analysis activities through coordination bodies such as UNOCHA [1]. Coordination improves the needs assessment flow by finding critical information gaps early on. In this spirit, the objective of this note is to highlight conceptual challenges that beset the measurement of such gaps. Universal solutions may not be available for all challenges, and pragmatic ones will vary from situation to situation. An accompanying Excel template demonstrates the mechanics of computing gap measures. These, as always, depend on assumptions – assumptions that may be plausible, if unproven. Moreover, templates have to be adapted to contexts, information needs and new skills.

The value of humanitarian information

Humanitarian agencies conduct needs assessments in a decision-making perspective. The assessments help us understand what has happened and what *is* happening – and not only that. They are meant also to inform what likely *will* happen (in terms of the evolving humanitarian situation) as well as what *should* happen (in terms of an appropriate response). The needs profiles that they provide are expected to support decisions to allocate assistance and protection resources.

Theoretically, therefore, the value of assessments can be conceptualized in the same way as any other information used in decision making. In simplified terms, the value of information is based on three quantities:

1. The expected utility of the outcome from a decision made using this information,

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[1] See the global registry at https://www.humanitarianresponse.info/en/assessments/map, listing 1,820 assessments (as of 8 January 2016).

2. the utility of the outcome from a decision taken when information is absent (Wikipedia 2015b, Wikipedia 2015a), and finally
3. the cost of the information.

Utility and cost are comparable when their metrics can be mutually translated. This is most obviously the case when both can be expressed in monetary terms. In this case, the information value equals utility-with-info minus (utility-without-info plus cost).

Such commensurability is absent from the outcomes of humanitarian action. Lives saved, persons protected and households assisted all have value, but these are not accessible to a unified metric. This would be true even if their production functions – e.g. the cost of saving a life – were perfectly known. Practically, this does not lower the value of information from needs assessments. It is even plausible that in the last ten years it has gone up because decisions have been made on growing resources. Between the UN humanitarian appeals for 2006 and 2016 the number of persons targeted has tripled (from 31 million to 90 million) while the total aid requested increased more than fourfold (from US$ 4.7 billion to 20.1 billion in 2015) (Banning-Lover 2015).

However, incommensurability has methodological consequences. It obliges us to lower standards for measuring information value. Resource allocations are not expected to be fully determined by needs assessments (because the maximum utility across different humanitarian activities cannot be computed algorithmically). Instead, the assessments produce a measure of severity, such as of unmet needs. The resources allocated are supposed to be monotonously increasing in the severity measure. In simple language we would say that the communities most severely impacted will be given priority for assistance and protection.

The ability to prioritize

The value of the assessment information then is in the "ability to prioritize". This implies that the analyst can evaluate the information for its suitability to aid the ponderation of possible courses of action, and that there are criteria for this evaluation. The criteria can be borrowed from social research in general, but their applicability to needs assessments is less than straightforward:

We expect a needs assessment to deliver a *valid* measure of severity – the measure must be proportionate to an objective unmet need[2]. The validity of such a measure may be intuitively clear in sudden-onset disasters, such as when we express the severity of an earthquake by the number of destroyed buildings. In complex emergencies and persistent crises, validity may be harder to establish. In a similar logic, we may at first stipulate that the assessment must be *reliable* – if different observers could look at the same situation, their evaluations would be identical. On second thought we realize that we cannot know the reliability until repeated measurements have been made and have been compared. This may happen for certain areas and sectors, but not always for all. Some are assessed only once – or never.

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[2] If proportionality is too stringent a requirement, then at least the measure must be increasing with the underlying need. This milder requirement is appropriate for ordinal severity scales.

These difficulties motivate us to make validity and reliability <u>optional</u> criteria *for the measurement of the information value* of needs assessments (but, of course, not for the *design* of assessments). We may be able to approximately judge these qualities in some assessments. This may be done notably under in a systematic assessment registry format when a supporting body such as ACAPS catalogues every published assessment report and rates them for their usefulness in decision-making. Usefulness, of course, is in the eye of the beholder; the evaluations by a distant registry may be miles apart from those of the interested assessment teams or of the agencies commissioning the need assessments. The point is that validity and reliability are hard to establish, but there are other aspects of needs assessments that are easier to learn from the reports – notably coverage, analytic value and speed. Which areas did the assessment cover? What level of detail did it provide? Counting from the sudden onset date, when was the report made available, was it updated later, and when?

The presumption thus is changed. We now presume that if an assessment

- covers the areas affected (and the affected social groups living there),
- speaks to key concerns of preserving life and dignity,
- enables comparisons by areas, social groups or sectors,
- and is available within useful time,

then its information is sufficient. If it meets these conditions, we presume adequate "ability to prioritize"[3]. If this definition is acceptable, it holds also for multiple assessments – those that different agencies conduct and make mutually available. This, of course, is the prevailing situation in most of the larger crises and disasters. There is not one grand, all-encompassing needs assessment, but a stream of partial assessments, each with a different combination of coverage, scope and publication time.

A modest standard

This new standard, modest because it does not evaluate validity and reliability, is consequential. It changes our optics. They shift from a preoccupation with *information value* to the identification of *information gaps*. Gaps occur when assessments leave out affected areas or groups, do not speak to needs critical for the preservation of life and dignity, or have not been updated for so long as to become obsolete.

These conditions are not self-explanatory. "Coverage" depends on the degree of resolution ("granularity", administrative and household levels). Is it sufficient for an assessment to report needs and resources at the district level? Or are situations within given districts so fundamentally divergent that only sub-district measures have practical value? Critical needs - and consequently in the response planning -, critical sectors are situational. Obsolescence is dynamic – in rapid-onset disasters the assessment produced within the first

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[3] One may debate whether analysts recording assessment reports in a central registry can meaningfully evaluate the methodologies used. If one desires a rating for methodological adequacy, then one needs the relevant information from each report, the time and consistency to convert it to ratings, and a rule to penalize reports short on methodological notes – or to give them the benefit of the doubt.

72 hours will be of little value unless refined in a more detailed version within two weeks, and this one in turn will be obsolete after some months when a new round of funding appeals relies on updated assessments[4].

What to expect

The remainder of this note will focus on information gaps, with occasional forays into information value. We describe analyses that ACAPS analysts performed in order to gauge the information gaps in needs assessments from four different crisis contexts. Two of the four retrospectives go into a fair amount of detail (Nigeria, Nepal), in order to outline the logic as well as challenges awaiting future analyses. Using simulated data, we create a demonstration Excel workbook as a possible template. Reviewers of future assessment reports, tasked to monitor gaps over time as well as across sectors and regions, might find it helpful in devising their own applications, adapted to their crisis and response contexts. We have retrospectively tested the template with Nepal assessment registry data; it produces the desired outputs for any combination of user-defined parameters.

[Sidebar:] Information value and information gaps

This sidebar is intended for readers interested in the differences between information gap and information value analysis. It also speaks to some theoretical concepts and to the simplifications that practical gap analysis imposes. In particular, it addresses two challenges in information gap monitoring that are recurrent – obsolescence and "multi-resolution".

Gaps in what exactly?

We assume that the person(s) in charge of the assessment registry are the one(s) gathering the raw material for the analysis of the information gaps. They themselves may or may not be the analysts. They may or may not receive and archive the datasets that the various agencies collected for their needs assessments, but, in most cases, they do receive copies of the reports[5]. Regardless, the analysts will base their gap evaluations on the reports (and at most also on a cursory inspection of the underlying datasets). They do not have the time to review or expand the analyses that the assessment lead agencies have already done of the datasets. Of these the registry unit may anyway not have complete copies.

We thus assume a notional analyst given a growing pile of assessment reports and the task to define a measure of information gap[6]. He or she is to rate each unit of humanitarian interest by the extent to which the reports show the desired "ability to prioritize" the unit vis-à-vis other units. For simplicity, we make the further assumption that a unit of interest

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[4] In the terminology of the Multi-Sector Initial Rapid Assessment (MIRA), the first 72 hours of assessment work are to produce a "situation analysis" that will inform the "MIRA phase 2" resulting in a "MIRA report" within two weeks from the onset. The report is to inform prioritization, response planning and the design of further detailed assessments (NATF 2015).

[5] In most cases, but not always. The Nepal Assessment Cell received several cleaned, but undocumented datasets, with very little in the way of reports, and then pursued the agencies for meaningful metadata.

[6] The task may be defined inversely, not as a measure of gaps, but of usable information. Either way, the intent remains to monitor the flow of assessments with a view to forestalling or, have they already opened up, closing significant gaps.

can be defined as the combination of a sector, region and point in time. Food security in district XYZ two weeks after an earthquake exemplifies the combination. Social groups may be added as a fourth dimension, but the logic of the argument will not be altered. Remembering what we said above about reliability and validity, the analyst may want to rate the reports – and the units of interest that they cover – on these qualities, but in many cases this is unlikely to succeed.

The analyst must map the reports to the units of interest. This requires that the sectoral, geographic, administrative and temporal categories used in the reports can be mapped to the analyst's category system. For sectoral categories, usage may agree to a high degree. Problems arise only later when summary gap measures are to be defined, and the analyst must make a selection of those that he considers relevant for the immediate preservation of life and dignity (which may, for example, exclude "early recovery" as a sector). Let us assume that the analyst has a free hand in defining the set of relevant sectors for the gap analysis.

The multi-resolution problem

Geographic and administrative categories are more problematic, not by their definitions, but due to different levels and mixtures across reports. Let us again simplify by assuming that the definitions are exhaustive, clear and completely respected by all assessment teams. This is the case when both the normal national administration and the teams conducting assessments in the crisis-affected region use the same reference system, such as the famed p-codes for administrative units. For example, in Nepal, it would appear that both pre-earthquake practice and the needs assessment unit mastered this discipline, not least as the fruit of long preparations by national authorities and UN agencies. Some organizations kept using different sets of p-codes, but there were reconciliation tables to make their data compliant.

The problem arises from the different mixtures of data points between assessments and, in some cases, also from their imprecise reporting. Let us assume, for the sake of illustration, that the disaster affects a province that encompasses five districts, each of which is sub-divided into five sub-districts. For all three levels administrative definitions and codes are complete. If every assessment report listed the sub-districts visited by its team, gaps could be neatly defined as sub-districts *not visited by any teams* (during the relevant period of time).

This is usually not the case across reports. Some of the reports may specify the exact sub-districts visited and thus allow for a record to be created in the registry database keyed by the unique tuple "lead agency x sub-district x publication date"[7]. For every such record, the attributes observed can be expanded, notably on the sectors covered or, if feasible, with ratings on validity and/or reliability.

Other reports, however, will be vague about the lowest-level units covered. They may say something like "the team visited two of the five sub-districts" or "visited the district head-quarters and several outlying towns and villages". This reduces the granularity to "lead agency x *district* x publication date". The reduction at first affects only the records based on the particular report, but eventually, in the analysis of the full report set, the analyst will be forced to settle for the district as the lowest level at which he can describe the information gaps. This is so because probabilistic statements on sub-districts not covered

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[7] Or equivalently written as (lead agency, sub-district, publication date)-tuple.

(of the kind "from what we know from this report, there is a 60 percent chance that sub-district XYZ was not visited") are not practical in the analysis[8].

In sum, we must expect that needs assessments are heterogeneous in the granularity of the administrative-geographic units that they report on. This forces compromises as to the level at which to conduct the analysis, with attendant loss of the higher resolution that some of the reports do provide. We get a map of gaps at the district level even if it is known that in some districts shown as "covered" particular sub-districts were never assessed.

Modeling obsolescence

A challenge arises also in the handling of the temporal dimension. The publication date seems a useful measure of when the assessment information becomes available to the interested consumers. But it is not always the best. It is less relevant in cases where key findings have been communicated prior to the formal release. And, in some contexts, or on some assessments, reports may never be formally published. The publication date is similarly misleading where a formally released report gains attention slowly and partially, depending on consumers' access and pre-existing perceptions. In terms of obsolescence the date when the data collection was completed may be more meaningful if most of the assessment partners report it.

But these uncertainties are less serious in comparison to the question of how long the released information stays relevant, and from which point in time onwards it should be dismissed as obsolete. Intuitively, assessments become obsolete more slowly the more time has elapsed, and greater stability has been regained, since the onset of the disaster.

Practical considerations will prevail in solving also this challenge. One can model obsolescence in various ways. Ideally, we could arrange increasing shelf-life periods, i.e. increasingly delayed obsolescence cut-offs. Technically, a look-up table that defines cut-off times as a function of time since the crisis onset can take care of this. It would be more realistic, but would likely tax the skills of some analysts and confuse the audience of the information gap findings. Thus a simple, constant rule is more appropriate. The rule may say that

> *A unit X – e.g. a district x sector combination – at date Y is in gap condition if no assessment published less than Z days earlier covers it.*

This Z value, e.g. three weeks, less than 22 days, is to be applied throughout the observation period.

More and less important gaps

An omitted or poorly executed assessment creates a larger gap when it concerns a more severely affected unit of interest. Gaps should therefore be weighted by a severity indicator. The weights may warrant updating as the severity distribution becomes better known. We deal with this towards the end of this note. Weights are built into the template.

