Turning data into action: supporting humanitarian field workers with open data

Paulus, David; Meesters, Kenny; van de Walle, Bartel

Publication date
2018

Document Version
Final published version

Published in
Proceedings of the 15th ISCRAM Conference

Citation (APA)
Paulus, D., Meesters, K., & van de Walle, B. (2018). Turning data into action: supporting humanitarian field workers with open data. In K. Boersma, & B. Tomaszewski (Eds.), *Proceedings of the 15th ISCRAM Conference* (Vol. 15, pp. 1030-1040). ISCRAM.

Turning data into action: supporting humanitarian field workers with open data

David Paulus
TU Delft
d.paulus@tudelft.nl

Kenny Meesters
TU Delft
k.meesters@gmail.com

Bartel Van de Walle
TU Delft
B.A.vandeWalle-1@tudelft.nl

ABSTRACT

In the aftermath of disasters, information is of the essence for humanitarian decision makers in the field. Their concrete information needs is highly context-influenced and often they find themselves unable to access the right information at the right time. We propose a novel ICT-based approach to address these information needs more accurately. First, we select a group of in-field decision makers and collect their concrete information needs in the disaster aftermath. We then review to what extent existing data and tools can already address these needs. We conclude that existing solutions fall short in meeting important information needs of the selected group. We describe the design of an information system prototype to address these gaps more accurately. We combine data of the International Aid Transparency Initiative and the Humanitarian Data Exchange to form the data-backend of our system. We describe our implementation approach and evaluation plan.

Keywords

Humanitarian disaster response, decision-making support, information needs, information systems

INTRODUCTION

Even with general consensus that information management is a key element in disaster response (e.g. Van de Walle et al., 2009; Van de Walle et al., 2015; Knox Clarke et al., 2016) the issue of unmet information requirements in the disaster aftermath persists. Field-based humanitarian decision makers today still have a daunting task to fulfill when they have to draw conclusions out of the myriad data from field assessments, reports, phone calls, emails, social media and mobile services available to them.

The rise of new humanitarian and development technologies such as HDX and IATI, offer more data access for humanitarians than ever before. The challenge in utilizing these lies in shifting from simple data gathering to extracting meaningful information (Van den Homberg et al., 2014). It becomes evident that intelligent, context-aware tools are needed that infer the situation of the decision maker, can opaquely analyze various data in the background and present meaningful, actionable information to the user.

Therefore, the ways in which decision makers are equipped with data, has to receive stronger research focus. In the pressing and demanding circumstances in which humanitarian decision makers operate, they cannot be expected to browse through filters, functions and data that do not relate to their particular context.

Objective

In this work in progress we therefore examine the feasibility of a novel ICT-based approach, a prototypically implemented software that builds on existing data sources to address particular information needs of humanitarian decision makers in the field. We argue that, using our presented system, both, generic information needs (e.g. on

the developing response situation) as well as specific information needs (e.g. localized priorities) can be better met. Throughout or research process, we collect the technical and organizational challenges (e.g. data quality, data literacy, data governance, privacy, ethics) in developing, adopting and evaluating such a system and combine our findings in *lessons learnt*.

To keep our development and evaluation approach feasible, we deliberately choose a narrow research focus. We collect concrete information needs from a small group of humanitarian decision makers who have been active in a specific geographic area during a specific humanitarian response. This group represents our target group for whom the system will be prototypically developed. The group will evaluate the system, allowing us to measure its capability to address the groups' information needs.

We aim to demonstrate that data from state-of-the-art humanitarian and development initiatives, can satisfy some of the identified information needs. And thus, a higher incentive is offered to humanitarians to actively collect, process and share data through jointly creating a common operational picture.

RELATED WORK

Gralla et al., in their 2015 report, summarize humanitarian field managers' information needs and common decision problems. They collected concrete information needs for different phases of disaster response and categorized identified decisions into broader categories. Their findings are particularly valuable for the requirements definition of humanitarian decision support systems (Gralla et al., 2015). This work was further verified and examined in the wake of the 2013 Typhoon Yolanda that struck the Philippines (Comes et al., 2015).

One study that aims to address humanitarian information challenges practically was conducted by Calderon et al. They implemented a collaborative system that can be utilized as an information hub for humanitarian workers (Calderon et al., 2014). The hub pooled information from various sources and offered it as a 'single-stop'-shop for addressing information needs in disasters. We propose a different approach in the way, context is understood by the system. Calderon et al. expect continuous user inputs into their system to understand the user's context - a requirement that might add to users' information overload and demand mental capacity and time that might not be available for in-field decision makers. We will focus on automatic context-detection by the system itself.

In their fundamental work on the conceptualization of information systems for emergencies Turoff et al. outlined principles for the development of these kind of systems (Turoff et al., 2004). The here developed prototype, with its deliberately limited case, will especially follow the premises on Information Focus as well as Information Validity and Timeliness.

From the report of Hall et al. on the 2015 Nepal earthquake response, two main indications for improved humanitarian information support can be drawn which will inform our prototype requirement analysis: decision makers should be informed on the relief activities that pertain to them in order to support their sensemaking and situational awareness and they should be able to report their information needs proactively.

We will further draw from the findings of Comes et al. on their design principles, challenges and characteristics of humanitarian information systems, with a specific focus on logistics, supply chain management and situational awareness (Comes et al., 2016).

These findings clearly uncover practical in-field challenges in humanitarian information work. Humanitarian workers need stronger evidence and therefore more tailored, reliable information to base their decisions. In the following we outline our proposed approach to address this pressing problematic.

METHODOLOGY

Based on the above described current state of research, in the following we outline our approach to design a novel information system that is suited to address a very specific set of humanitarian workers' information needs. We use a specific methodology comprised of several steps: First, we narrow our focus to a specific geographic area: Gorkha District, Nepal, building on previous research (e.g. Baharmand et al., 2016). Second, we select a small group of humanitarian decision makers as our concrete target group in this district and collect specific information needs from that group. Third, we review available data and systems that can be utilized in meeting some of those information needs. By comparing the information needs and the available data and systems, we can observe discrepancies between *what needs to be known* and *how it can be answered*. Fourth, this uncovers concrete information gaps and informs our development plan for a novel prototypically implemented software that addresses these gaps and aims to transform the already available data into actionable information. Fifth, we describe an evaluation plan that will measure the impact, adoption and perceived usefulness of the prototype.

Selection of Case

The 2015 Gorkha earthquake in Nepal killed almost 9.000 people (Guha-Sapir et al., 2015). Remarkably, considering the recent history of earthquakes and flooding in Nepal, the country is not ranked under the global disaster hotspots: it ranks 107. in the World Risk Index and 43. in the INFORM Index (INFORM, 2018; Krich et al., 2017). Droughts, flooding and landslides add to Nepal's risk profile and cause continuous humanitarian involvements. This provides a large pool of actors familiar with the Nepalese context who have fresh memories of what information needs are crucial to fulfill in disaster response which can guide our system requirement analysis. Prior work of the authors involved the collaboration with humanitarian organizations in Nepal. Those existing relations provide an environment of trust and ease the interview and data collection process. Based on these relations, a small group of humanitarian decision makers will be selected as the target group.

Determining Information Needs

We will conduct semi-structured interviews with the selected target group. The identified information needs, decisions and their categorization by Gralla et al. (2015) constitute our baseline. Based on those, we investigate what concrete decision problems and information needs the interviewees frequently face and what information they require to be able to make the best possible decision. We focus on information needs that occur in the first days, weeks and months in the disaster aftermath and that recur frequently, rather than arise only occasionally