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[8] This does not mean that in other domains such probabilistic aggregation could not be modeled. In fact, such algorithms have been developed for the analysis of what is known as "multi-resolution" data, such as in satellite image fine-scale analysis. A Google Scholar search for "multi-resolution" AND "humanitarian" returns 292 references. Most of these concern applications with big data and physical measures.

Value vs. gap analysis

This is a good juncture to set the difference between information value and information gap analysis into sharper relief. As the above gap rule implies, after a set number of days the value of a needs assessment instantly drops to zero. It is only by using such an assumption that a simple and persuasive *gap model* can be calculated. This stark requirement does not apply to information *value models*. The information value does not evaporate instantly. Rather it decays over time, without ever being reduced to zero. An exponential decay with a defined half-life is easy to model in a spreadsheet. The idea that information gradually loses its value is more intuitive than abrupt obsolescence. Moreover, information remains valuable if it serves as a baseline or midline in later comparisons and for the context that it provides for the interpretation of newer information.

Conversely, the information gap model, with a simple fixed shelf-life, is undisturbed by the multiplicity of assessments that are conducted, some of them in the same region and sector and with almost the same publication dates. The model is indifferent to the extent of overlap; the sole definitional requirement for a gap is that the unit of interest not be covered by any recent assessment.

In the information value perspective, this very overlap is a problem. Intuitively, two assessments of the same unit of interest produce more information than just one. But how much more? To gauge the value of redundancy, ultimately the analyst must assume a transfer function of the kind that X overlapping assessments produce Y times the amount of the useful knowledge expected of a single assessment. One might adduce a far-fetched analogy with sampling theory – in order to double precision, the sample size has to grow four-fold. Analogously, the information value of overlapping assessments would be the square root of the sum of the values of the individual assessments. Such an intuition is legitimate, but the choice of aggregation function remains arbitrary[9].

This table summarizes the challenges that gap and value analysis face with obsolescence and redundancy.

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[9] Statistically minded readers may find the analogy with meta-analysis tempting (Wikipedia 2015c). Meta-analysis searches for a common truth in several pieces of research that speak to the same object, an ambition that can be assumed also for overlapping needs assessments. In fact, some meta-analytic approaches grapple with similar multi-resolution challenges as they obtain in the world of needs assessments with incomplete lower-level data (discussed further above in terms of districts and sub-districts), see e.g. Riley et al. (2008). However, the analogy is of limited value. Meta-analyses require that the contributing studies strictly estimate the same kind of effect using the same metric. Overlapping needs assessments may not always use the same effect variables and may not define the experimental and control groups essential for effect size (or only indirectly, e.g. by stating locations so that some key baseline difference can be observed via other datasets, e.g. the local Modified Mercalli Scale values in an earthquake setting). The value of overlap results rather from the concurrent assessments highlighting slightly different aspects and needs measures; thus their redundancy can be evaluated in the triangulation perspective of qualitative research.

Table 1: Obsolescence and redundancy in gap and value analysis

	Information gap analysis	Information value analysis
Obsolescence	Problematic: Gaps open <u>abruptly</u> as soon as no recent assessment covers the unit of interest.	Unproblematic: The information value can be modeled as decaying <u>gradually</u> with time since publication.
Redundancy	Unproblematic: There is no gap as long as at least one recent assessment covers the unit of interest. Overlapping assessments are of <u>no interest</u>. Only the distinction "gap / no gap" matters.	Problematic: The <u>combined information value</u> of overlapping assessments is more than that of any individual assessment and less than the sum of their values. But how much exactly?

Information gaps and confidence ratings

A final remark is due regarding the relationship between needs assessment gaps and confidence ratings of assessment data. Gap analysis concerns the relationship between the stream of assessments and units of interest that are supposed to be covered by (sufficiently recent) assessments during the observed response period. Confidence ratings are assigned to the information recorded in a single questionnaire. They concern 1. the reliability of the sources that the enumerator used and 2. the coherence of those data elements that are measures of the same object (e.g., food security) (Benini, Aiyob et al. 2015:15). Only if 3. the enumerator records his own conclusions from various pieces (e.g., on the severity of food insecurity in the sub-district that the questionnaire covers) and somebody higher up rates the confidence in these conclusions can we construe a relationship between confidence ratings and gap analysis. Questionnaires rejected for weak or invalid conclusions then are the equivalent of an assessment gap.

The relationship is weak. We usually rate confidence in the elements of a large needs assessment whose combined report will appear at one point in time. By contrast gap analysis looks at a stream of assessments with different regional, sectoral and temporal coverage, published over a significant response period.

Precedents

This section reviews information gap analyses that ACAPS performed in 2014 and 2015. The four analyses from the Syria/Iraq, Sierra Leone/Liberia, Nigeria and Nepal contexts show a line of development from static (= one point in time) gap analysis to one with some dynamic elements, and hence to a fully dynamic one.

In particular, the study of assessments in the conflict-torn northeast region of Nigeria exploits a one-year long assessment registry, together with ratings of the information depth. The original ACAPS note focused on the information *gaps*; in the segment here we complement that with an information *value* perspective. We divide the population into situations with known lesser and greater severity and calculate the relative information

value per group. While this analysis is retrospective, it has potential for ongoing monitoring of the allocation of assessment effort to more severely vs. less severely impacted groups.

The fourth study addresses the identification of information gaps in the assessment stream that the Nepal earthquakes in 2015 set in motion. The Nepal assessment registry illustrates the multi-resolution problem. A minority, but nevertheless substantial, proportion of the assessment reports stopped at the district level, not observing differences among sub-districts ("Village Development Committee" [VDC] areas in Nepal). We calculate the coverage scores aggregated to the districts, giving away the VDC information. This produces a gap measure for all affected districts, good enough for a modelling exercise in this note, but not for practical monitoring of an assessment effort. In practice, meaningful gap monitoring need also a weighting system based on severity – gaps in the assessments of more severely impacted areas and social groups ought to carry greater weight. In Nepal this was well understood within a week or so after the first quake. Afterwards less affected units needed comparatively fewer assessment resources, and information gaps there were considered less serious. We do not have weights in the Nepal dataset, but we will simulate them in the demonstration template.

Finally, for conceptual reasons, in a sidebar we summarize also an older study – the only available one in the humanitarian realm that incorporates the cost of information.

Syria Needs Assessment Project (SNAP), 2014

The assessment challenge in Syria

Gathering and sharing information on the humanitarian situation in Syria is politically sensitive. Access to the field is severely restricted. These factors have been impeding the accurate monitoring of needs in this country. At the time of the set-up of the "Syria Needs Analysis Project" ("SNAP") in 2012, these challenges were compounded by the fact that three cross-border operations from Turkey, Lebanon and Jordan were de facto independent from each other, with limited coordination. While the 'Whole of Syria' approach, introduced in 2014, has addressed some of these challenges, the picture of the humanitarian situation remains incoherent and fragmented.

Until mid-2015, there is no centralized, publicly available assessment registry. But while ACAPS and MapAction operated the SNAP between 2013 and 2015, it served as a surrogate repository, albeit primarily for internal use.

ACAPS' analysis

In ACAPS, the first conceptual developments on information gaps after the 2011 note (Tatham, op.cit.) emerged from the information landscape in Iraq and Syria. Leonie Tax, reviewing information available to the SNAP, devised an information gap scheme that was forward-looking and closely tied to humanitarian decision-makers' needs (Tax 2014). Her point of departure was the intuition that information needs increased apace with the severity of the humanitarian crisis. Information gathering efforts therefore needed to be concentrated on the worst affected groups or areas. The effort needed to effectively close the information gaps that prevented adequate decision making at every level of severity.

But it must not be excessive, producing a glut of data much of which was not needed for decision-making in less affected or already well surveyed areas. In terms of measurement of severity and information gaps, she developed three guidelines:

1. Typically, very few indicators of severity were available with complete national coverage, and the few that could be measured were difficult to combine in their raw forms. Combining them was easier if they were reduced to ordinal variables. Tax experimented with five-level ordinal measures. For example, the estimated proportions of persons in need in the Syrian governorates would be broken down into ranges, each of which was assigned to one of the five severity levels. If several ordinal severity indicators were available, the cautionary principle dictated that the highest (= most severe) one should determine the index value of the governorate in point.
2. The available information could be evaluated by the extent to which decision makers could affirm that the available information was good enough to make a *"solid judgment on the priority needs and to quantify the need on a sectoral level"*. The degree of possible sector prioritization and needs estimation too could be expressed on a five-level scale, as in the diagram below.

Figure 2: A five-level scale to rate the "ability to prioritize"
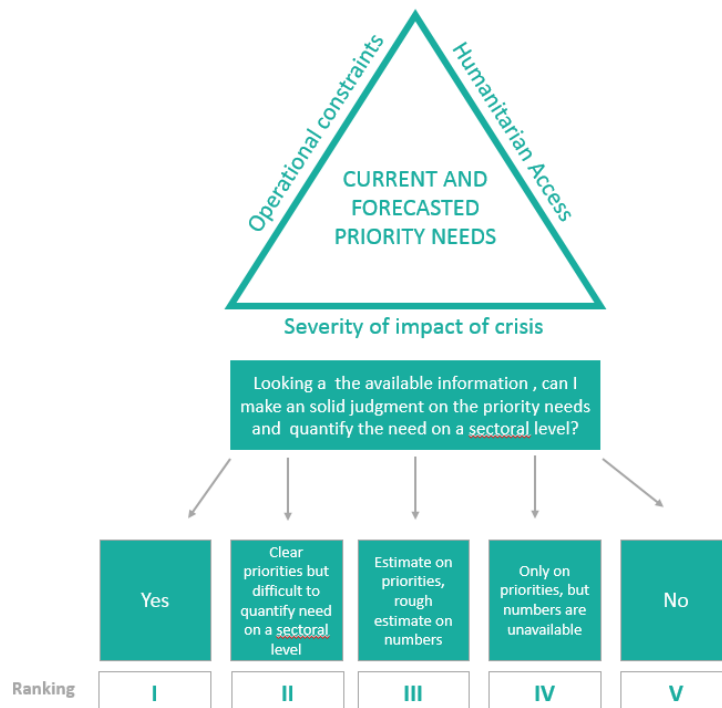
3. Finally, the information gap score was calculated from the two indices of severity and available information. Both of these were conservatively measured, which meant that the *maximum* of their respective indicator values was taken (the more severe conditions, respectively the progressive inability to identify priority needs

and to quantify them are assigned higher levels). The gap score, then, is the *minimum* of these two index values.

This minmax formula appears counterintuitive at first sight. However, it is based on the correct insight that the marginal value of additional information is higher when less information is available to begin with, but this is moderated by the severity level. Conversely, the marginal value is higher when the crisis is more severe, but this in turn is moderated by the information already collected.

This table reproduces the calculations that Tax made for the situation of the Syrian governorates in January 2015 (op.cit.: 6)[10].

Figure 3: **Severity, information and gap scores for the governorates of Syria**

GOVERNORATE	Severity score (5 = most severe)	Information score (5 = least information)	Gap score (5 = most serious)
Homs	5	5	5
Rural Damascus	5	5	5
Damascus	4	4	4
Daraa	5	4	4
Lattakia	4	3	3
Quneitra	5	3	3
Tartous	3	4	3
Aleppo	3	2	2
Hama	4	2	2
Al-Hasakeh	1	1	1
Al-Rakka	2	1	1
As-Sweida	1	4	1
Deir-ez-zor	3	1	1
Idleb	3	1	1

Tax recognized that conditions could vary dramatically within a governorate, including widely different information gaps. While she advocated special recognition of the more severely impacted sub-governorate regions (such as the Kurdish town of Kobane), she thereby anticipated the challenge that streams of needs assessments in a crisis zone will produce heterogeneous information with regards to administrative and geographic levels.

Also she interpreted the gap scores prescriptively, with levels four and five calling for "immediate data gathering", two and three demanding some "data gathering" and level one requiring "no action". The practicality of these graded calls for action, however, founders on the cliff of humanitarian access. The widest information gaps occur in constellations

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[10] We renamed the column headings for greater clarity.

where severe conditions interdict access, resulting in far-reaching information black-outs in the first place.

The lasting value of Tax's information gap concept is that it pioneered the "ability to prioritize" as the key criterion, rating gaps by the marginal value of additional information gathering. This value depends on how much we already know, and how much we need to know in response of situations that are more or less severe. The ratings, particularly of the information scores, may admit of a measure of subjectivity, but they are not arbitrary, given the sharp differences among units of interest.

Ebola viral disease (EVD) in West Africa, 2014-15

The humanitarian challenge

The West African Ebola Virus epidemic was centered in Liberia, Guinea and Sierra Leone, starting in December 2013 and ongoing as recently as January 2016 (with a flare-up in Sierra Leone) (Wikipedia 2016c). A massive international response focused on containing and extinguishing the epidemic. Much less attention was paid on the associated humanitarian needs in other sectors until the foreseeable end of the epidemic opened a space for recovery concerns (Tax and Noumri 2015b). Various UN Clusters conducted or supported assessments, on which they kept simple registries. A centralized inter-sectoral assessment registry did not exist.

ACAPS' analysis

ACAPS followed the evolution of needs assessments in the Ebola-affected countries in West Africa closely (besides being directly involved in the design and evaluation of surveys in Sierra Leone and Liberia). Its analysts kept a daily needs update, based on a variety of document types. Besides that, ACAPS evaluated formal assessment reports. It published an gap analysis on the basis of reports released between December 2014 and mid-March 2015 (Tax and Noumri 2015a). The analysis was based on 67 reports from Sierra Leone and 48 from Liberia. As a general rule, coverage and quality of the completed assessments were highly variable.

ACAPS was limited to rating districts (Sierra Leone), respectively counties (Liberia), sector by sector, by the ability of the relevant assessments to gauge humanitarian impact and to prioritize for action. Both dimensions – inferred impact and ability to prioritize – were rated on three-level scales of information gaps. Subsequently, Benini (2015) broke this complexity further down by assuming that certain combinations of levels were unlikely, as marked in this table.

Table 2: Combinations of impact knowledge and priorities

Humanitarian impact	Can be prioritized		
	No	Vaguely	Clearly
Unknown		Unlikely combinations	
Vaguely known			
Known and rated			

The remaining five combinations could therefore be treated as a one-dimensional order. We exemplify the approach with the case of Sierra Leone.

The analysts evaluated the combined information content of the reports in a 14-districts-by-15-sectors table. From this table we produce counts of districts that reached, by March 2015, particular levels of information in the various sectors. Table 3 visualizes the counts, by sectors and sector aspects.

Table 3: Levels of information by sector, Sierra Leone, March 2015

Humanitarian impact:	Unknown	Vaguely known	Known and rated		
Ability to prioritize:		None		Vague	Clear
SECTORS:					
NON-SECTORAL					
Access		11		3	
Displacement		9	5		
FOOD AND LIVELIHOODS					
Food security		4	10		
Market prices	14				
Food production	10			1	3
Livelihood	13			1	
HEALTH					
System performance					14
Services availability				14	
Disease surveillance	14				
Undernutrition			14		
WASH					
Non-Ebola related	14				
PROTECTION					
Child protection			14		
Gender based violence	14				
Harassment or discrimination		14			
EDUCATION					
Education					14

The distribution suggests that the existing assessments supplied information sufficient for clear prioritizations only for very few aspects of the humanitarian gamut. Of note, information gaps within one sector were highly variable, as is evident particularly in the ratings about health sector aspects. By contrast, inter-district variation was minimal.

Plausibly the assessment dynamic was driven chiefly by the fear of contracting Ebola, by travel and access restrictions, and thus by the severely limited opportunities for primary information collection. Moreover, the crisis was considered primarily a health crisis, much less a multi-sectoral humanitarian crisis. Therefore, needs assessments outside EVD surveillance had low priority. Secondary effects in such areas as food security and education were long neglected, their needs accumulated and were met by delayed response.

Nigeria, 2014-15

The humanitarian situation

The war between the Nigerian authorities and the opposition movement "Boko Haram" has since 2012 created an increasingly serious humanitarian situation in the northeastern states of the country. The humanitarian response has concentrated on the food security, livelihood support, health care and protection sectors. A number of needs assessments were carried out, but have mostly remained incomplete due to security concerns and restricted access.

ACAPS analysis

ACAPS performed an information gap analysis mapping 35 needs assessments from the region ravaged by the conflict in Northeast Nigeria (Wilkins 2015) . The assessments had been produced between August 2014 and August 2015. The region encompassed the four states of Adamawa, Borno, Yobe and Gombe – the region where hostilities between Boko Haram and the Nigerian army were causing the most important disruption of livelihoods and internal displacements.

The analysts in Geneva looked into the coverage of 112 Local Government Areas (LGAs) in the region. A dataset was created, with one record for each of the 319 distinct assessment x LGA combinations observed. The analysts calculated an information gap score that took into account the degree to which the assessments covered social groups, sectors and areas, the regularity of updates, as well as the depth of information. Depth was rated on a three-level scale (none, partial, comprehensive), per sector.

Figure 4: Nigeria - Number of assessments, by sector, in affected LGAs, 2015
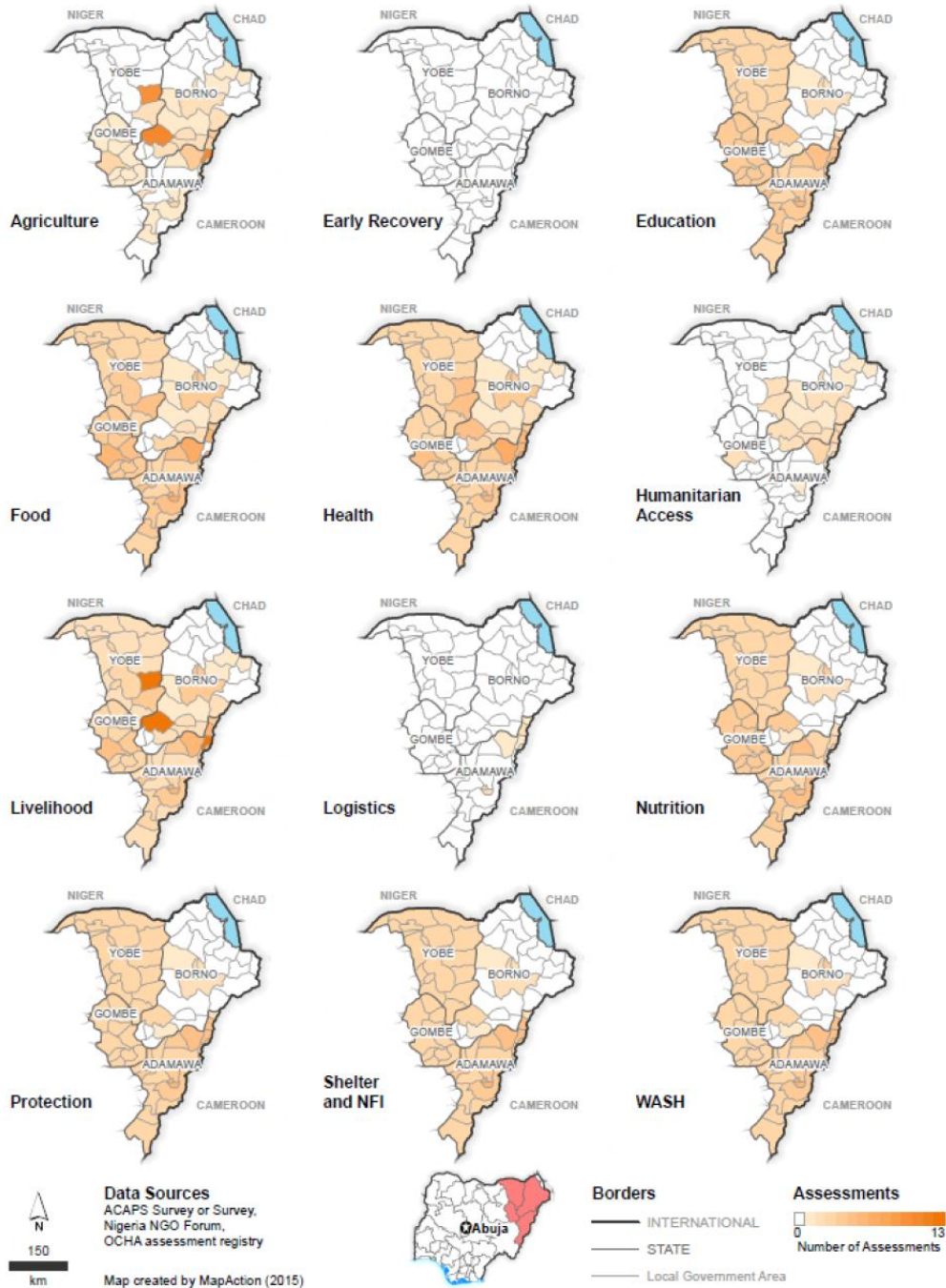
Source: Wilkins, op.cit.: 3

This case is of special interest for two reasons. First, the LGAs were characterized on two indicators of humanitarian severity – the proportion of internally displaced persons (IDPs) in the total population, and then also by the Integrated Food Security Phase Classification (IPC) level (Wikipedia 2013). Second, a number of LGAs, particularly north and east of the city of Maiduguri in Borno State, had been inaccessible most of the time (assessments may in part have been done by way of interviewing IDPs). While an IPC rating had been

given to all 112 LGAs, the IDP situation in 26 LGAs was unknown. This necessitated an auxiliary assumption that it was worse than in any of the LGAs with known IDP proportions. The case of Nigeria, therefore, illustrates analytical problems arising from missing values in key variables. It also highlights the role of assumptions in information gap analysis.

The two-way bar chart below displays the population, across all LGAs, for every combination of IDP and IPC levels, with an extra column for inaccessible areas with unknown IDP situation.

Figure 5: Population, by IDP proportion and IPC phase, Nigeria
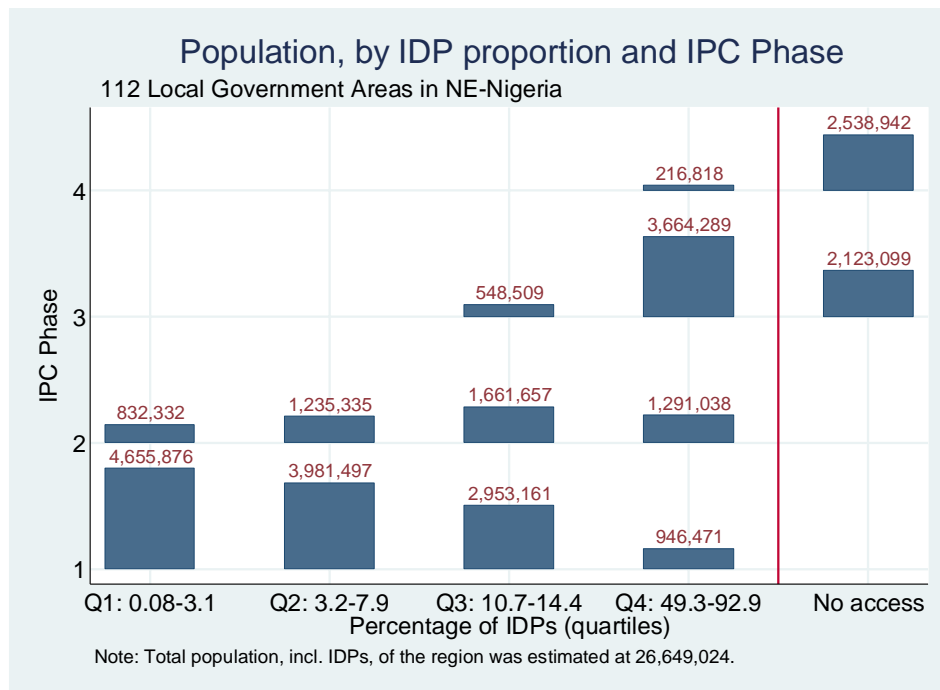
Under the assumption that the situation in inaccessible areas was indeed worse than elsewhere, it is obvious that the humanitarian situation was bipolar. The population of the region was estimated around 26.6 million. The majority were still living in LGAs with moderate levels of distress – with IDP proportions less than 15 percent, and IPC phase ratings 1 or 2. A large minority – about 40 percent - lived in areas with elevated levels of both indicators or with elevated IPC and unknown IDP values. Only about 10 percent were in LGAs rated elevated on one, but not on the other indicator. The correlation between the two ordinal indicators is strong[11].

This bipolar situation is of heightened interest in the information gap perspective, again for two reasons. First, we assume that the need for detailed assessments is greatest for the populations shown in the upper right corner of the bar chart – those in IPC phases 3 or 4

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[11] Goodman and Kruskal's gamma = 0.86.

and in the 4th IDP proportion quartile or with no access. At the same time, we expect that the density of assessments will be particularly low for inaccessible populations.

Second, because the analysts were able to rate the information depth, an information *value* analysis is feasible, at least of a rudimentary kind. This can complement the published *gap* analysis. It is especially tempting because ACAPS observed the assessment flow during a full year. This allows us to model obsolescence – a feature that we will repeat later when proposing elements for a generic gap analysis template.

For space reasons, we limit the presentation here to the description of the essential analysis steps and to answering the question whether indeed the assessment density (frequency and quality) was higher in the worse affected populations, and how dense it was for the inaccessible ones. We evaluate the information values of the assessments as of 15 August 2015, the date when the observation period ended. The Excel workbook in which the analysis was performed is available upon request.

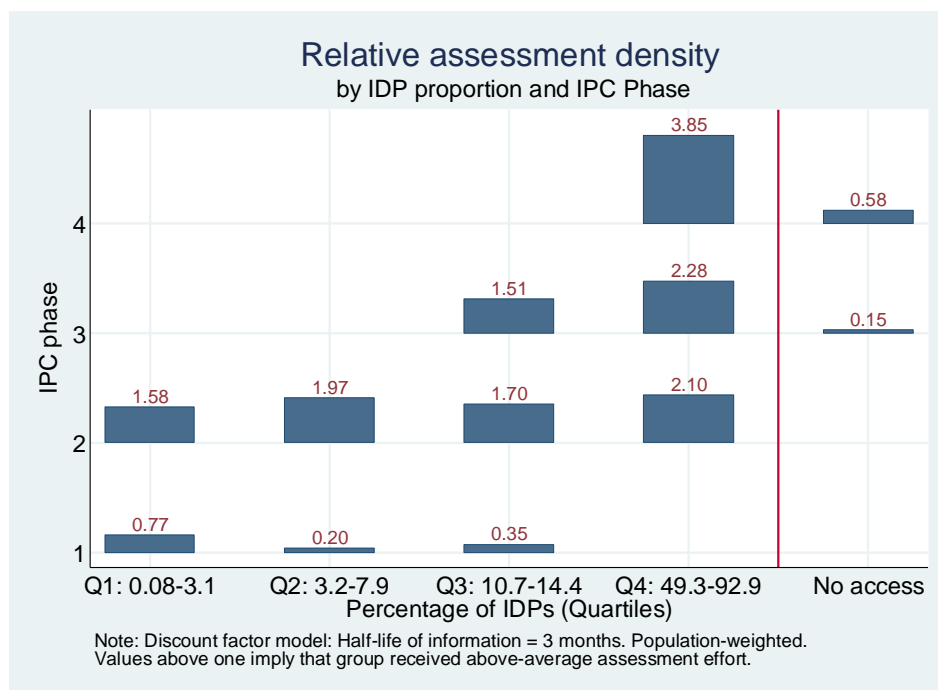The analysis proceeds through these steps:

- The raw material arrived as a table with 319 records, one for each observed combination of assessment and LGA. The substantive variables of interest are the publication date plus the aforementioned information depth ratings. ACAPS analysts assigned 15 separate ratings to the different sectors, access and logistics as well as social groups (displaced, residents, all)[12]. This makes for a theoretical maximum score sum of 15 * 2 = 30 over all 15 aspects. In each of the 319 records, we compute an information value as a function of the depth ratings and the time that passed between publication and cut-off date. The information value comes in two flavors. In the *binary obsolescence* model, the value is a function of the depth ratings only if the assessment is younger that the expiry period; beyond that, the information value is zero. The *discount factor* model avoids abrupt decreases; in it the information value decays exponentially by a half-life parameter. The first flavor is easier to understand, the second more realistic.

- In the next step, the 319 records, defined by assessment x LGA combinations, are collapsed into 112 LGAs records, summing the information values from the previous table. In the discount factor model, the sum of information values over all assessments in a given LGA is straightforward (the underlying idea is cumulative knowledge over time). In the binary-obsolescence model, that sum is compared to a normative standard – the sum that would result if we had a recent assessment providing comprehensive information on every aspect. Given the vast differences in the total population size across LGAs, the sums are multiplied with the respective total LGA populations. This anticipates the population weighting in the next step.

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[12] It is easy to create, in a parameter sheet, switches that activate/deactivate any sub-set of the 15 information depth aspects and accordingly re-calculated information values throughout the workbook. For simplicity, for this summary we leave all 15 active. The depth scale is ordinal by nature, and summing scores over the aspects is questionable. However, one might consider each variable as reflecting an item in a primitive Likert scale (Wikipedia 2011b) with three levels only and justify sums and means on this bold assumption.

- In the third and final step, the population-weighted information value is computed for each of the observed IDP proportion quartile x IPC phase combinations. This produces the result of interest, an index of *relative* information value or, if you will, a measure of the needs assessment density for the LGA population in each of those combinations[13]. These results are best visualized in the same format of a two-way bar graph. Values above one indicate that the assessments produced information of a value higher than what efforts simply proportionate to LGA populations would have achieved. Values below one indicate a less-than-average assessment effort, either because this group was not a priority (low IDP and IPC) or it was not accessible.

Figure 6 displays the relative assessment density for the discount factor model, by the same groups as in the previous population chart.

Figure 6: Relative assessment density, by IDP proportion and IPC phase, in Nigeria

Relative assessment density
by IDP proportion and IPC Phase

Note: Discount factor model: Half-life of information = 3 months. Population-weighted.
Values above one imply that group received above-average assessment effort.

The results from this model indicate that the assessment activity was indeed concentrated on the more severely impacted groups. This yielded information of a value that, in the case of LGAs in the fourth quartile of IDP proportions as well as in IPC phase 4, was almost four times higher than what the humanitarian community would have obtained if effort and

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[13] In Excel, the key function achieving this calculation is SUMIFS, the sum of values from all records that meet the multiple conditions specified in the "ifs" part of the syntax. The raw result has to be calibrated in order to obtain the metric using 1 as the threshold for above-average assessment effort. The index is dimensionless and has no theoretical maximum because it is data-dependent. For the technicalities, the interested reader is referred to the Excel workbook available on request.

quality were uniformly distributed. Overall it seems the allocation of assessment resources was more responsive to difference in IPC phases than to those in IDP burdens. Where assessment teams had access, they concentrated their efforts to a significant degree on populations more severely impacted. Trivially, the relative information values for the two groups in the "no access" column are low.

The values from the binary-obsolescence model are similar, if more muted – e.g. 2.20 instead of 3.85 for the IDP-Q4 x IPC 4 group singled out above.

The value of the Nigeria survey-of-surveys analysis lies in its ability to assess the "ability to prioritize", expressed by the depth of the sector information, in terms of humanitarian severity. The information value measure developed for this purpose may not be immediately intuitive for the readers. However, the premises on which it is built – information ages (obsolescence), and multiple assessments of the same groups are worth more than just one assessment (redundancy) – should be philosophically acceptable. This analysis weighted the information value by the local population size, a feature that may be appropriate in some situations, and less so in others.

Nepal, 2015

The earthquake and the humanitarian response

In short succession, two earthquakes shook Nepal in spring 2015, on April 25 and May 12, killing more than 9,000 people (Wikipedia 2016a, Wikipedia 2016b). In the wake of the first quake, UNDAC established an On-Site Operations Coordination Center (OSOCC)[14] in charge of doing situation analysis and reporting on the humanitarian impact of the earthquake. Later on, the cell was institutionalized within the UNOCHA office as the OCHA Assessment Cell, funded by DFID and in collaboration with UNOCHA[15].

Assessment reports recorded

A designated UNDAC/UNOCHA information officer in Kathmandu collected assessment-relevant documents. Eventually the collection grew to 230 documents published between April 27 and August 19, 2015. The word "assessment" occurs in 137 of the document titles; other reports are called "situation report", "update", "summary of findings", "cluster report" as well as a few other designations. For simplicity, we will henceforth refer to all as "assessment reports". The officer logged the reports in a database with one or multiple records for a given record, depending on the number of distinctly assessed administrative units. This procedure expanded the table to 1,482 records. The combination of assessment ID and area ID becomes the primary record key.

For information gap purposes the attributes of interest consist of a set of binary indicators of whether the report covered certain sectors and of its publication date. The list of twelve sectors included "humanitarian access" and "logistics", which one usually considers functions rather than substantive sectors.

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[14] http://www.unocha.org/what-we-do/coordination-tools/osocc-rdc/overview .
[15] Its work is still accessible at http://nepalassessments.github.io/ .

Granularity by administrative levels

The 1,482 records must be distinguished by the administrative levels to which the assessments reached down. At the lowest recorded level, the Village Development Committee (VDC), 181 reports generated 1,186 records, touching as many as 662 distinct VDCs. Other reports, however, penetrated only as far down as the districts. There were 47 of them, generating 292 records touching 22 districts. Four records were at the region or zonal levels or unspecific, presumably the result of processing errors.

If the VDC level was the universally desired granularity, the result is impressive, with 181 / 230 = 79 percent of the reports detailing findings at that level. The problem of multi-resolution, thus, was mild in this ensemble of assessment reports. As this chart shows, already by the second week after April 25, the humanitarian community produced assessment information largely at the VDC level. A residual of district-level reports continued to appear throughout the observation period, presumably – we have not tested this – describing needs in the less impacted, therefore less densely assessed districts.

Figure 7: Granularity of assessment reports over time
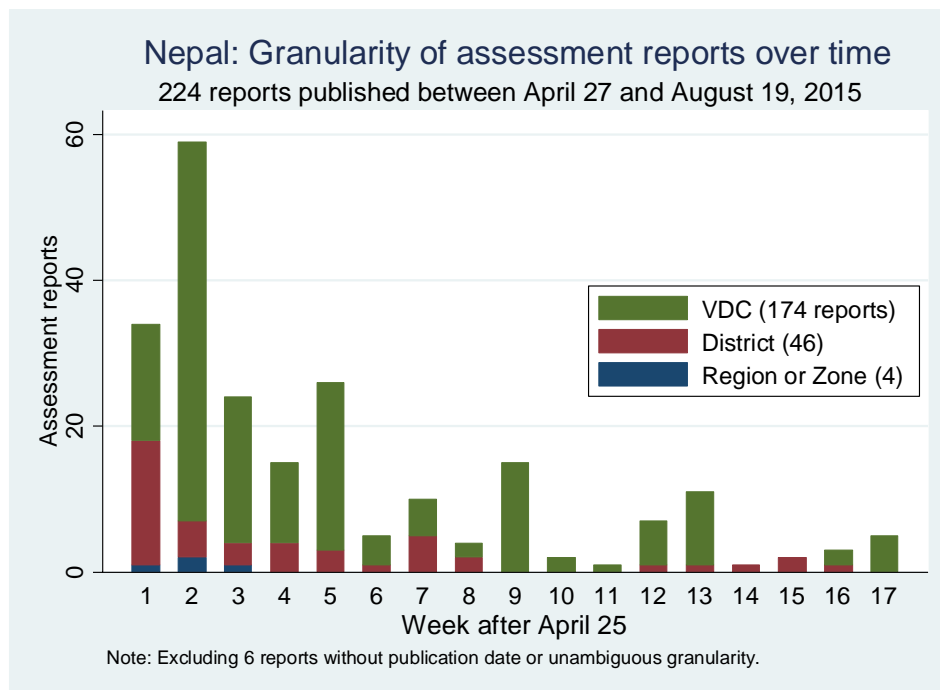
At several points in time, the information officer visualized the progress of the assessment activities in maps, color-coding districts by the number of assessments covering them since the first earthquake, and putting into stark relief the VDCs to which these assessments spoke specifically. As expected and confirmed in this sample map, the VDC coverage tended to increase with the number of assessments in the encompassing districts. Such map-based visualizations respond to Tatham's (op.cit.) call to exploit the potential of assessment registries through stronger connections to GIS (and increasingly Web-based) facilities.

Figure 8: Needs assessment by 25 May 2015 - Districts and VDCs

This map shows the total number of needs assessments conducted per district, as well as highlighting the VDCs that were assessed. This map is generated based on completed and ongoing assessments reported to the Assessment Cell as of 25 May.

Kaski 1
Lamjung 11
Gorkha 73
Rasuwa 14
Syangja 1
Tanahu 3
Dhading 56
Nuwakot 52
Sindhupalchok 51
Dolakha 15
Palpa 1
Kathmandu 11
Lalitpur 12
Nawalparasi 1
Chitawan 2
Makawanpur 12
Kabhrepalanchok 16
Ramechhap 8
Solukhumbu 2
Okhaldhunga 2
Sindhuli 18

Legend
Total Assessments by District
1 - 3
4 - 12
13 - 18
19 - 73
VDCs Assessed

Source: Assessment Registry, OSOCC Assessment Cell, Kathmandu

Aggregation to the district level

Nevertheless, information gaps can practically be evaluated only at one level, and the 21 percent of the reports that lack VDC-specific information encouraged us to aggregate all records to the district level.

This solution is not compelling; one could evaluate gaps at the VDC level by taking a list of all VDCs in the maximum area known to be affected, and treat all VDCs not covered as information gaps. This would omit the district-only information, declaring some districts and their VDCs not covered while in actual fact they were "somewhat" assessed at the district level. Pragmatically, this is largely a question of how far the response has progressed. In the first few weeks of a sudden-onset disaster, or in theaters with limited humanitarian access, district-level assessment coverage maps may do the job. As the response unfolds, or access improves, sub-district granularity will likely become the standard, as in fact it did in Nepal (see figure further 7 7above) .

With the Nepal data, we aggregated to districts, primarily to try out how a multi-resolution dataset could be handled. Why, what and how?

- **Why:** We wish to determine whether information was available on a given sector in a given district at a given point of time and to treat the absence of such information as a gap.
- **What:** The starting point is the variables that record which sectors the report covered in the administrative unit concerned. We limit the coverage evaluation to

five vital sectors: food; water, sanitation and hygiene (WASH); health; shelter; protection[16]. Every report has a recorded publication date.

- **How:** Although the gap calculations traverse a forest of technical formulas, they are based on *substantive* assumptions. These are more important than the technicalities.

In particular, we assume that

1. A district is covered for a certain sector if at least one recent report covers the sector in at least one of its VDCs.
2. A report is recent if between its publication date and the date of interest fewer days have passed than the period beyond which we consider all reports as obsolete.

This period was set as 21 days, in the form of a named parameter that can be changed, if desired, with results updating automatically.

Technical steps

The aggregation and subsequent computation of information gap statistics proceed through several steps. This table describes them as a sequence of tables, with their nature, numbers of records and primary keys.

Table 4: Nepal - Steps in transforming the SoS to a timeline of sectoral information gaps

Step	Content – Records defined by	Records	Primary key
0	**Original data** – Combination of assessment report and lowest recorded administrative unit	1,482	Record ID
1	**Aggregation from VDC** to district using rule #1 – Combination of report and district	535	ID derived from assessment and district IDs
2	**Parameter definition:** Days before the report is obsolete	N/A	
3	**Is the report still relevant?** Indicators for each day of monitoring period x each sector, and totals over sectors. (5 + 1) * 117 = 936 auxiliary variables (primarily for later timeline graphs) .	535	Same as in step #1
4	**Aggregation to the district:** For each date and sector, the sum of indicator values in step #3, within a given district, is a rough information *value* index. Again 936 auxiliary variables.	23	p-code of the district
5	**Binary information *gap* index**, for each date and sector: = IF(InfoValueIndex from #4 = 0, 1, 0). Again 936 auxiliary variables.	23	p-code of the district
6	**Timeline of information gaps** by sector as well as for all 5 sectors: Sum of gap index values, for each date and sector, over all districts, divided by the number of districts (23). Mean of five-sector totals for all 5 sectors. Reshape table (as shown below), with date and sector gap results only.	117	Date

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[16] For convenience reasons, and without loss of generality. To build a historic timeline graph for Nepal, for every sector 117 auxiliary variables had to be computed, one for each day of the monitoring period. A practical monitoring template that looks only at gaps as of current date can do away with that complication. One may work with fewer or more sectors. We did not build the sectoral switches of the kind that allowed us to work with any sub-set of sector in the Nigeria dataset; so our results are for the five sectors only.

The resulting timeline table is the basis for the subsequent graph. This segment implies that three of the five sectors reduced their assessment gaps by May 10, i.e. within the two-week period that the Multi-Sector Initial Rapid Assessment (MIRA) guidance stipulates.

Table 5: Nepal - Fraction of districts without recent assessment reports, by sector and date
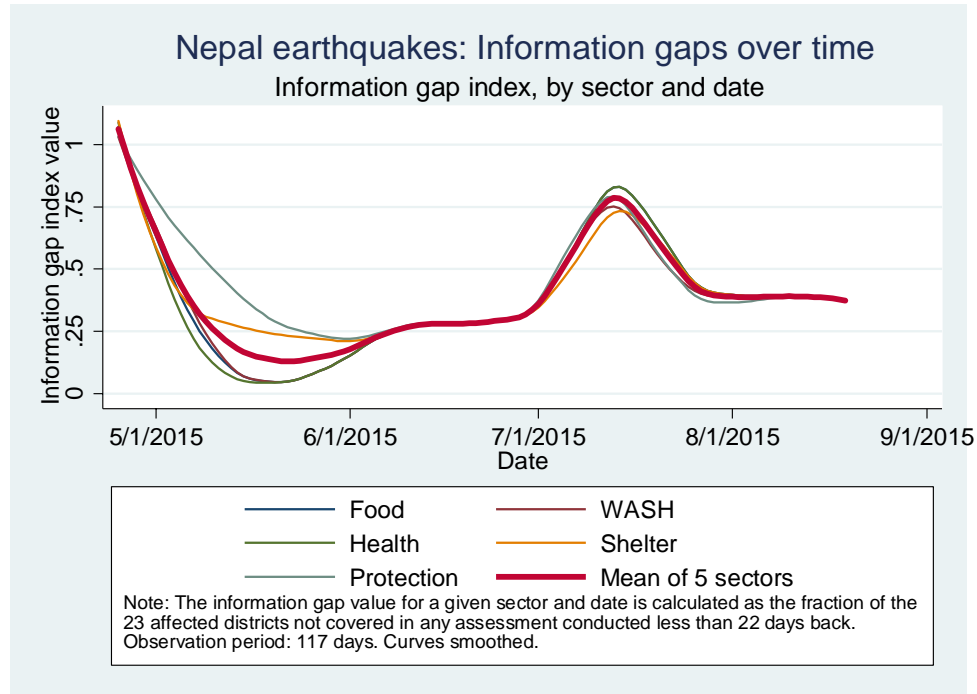
Date	Food	WASH	Health	Shelter	Protection	Mean of 5 sectors
4/25/2015	1.00	1.00	1.00	1.00	1.00	1.00
4/26/2015	1.00	1.00	1.00	1.00	1.00	1.00
4/27/2015	1.00	0.91	1.00	1.00	1.00	0.98
4/28/2015	0.83	0.83	0.83	0.83	0.87	0.83
4/29/2015	0.83	0.83	0.83	0.83	0.87	0.83
4/30/2015	0.57	0.61	0.52	0.52	0.78	0.60
5/1/2015	0.48	0.61	0.48	0.43	0.78	0.56
5/2/2015	0.48	0.57	0.39	0.35	0.70	0.50
5/3/2015	0.48	0.57	0.39	0.35	0.70	0.50
5/4/2015	0.48	0.57	0.35	0.35	0.70	0.49
5/5/2015	0.43	0.52	0.30	0.30	0.57	0.43
5/6/2015	0.39	0.43	0.26	0.30	0.57	0.39
5/7/2015	0.39	0.43	0.26	0.30	0.57	0.39
5/8/2015	0.09	0.09	0.04	0.30	0.57	0.22
5/9/2015	0.09	0.09	0.04	0.30	0.52	0.21
5/10/2015	0.09	0.09	0.04	0.30	0.52	0.21

Note: Values for the full observation period are presented in the next figure below.

Key findings

The essence of the gap dynamic is captured in this graph spanning the entire period of interest. It uses the same statistic as the table, the fraction of districts without recent assessment reports, but the lines have been smoothed. The gap is smallest one month after the first quake, with some sectoral differences. Over the following month it grows very little, with new assessments almost compensating for the obsolescence of the initial ones. By mid-July, accelerated obsolescence drives up the gap index. By late July it is again lower, due to a flurry of new assessments. Many of these were carried out presumably to support a new round of proposals towards the end of the initial funding cycle.

Figure 9: Nepal - Information gaps over time

Nepal earthquakes: Information gaps over time
Information gap index, by sector and date

Legend:
- Food
- Health
- Protection
- WASH
- Shelter
- Mean of 5 sectors

Note: The information gap value for a given sector and date is calculated as the fraction of the 23 affected districts not covered in any assessment conducted less than 22 days back. Observation period: 117 days. Curves smoothed.

Note that the sectoral indices refer to the entire affected area, composed of 23 districts. The narrow bunching of lines after June 1st creates an impression that the sectors marched in lockstep, through a predominance of assessments that looked at all sectors in the same places and times. But in a spatial perspective, that is not so. The food security sector followed its own dynamic throughout; after June 1st its assessments grew more aligned with those of the other four sectors, but only slightly so. The dendrogram, based on a coincidence analysis (Escobar and Berrocal 2015) of the 535 assessment x district combinations, reveals that the WASH and health assessments moved together most closely. Shelter-NFI had a bit more independence, protection yet more, and the food security assessments were the most independent even when its gap index was similar to the indices of the others.

Figure 10: Co-incidence pattern of sectoral concerns (for the entire monitoring period)

Needs assessments after Nepal earthquakes 2015
Co-incidence pattern of sectoral concerns

Note: 535 assessment X district combinations. Dendrogram.
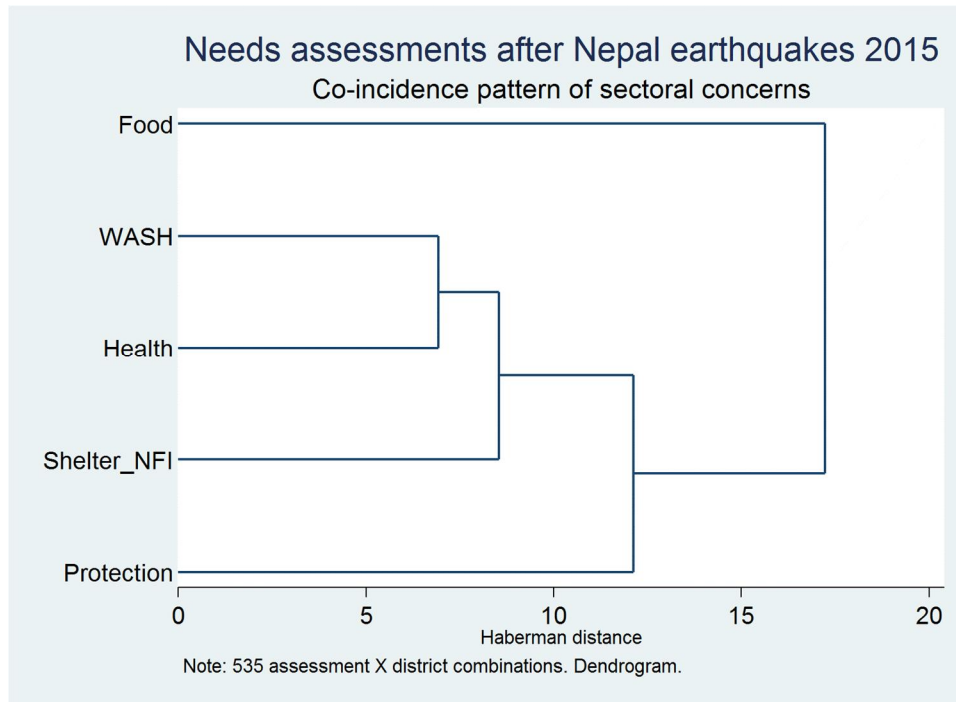
Proof of concept and limitations

The Nepal study demonstrates that, starting from the assessment registry database, information gaps and their dynamic in time and space can be revealed. Our approach favored the temporal dimension. UNOCHA GIS experts worked in the spatial dimension, creating maps of VDCs never assessed by certain points in time (see Figure 8 on page 31). These have greater practical value for the ongoing management of assessments. By contrast, our accounting is retrospective and aimed at finding building blocks for a gap monitoring template.

At the same time, this study has two limitations. The officer recording the reports used binary indicators for sectoral coverage. Unlike the Nigeria survey-of-surveys, the Nepal version carries no qualitative ratings. To what extent the assessment reports convey "the ability to prioritize" remains unclear.

Second, the gaps are unweighted. This may explain why, after the assessments in July, the gaps settled at a level about twice the minimum reached in May. Districts without recent assessments in August were counted as gaps, but some or most of these may have been districts that were not severely affected and no longer warranted frequent assessments. A weighting factor based on some impact index known by that time would likely change the picture. In fact, the Nepal Earthquake Assessment Unit (2015:3) published this map in July, doing this for the VDC level within priority districts.

Figure 11: Nepal - Assessment gaps among seriously affected VDCs, July 2015
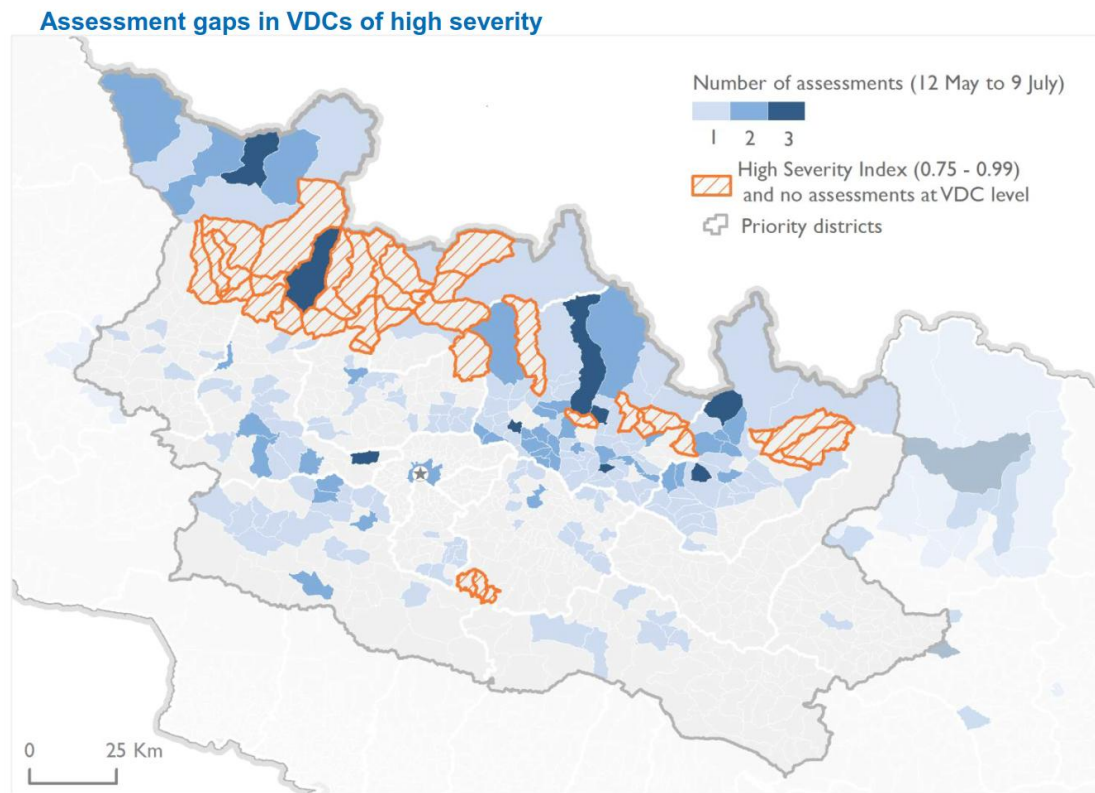
The above map is based on an overlay of the current assessment coverage and the severity index, which is a composite measure of severity, reflecting three categories: baseline information of socio-economical, physical vulnerability, and earthquake impact based on assessment data. The highlighted areas of the map shows VDCs with high severity index (above 0.75) which do not have any assessment data available. The Assessment Unit welcomes further assessment data to address these gaps and/or can provide technical support to collect data in these areas.

[Sidebar:] Information value and survey cost

In 2003-2004, NGOs under the auspices of the UN Mine Action Survey conducted an Emergency Mine Action Survey (EMAS) in northern Iraq, with the objective of identifying communities contaminated by mines and unexploded ordnance. Benini and Conley (2007) analyzed the movement of survey teams across 2,425 local communities, of which the teams actively visited 1,760. Of these, 290 were found contaminated. Essentially, the survey amounted to a one-sector (mine action) needs assessment.

The authors defined an information value function for each visited community in terms of magnitudes of population and of estimated contaminated area (in square meters):

Value of survey of community i =

(1 + log10(population of i + 1) / [mean of log10(pop + 1) over all surveyed communities])
* (1 + log10(contaminated area in i + 1) / [mean of log10(area + 1) over all surv. comm.])

The rationale was that this quantity was thought to be proportionate to the chance of encounters between people and explosives and thus a fair information value indicator.

The values were computed for 1,756 communities. The survey cost slightly more than US$ 1 million; the data collection period stretched over almost 300 days, with extended downtime periods due to insecurity. Assuming that the cost was distributed equally over the data collection period (some of the teams were maintained during downtimes), the cumulative average cost per information value unit can be estimated. This figure overlays the distribution of information values with the average cost curve (op.cit., 42).

Figure 12: Value and cost of information over time, Iraq 2003
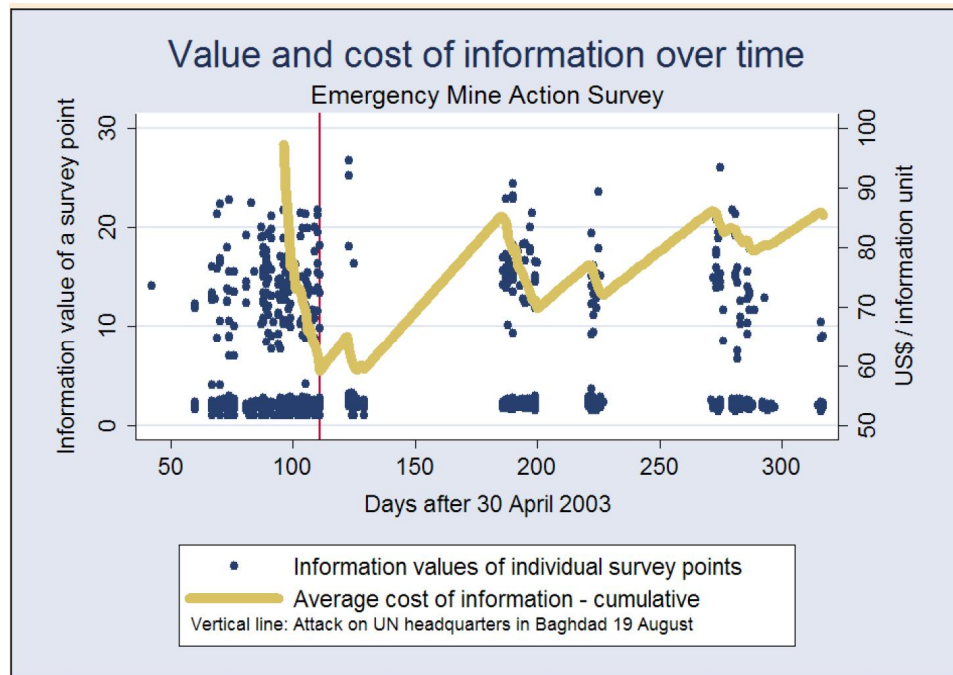
It is obvious that the survey never recovered the efficiency that it had enjoyed shortly before and after the August 2003 attack on the UN headquarters. If cost had been the only concern, it would have been rational to terminate data collection 150, or at the very most 250, days after April 30, the date of initiating the EMAS. In other words, the information value analysis might have inspired a stopping rule to deliberately leave gaps open, anticipating that very few high-value survey points remained to be detected without further cost escalation. The ethics of mine action did not permit this kind of consideration; eventually deteriorating security brought data collection to a halt. Security, however, was not the only determinant of gaps; for the almost 700 communities never visited, factors like the mental image of the geography of contamination, agency policy and the behavior of local experts were influential too.

This study is the only known example (with the exception of relief supply chain simulations) of an analysis of information value related to a cost parameter. It was feasible because of the simple assessment design and the minimalist criteria of information value. The complementary analysis of coverage gaps – what kinds of communities tended not to be visited – was more compelling because it did not depend on assumptions of information value or of cost evolution. It is unlikely that "survey of surveys" datasets can be collected to the high degrees of homogeneity and completeness that permitted the statistical

analysis of the EMAS behavior. In this sense, the analysis was due to the luck of circumstances.

The practicalities of measuring information gaps

Objective

An analyst, or small team of analysts, read, rate and record in a registry all reports that reach the assessment coordination center. If they follow recent practice, they create a record for each combination of unit of interest and document. A unit of interest may be defined variously, depending on the response planning interest, but most likely it will refer to a distinct administrative unit or a social group or the combination of both. Records will host data for yet other fields, some of which are essential (key sectors, date of publication). Others are desirable and practical, or not, in the circumstances (lead agency, etc.). The ratings are about the usability of the information in the reports, by sector.

[Sidebar:] A scale of how usable the information is

"Usability" is in the eye of the beholder. But this beholder, the analyst who rates the reports, should be conscious of thresholds between more or less usable information. These thresholds define the levels of a scale on which the analyst is to assign *each sector* in the report under review a rating. These ratings should be applied as consistently as possible. We propose a scale, based on two dimension – quantification and analytical value. The levels on these dimensions are mapped to six levels of the usability scale, numbered from 0 to 5.

Table 6: The five levels of the information usability scale

		Quantification				
		Sector not covered	No persons-in-need (PiN) estimates	Verbal qualifiers only	Rough PiN estimates	Good PiN estimates
Analytical value	The report details: Unmet needs	0	1	1	1	2
	Unmet needs and root factors	0	1	1	2	3
	Unmet needs, root factors and priority issues	0	1	2	3	4
	Unmet needs, root factors and intensity	0	2	3	4	5
	Unmet needs, root factors, intensity and priority issues	0	3	4	5	5

The analyst evaluates the contribution that the report makes to the knowledge of each sector on both dimensions, derives the combined usability rating and enters this score in the concerned sector column and report x unit of interest row. The interpretation of the scale levels is open to considerable discretion. A measure of inconsistency over time, due to learning effects (such as in

the understanding of "intensity") and to personnel turnover, may be unavoidable. Yet we trust that the intense daily exchanges within coordination centers promote conceptual agreement.

Products

Conceivably, the analysts will be asked for three types of products:

First, users will want a purely **descriptive look-up** facility to establish whether an assessment report exists that

- Concerns a particular unit of interest
- Is no older than a certain number of days, counting back from a particular date (practically, this will in most situations be the current date)
- Speaks to a particular sector (or set of sectors), achieving the needed degree of usable information or not.

Second, the consumers will want an **overview of the assessment activities** in terms of information gaps opening and closing over time, for the entire theater. This task needs more than description. For, naturally, assessment gaps in less severely affected units of interest ought to matter less than those in the more severely affected ones. Gaps, therefore, have to be weighted by a severity measure. However, the severity distribution is the *result* of complete assessments; it is not known ex ante. This circle of the dog chasing its own tail can be broken by using the *initial assumptions* of the humanitarian community, and then periodically *updating* them with the accepted assessment findings[17]. This requirement is not without its conceptual problems: in order to serve as weights, the severity scale must be ratio-level. If justified, a single indicator with this property can be used, such as the number of displaced persons or of destroyed buildings. Else an index of sorts may have to be improvised using several indicators, or – just as likely – the analysts have to go around eliciting expert beliefs, mapping them to a ratio scale, or even, *faute de mieux*, plug in their own beliefs.

The third product too depends on severity-weighted gaps. The consumers will find the instrument much more convenient if it offers an **at-a-glance list of the units of interest** with the most highly weighted gaps.

What is needed, then, is a database template that meets the two functions – specific look-up as well as broad overview – and can be modified and expanded with relative ease.

A template and its application

We offer such a template in the shape of an Excel workbook. At first, we developed a minimalist template with two tables, one for units of interest, the other as an assessment registry:

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[17] For example, in the Nepal earthquakes, initial assumptions were detailed in the Joint Research Center's remotely sensed "Nepal Earthquake Severity Index", which itself underwent several updates (JRC 2015) and subsequently was overtaken by the knowledge accumulating in the coordination center in Kathmandu.

1. **Units of interest**, with an impact scenario: The template has been populated with sub-districts contained in districts, which in turn are contained in regions, which fill the affected country. For each sub-district, a severity score was generated, representing the initial beliefs of the humanitarian community.
2. **Assessment registry:** Concurrently, we populated an assessment registry with hundreds records created during the first 200 days after the onset of the crisis. Again, these numbers are entirely arbitrary. The basic set of fields includes the record ID, the document ID and title, a date (of publication or end of fieldwork, as appropriate in the context), ID variables and names for the units of interest, as well as the usability ratings for the sectors. By design, it is the combination of the document and the unit of interest that defines the record.

The challenge then is to transform those two sets of information into the desired products. Our Excel template outlines a possible architecture for this purpose. It is not necessarily the best; there are other architectures conceivable. For simplicity, our does without macros or functions that require coding (in Excel's macro language VBA).

For authenticity, and because earlier in the note we have given considerable background on this case, we then filled the template with the Nepal assessment registry data. It is in this applied version that we present it here to the reader. The loss in generality is minimal: The Nepal registry evaluated only coverage, not usability. However, we have preserved the structure that would calculate gaps reflecting a user-defined minimum usability level. Should a reader wish to populate the template with data from a registry with usability ratings, these can be copied into ready columns; the formulas in the workbook will pick them up and use them as arguments in the gap calculations.

Building blocks

This flow diagram compresses the template structure to its essentials while expressing key conceptual distinctions and operations in the flow.

Figure 13: Information gap template – Conceptual diagram

Definition and data tables | Intermediate operations | Products

Assessment registry

Record ID	Date	Other fields
1	..	e.g., doc ID
2	..	..
3	..	..

Coverage statistics

	Units of interest	
Dates	A	B, etc.
Day 1	Was covered by recent	
Day2, etc.	asssessm. - yes or no?	

Specific look-ups
Is there a recent assessment given these criteria?:
.. yes or no
..

Table of units of interest

ID variables	Definition	Other fields
1	..	e.g. pre-crisis
2	..	variables
3	..	

Overviews
of severity-weighted gaps
For all units of interest
Over the full course of time
For a chosen set of sectors

Information gap calendar

	Level of granularity	
Dates	e.g. Region	District
Day 1	Weighted information	
Day2, etc.	gap scores	

Assumed distribution of severity

ID variables	Severity score	Other fields
as above for	..	e.g. source,
the units of	..	date when
interest	..	updated

List of units of interest with the largest weighted gaps
For the top 10 or so units
At a point in time (e.g., today)
For a chosen set of sectors

To begin, note that in the left-side column we work with three tables, rather than two (units of interest, registry) as posited before. We do so for two reasons:

- First, for simple look-up purposes assumptions about severity are not needed; these come into play for purposes of overviews and lists that process weighted gaps.
- Second, estimating an initial severity score for each unit of interest may not be straightforward or may be impossible until after some time.

Conceivably, the earliest indicators may arrive in coarse granularity– say, as an estimate of displaced persons for the entire district. If the sub-districts are the final units of interest, then they have to "inherit" the initial severity values from their respective districts until they can be replaced with the results of local assessments. In other words, constructing the initial severity distribution table may involve additional expert judgment, hence additional data management work. The exact shape of this will depend on circumstances. The generic desire is to have some kind of measure expressing assumed differences in severity, however preliminary, and to update its values as more specific, more reliable information is acquired.

A first strategic operation is indicated in the box "Coverage statistics" in the middle column. It is a mapping of the assessment registry information into a table with a cell for each combination of dates and units of interest. This is necessary because:

- The assessment registry consists of records defined by units of interest and documents, each with a specific date (most likely the date of publication). There may be one or several records with the same date in the registry; and some dates may not have been used at all because no reports were published on these dates.
- The question that matters for the users is whether for a particular unit of interest and for a particular date, there is a relevant and recent assessment report. It is relevant if it speaks to the sectors that concern the user and offers information that

meets a chosen level of usability. It is recent if it is no older than the number of days that the user sets for its shelf-life. Answers are required for every combination of date and unit of interest.

Those answers depend on a number of parameters. This screenshot of a segment of the user interface indicates the choices. As mentioned, in Nepal usability was not rated; this parameter therefore is frozen here, but will be available for applications using other registry data. "Sub-district" has been replaced with the corresponding level in Nepal, the "Village Development Committee" ("VDC").

Figure 14: Parameters that the user sets

	Parameter name	Value	Meaning
1	Sector information usability		
	InfoStandard	1	Sector considered covered if at least this usability value was reached
			This parameter is meant to be an ordinal scale (possibly with 6 levels - see note); for Nepal, however, only coverage, not usability, was evaluated. Therefore, the value is fixed to 1.
2	Possibility to compute statistics for a subset of sectors		
	Food	1	Note: Acceptable values for switches are:
	WASH	1	0 =off
	Health	1	1 =on
	Livelihood	1	
	Nutrition	0	
	Shelter_NFI	0	
	Education	0	
	Agriculture	0	
	Protection	0	
	Access	0	
	Logistic	0	
	Early_Recovery	0	
3	Shelf life of a report, to be considered recent		
	Days	14	Defines the recent period before the look-up data
4	Particular date for quick look-up and for lists of units with largest information gaps		
	Date	115	Days after onset

The workbook computes a table for all dates and units of interest answering whether a report thus defined is available in the registry or not.

Look-up results

In further key operations, Excel searches this table and reports, in the "Quick lookup" segment of the user interface, whether such a report exists at a specific date and for a specific unit of interest. In our Nepal set-up, the units of interest are administrative units; Excel answers the question separately at the zonal, district and VDC levels. If the set-up combined administration and social groups, these units of interest would be reflected differently, in accordance with the way they were handled in the registry table.

We enter the date as days after the onset; if users were interested only in the current date, the function

$$= TODAY() - DATEVALUE(\text{``DD/MM/YEAR''}) \text{ [for the onset date]}$$

would update the results daily.

For this screenshot, the VDC with the p-code 524 2 04 20 3 001 was chosen. It is part of district 524 2 04 20, which is in zone 524 2 04. The question is whether three and a half months (115 days) after the onset, there is a report – recent, no older than two weeks - that covers all of the four sectors chosen (food, WASH, Health, Livelihood). For the VDC, the question is straightforward; if such a report exists, the answer is yes. For the encompassing district and zone, a qualification is necessary: The answer is yes for the district if it is yes for any of the VDCs that it contains. Analogously, it is yes for the zone if it is yes for any of the district it contains.

Figure 15: Quick look-up whether a report meeting the criteria exists

Quick lookup for a particular date and administrative unit				
		Is there a recent assessment covering ALL the switched-on sectors at the chosen date?	Results appear here:	
Zone pcode	524 2 04	At the zonal level:	1	1 = yes; 0 = no
District pcode	524 2 04 20	At the district level:	1	
Pcode (chiefly VDC)	524 2 04 20 3 001	At the VDC level:	0	

Note: Enter a VDC pcode in the cell. The district and zonal pcodes above are automatically updated. You can also enter a district or zonal code - in this case the lower level result fields will show error codes or all zeros. Do not change the dotted cells.

Apparently, such a report is not available for this VDC. But it does exist for the district, based on information on its other VDCs. Perforce it exists for the zone.

Having needs in all sectors discussed in the same document is convenient and makes for easier inter-sectoral comparisons. However, assessment teams may be specialized, covering only one sector, or a subset of the sectors of interest. A comprehensive picture may nevertheless be available when we extract information from different reports. Putting it together is a burden on knowledge management, to which we earlier (page 8) referred to with the concept of "friction", in the sense economists use it (Griffin 1993).

Nevertheless, users may want to know whether the information on the sectors of interest is available in any reports, and at which degree of usability and granularity. The "Quick lookup" sections answers this question in two ways. First, side by side with the answers to whether all sectors are covered in one report (as seen just above), the same is done for "covered by any, possibly several, reports". Second, in a small table just below that, for all 12 sectors (not only those switched-on) the user can see the maximum usability among all

assessment reports that speak to the sectors. The next figure displays this table, for the same units, date, and shelf life as the previous.

Figure 16: Look-up whether any report covers a given sector, and how well

Are there any recent assessments covering a PARTICULAR SECTOR at the chosen date?	Results appear here:		
	Zone	District	VDC
Food	1	1	0
WASH	1	0	0
Health	1	0	0
Livelihood	1	1	0
Nutrition	0	0	0
Shelter_NFI	1	0	0
Education	1	0	0
Agriculture	1	1	0
Protection	0	0	0
Access	1	0	0
Logistic	1	0	0
Early_Recovery	1	1	0

Highest usability score among all recent reports about that sector, by administrative level

For Nepal, only coverage, not usability, was evaluated. Therefore, the values are 0 (not covered) or 1 (covered) only.

In this example, for this VDC there is no recent information available on any of the sectors. The situation is more favorable if we are content to consider only its parent district – the various recent reports cover four sectors. At the zonal level, coverage is even wider, extending to ten sectors. Thus, at a glance, the user may conclude that prioritization of the response in this VDC will need to extrapolate findings from the district and from the zone – or wait for an assessment team to visit and report back.

A warning is due at this point. It again has to do with friction, or, if you like this better, with the danger that, while the information can be collected from multiple reports, viewed together it may be unsuitable to help with prioritization.

Overview results

In a further operation, Excel calculates information gap scores for each day between the onset and a chosen end date, for the entire area observed. The scores are based on the importance of the available recent and relevant assessment reports. The importance is measured as the sum-product of binary indicators of the existence of reports X the severity scores, over all units of interest. It is calculated separately for each granularity level (zones, districts, VDCs). The gap score emerges as

$$= [1 – (importance\ score\ /\ theoretical\ maximum\ importance)] * 100\%$$

where maximum importance is the theoretical maximum, achieved if all units of interest were covered by reports. Sheet "GapCalendar" details the calculations, but users will want to work with the graphic illustration in "GapsTimelineGraph".

Figure 17: Visualization of the information gap dynamic
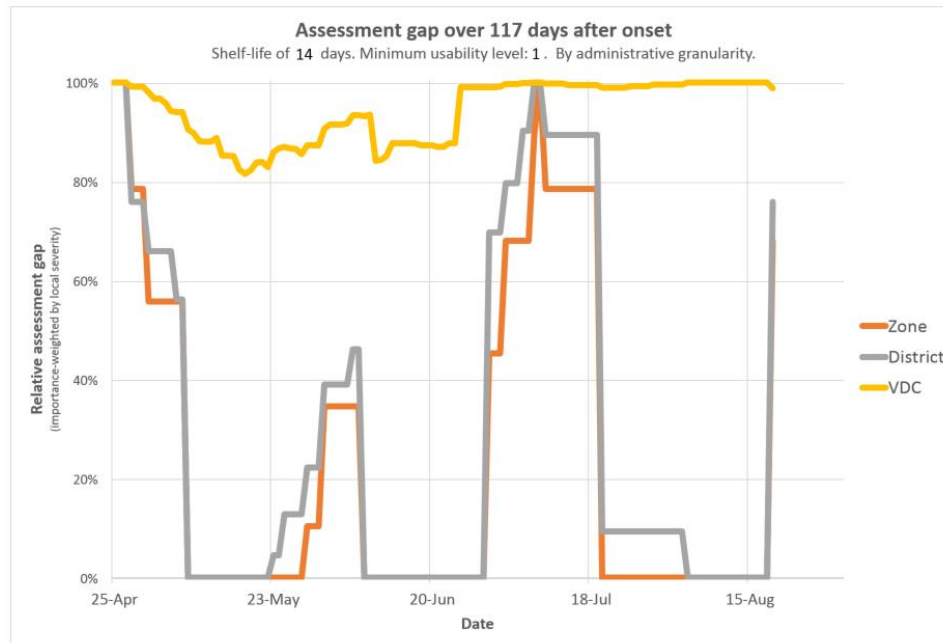
In Excel, the chart automatically updates when the user makes changes in the parameters.

The beauty of the underlying analysis is in the fact that the gaps are importance-weighted, emphasizing gaps in needs assessments in severely affected units of interest. Yet the **limitations** are significant:

- Gaps are defined by the flow of reports that speak to *all* of the considered sectors at once, rather than by the ensemble of reports that, among themselves, cover these sectors. This restrictive definition of coverage assumes that analysts will not have the time or ability to elaborate inter-sectoral comparisons in a synopsis of multiple documents. This may be so in some situations, but not in other, more relaxed ones.
- The shelf-life of reports is set constant for the entire observation period. This is unrealistic. Assessments have short shelf-lives in the early response phase. As the response lengthens, the information is of increasingly durable value – barring dramatic new developments that redefine the situation.

Nevertheless, this type of overview graph holds some management value. In this example, the analyst noted a month and a half into the response (in early June) that half of the district-relevant information had become obsolete. Entire zones were no longer covered with recent reports. These gaps were driven by the obsolescence in VDC level assessments. A sudden uptick of activity at this level caused all the districts and zones to be covered again for some time. In late June, however, the VDC gap rebounded to 100 percent. As a result, the district and zonal gaps exploded, then contracted again as assessments were restarted – perhaps under the imperative to demonstrate updated findings in a fresh round of funding requests.

A "complete gap of information", of course, never happens in real life – what the application reports is a clerical indicator that there are zero reports during such and such period, given such and such criteria for relevance and recency. This dynamic indicator is tightly coupled with the flow of new *data*, less so with *information*, and even less with *knowledge*. It is justified by the assumption that expansion and contraction of data flows will ultimately resonate in the ups and downs of information and knowledge as well.

Lists of units with large information gaps

The third product, list of units of zone, districts and VDCs with the most highly weighted gaps, is organized in these tables, placed side by side in the user interface.

Figure 18: Lists of units with large information gaps

Rank	Zone		District		VDC	
	Pcode	Severity	Pcode	Severity	Pcode	Severity
1	524 2 06	2127	524 2 06 31	2127	524 2 04 20 3 001	12246
2	524 3 07	1993	524 2 04 22	2013	524 3 07 36 3 001	11511
3	524 2 04	1851	524 3 07 36	1993	524 2 04 22 3 001	11328
4	No other gap	No other gap	524 2 05 28	1966	524 2 06 31 3 001	8892
5	No other gap	No other gap	524 2 04 20	1888	524 2 05 28 3 001	8609
6	All 5 Zones		524 2 04 21	1662	524 2 05 30 5 026	6527
7	All 11 Districts		524 2 05 29	1425	524 2 05 23 5 006	5385
8	The first 11 VDCs		524 2 05 24	1255	524 2 05 24 3 002	5325
9			524 1 03 13	915	524 3 07 36 5 049	4970
10			No other gap	No other gap	524 2 05 30 5 018	4617
11			No other gap	No other gap	524 2 04 20 5 040	4548

The lists are for all zones, all districts and a selection of VDCs. They are ordered descendingly by their severity scores, which are used as their weights. In this version, the VDC severity scores are equal to the severity scores computed by the Assessment Unit in June (Liew 2015) multiplied by the pre-crisis population size. The district scores are the averages of their appurtenant VDC scores (which explains with the maximum district-level score is smaller than the maximum VDC score); the zonal scores are averages of district scores. If the number of units with gaps is less than the number of places, the remainder are automatically filled with the message "No other gap". Trivially, there were always more than 11 VDCs in gap condition.

These lists too update automatically when the user changes a parameter. With over 600 VDC values to be recalculated, we experienced calculation times of about 18 seconds. If a user wants to change several parameters at a time, it may be efficient to set calculation mode to manual, make the changes, then reset to automatic.

In the practical life of an assessment unit producing these lists, the date would be the latest date for which the assessment reports have been recorded in the registry (ideally "today"). The lists essentially serve the tasking of assessment teams to visit units with large current information gaps.

Key technical elements

The Excel workbook consists of a sequence of worksheets that build one upon the other, in ways that produce the operations outlined in the flow diagram further above. A table of

contents lists the (hyper-linked) sheets by title and function. A diagram demonstrates the architecture of the worksheets in greater detail than in this note.

It should be easy for the reader to understand which sheets cooperate in order to bring about the various intermediate operations and results outlined in the flow diagram. Any practical adaptation of the workbook to the requirements of a field-based crisis response and accompanying assessment registry will need to preserve the major functions while fine-tuning the parameters and inter-sheet linkages.

The specifics of adaptation are not entirely foreseeable, but it is likely that several of the Excel functions that are key for the mechanics of this present template can be re-used. Some other Excel features will remain similarly important. Working with named ranges is almost indispensable – the workbook is too complex to simply rely on R1C1-style references in the formulas. Meanwhile the latest versions of Excel offer a more convenient table syntax in which the template could be modernized. However, it is our impression that the majority of humanitarian information management personnel are not yet conversant with the new style of referencing table elements across sheets.

The workhorse functions that carry the heavy load from sheet to sheet are few, but they are demanding. In the main, they take several arguments, and some have to be entered as array formulas. These are particularly important:

SUMIFS, OFFSET, MATCH, INDEX, MMULT

beyond the more commonly known ones such as IF, COUNT, SUM, MAX, MIN. The Internet offers ample help; an astute analyst will likely find improvements over the current architecture. Thus, for example, while finishing the template, we discovered a work-around that a blogger (DonkeyOte 2008) contributed in order to overcome the lack in Excel of a MAXIFS function – a device that we briefly demonstrate in the table at the bottom of the user interface. It could be exploited further in future adaptations of the template.

Most of the devices that we have made use of may not find grace in the eyes of advanced Excel programmers. Many could be replaced, with greater elegance and versatility, with macros and user-defined functions. However, the addition of such features would make adaptations in the field increasingly dependent on expert support from agency headquarters.

Outlook

Over the past ten years, the quality of humanitarian needs assessments – understood as the amount of useful information - has improved. This is the major finding of a worldwide review in which ACAPS dissected the reports of 105 so-called "multisectoral coordinated needs assessments" (Tax and Noumri 2016). Tools to monitor assessment activities and to identify information gaps early on have evolved in parallel. This at least can be surmised looking at ACAPS' own learning curve across the four contexts for which we describe its assessment analysis efforts. One might even adduce a distant analogy with the development of meta-analytic methods in statistics, in response to the multiplication of studies in comparable formats and to methodological progress at the individual study level. At the

same time, it is obvious that the effectiveness of assessment registries continues to depend on access, goodwill and rapid sharing. It is not by chance that Nepal, a natural disaster, hosted a registry cell right within a coordinating body in the country's capital. The flows of assessments in Syria, West Africa and Nigeria were recorded and analyzed in dispersed or remote locations, imposed by limited access, violence or the set-up of the humanitarian response itself. The Nepal registry benefitted from experience as well as local conditions.

On this cautiously optimistic note, we return to perspectives on the management of information gaps. Gap identification is an implicit (and sometime explicit) part of the goals of assessment registries; it is worth citing the list in which Tatham enumerated them for the "surveys of surveys" of the time (op.cit.:3):

- "Promote a shared understanding of the situation regarding assessment data collection in the field.
- Promote the temporal, geographic, and methodological harmonisation of assessment field activities.
- Reduce assessment fatigue, duplication of effort and donor fatigue by identifying complementary assessment plans and organizations for the purpose of collaboration.
- Highlight geographic and sectoral areas of overlap and gaps in assessment information and locations.
- Facilitate access to assessment reports, and the aggregation of the results where possible.
- Assist in prioritising the allocation of support to organisations conducting assessments to ensure that the data collected results in useful and shareable information.
- Create a database of what assessments have been done as a guide for planning future field assessments and for assessments to be used as secondary data sources of information.
- Contain assessment information in a standard way that can be used to create more value-added information products such as maps, charts, and reports with the minimum resource requirements."

These goals remain largely valid. But we add a couple nuances. Tatham envisioned assessment registries to generate summaries of key findings from among the recorded assessments. He exemplified this potential with a rapid synopsis sheet from Myanmar, with an entry for every surveyed township that provides population figures and a small text cell for other information. We believe that assessment registries are not the proper place for synoptic analyses of substantive variables. Either the various assessment agencies follow the same (or at least widely overlapping) formats, in which case data management and analysis best follow procedures for multi-site surveys. This job then belongs to other

sections of the coordination structure[18]. Or the formats across assessments have little overlap and thus call for separate regional or sectoral analysis arrangements.

Assessment registries should pursue other emphases. To monitor information gaps meaningfully, they should rate reports on their ability to help prioritize the response by sectors, or even sub-sectors. This requires creating and testing scales of how useful the information is, to be applied to every unit of interest and sector that the report being recorded covers. It further requires vigilance about the shelf-life of the assessments, with reasonable periods to obsolescence depending on the response phase.

We do go beyond Tatham's recommendations in one point. Gaps should be weighted; the intuition is that missing out on an area or social group is the more harmful the more severely its people are affected. The weights, however, have to come from some place – they have to be decided and applied before severity measures covering all or most of the affected units become available. Short of these, *beliefs* about the distribution of severity can fill in. Every unit of potential interest – e.g., the communities in administrative gazetteer – can be assigned a score of assumed severity. The shape of this scale barely matters; our template translates the severity-weighted gaps in a scale-free manner.

What does matter is the updating of these assumptions. If the ignorance of impacts is complete at the beginning, the severity scores are simply uniform. Typically, within a short time – in Nepal roughly within a week after the first earthquake – it is fairly reliably known which areas and groups are the most severely hit. One can then proceed to updating the severity score, perhaps in the shape of one prominent indicator such as IDPs, mixing the first observed values with assumed ones for the as yet unvisited units. Further updates can follow apace with the expanding knowledge of the crisis.

## [Sidebar:] Weighted information gaps and the idea of updating

The idea of evaluating information gaps several times, with the importance of particular gaps changing with the latest knowledge of the severity of the crisis, is not immediately intuitive. This sequence of diagrams helps to understand it. Because of the limits of visualization on paper, we assume that the affected region can be validly represented in just one dimension, such as on an east-west axis.

- **Panel 1** summarizes the assumptions that the humanitarian community makes in the first encounter with the affected region. For lack of any specific knowledge, the initial belief is that the impact is the same in all locations (equal height across the blue rectangle).

- **Panel 2** reports the results of the first field assessments. The impact is significantly unequally distributed, with a peak in the center of the region. This leads to

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[18] For example, in the Syria Multi-Sectoral Needs Assessment (MSNA), coverage control (chiefly through debriefings of returning enumerators) and data analysis were internally separated (Humanitarian Liaison Group 2014).

- The updated belief that the strength of the impacts is distributed in the shape of a triangle, as in **Panel 3**.

Figure 19: Belief updating and weighted information gaps
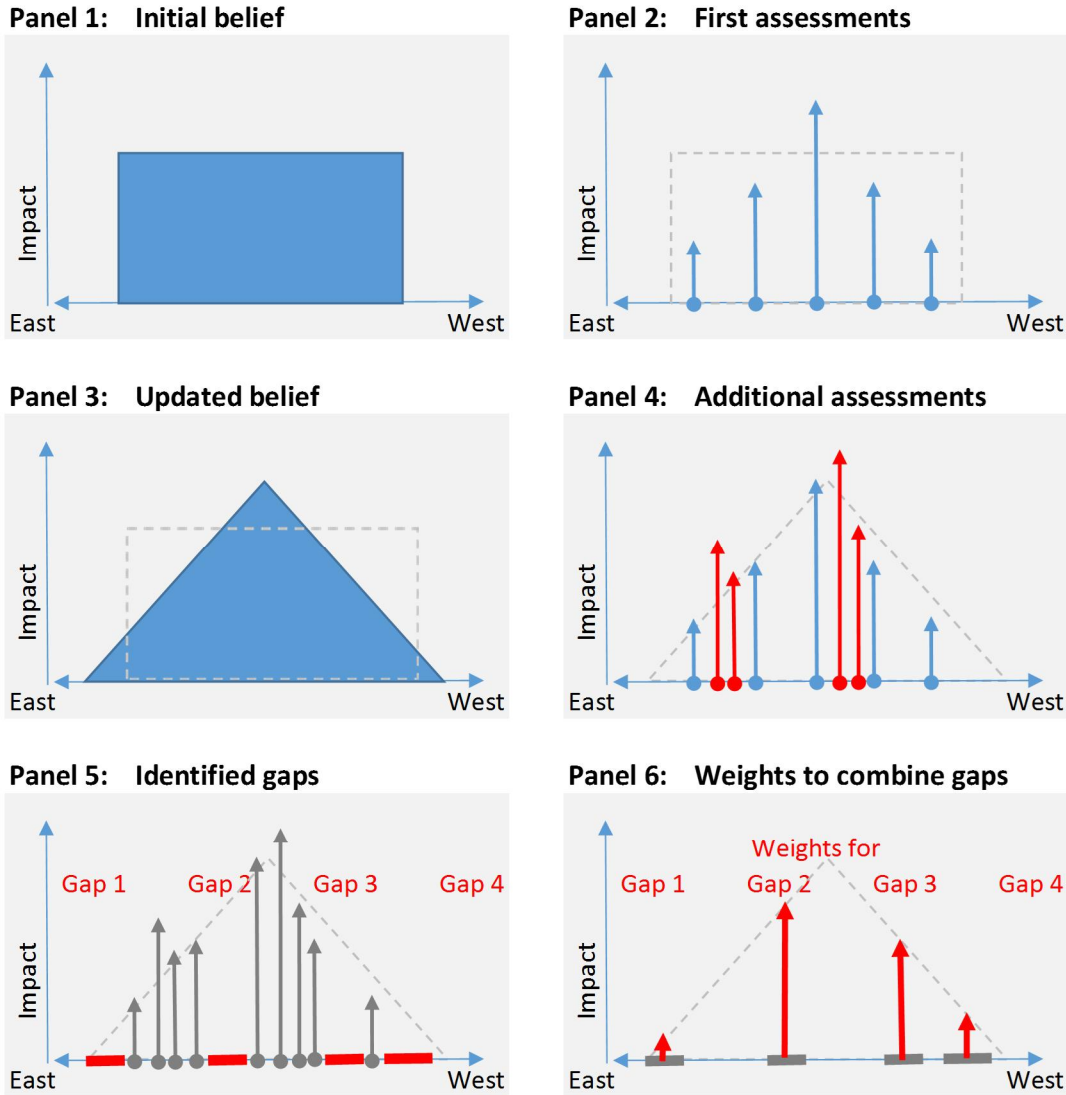
- **Panel 4** shows the locations of the first assessments (blue) and of more recent ones (red). The findings of the latter corroborate the current belief (Panel 3). (There is another belief update, but the change is so small that we do not show the second updated belief here.)

- The analyst identifies gaps **(Panel 5)**.

- A weighting function is needed and is obtained, in **Panel 6**, by projecting the locations of the gaps onto the latest belief function. The weighted gaps may be considered for the next round of assessments.

Our template has not yet implemented belief updating. It would be easy. The user would only have to copy-paste updated severity indicator values into the ranges for regions, districts and sub-districts in the sheet "SeverityByAdminLevels". The algorithm is indifferent to the source and meaning of the indicator (it can change with each updating, such as from Mercalli Scale readings to a compound socio-economic index). However, a ratio-level indicator is required in order to have meaningful zero points and equal intervals in the weights. An ordinal measure, such as the Integrated Food Security Phase Classification (IPC), would call for a plausible ratio-level re-mapping (e.g., 1 → 1, 2 → 3, 3 → 6, 4 → 10).

The intent here is simply to expose a concept. There are algorithms for combining evidence that would likely take care of the several challenges that we have met: redundancy in multiple assessments, multi-resolution, and sequential updating of beliefs (Wikipedia 2011a). They may be powerful, but would be hard to introduce to the humanitarian information management community and would likely prove a distraction while our purpose can be met with simpler, universally understood tools.

Recommendation: Experiment and adapt

The updating concept is motivated by more than a need to weight information gaps. With the humility that we can always be wrong, we also accept that assessments are nothing but systems of belief. Incorporating belief functions into assessment registries has two advantages. First, it encourages the responsible information officers to query the other coordination units for the kinds of information that they need to fashion weights. This reinforces feedback loops. Second, while the culture of updating each other frequently is paramount in the humanitarian community, algorithms that do so systematically in large bodies of data are not commonplace. Yet, built-in updating is a powerful driver in the world of data, from its fundamental place in modern statistics to the design of dynamic databases to the ways airplanes are piloted. In a suitable form, an updating mechanism should be helpful also in databases that monitor the flow of needs assessments.

Our recommendation therefore is simple and direct. Take this template, study its core mechanisms, rip it apart and rebuild it in a version that ensures your ability to monitor information gaps – test it in the real world and update the community of practitioners with your challenges and successes.

The template file can be downloaded from www.acaps.org/img/documents/i-information-gaps-in-multiple-needs-assessment-in-disaster-and-conflict-areas--demo-files-february-2016.xlsx .

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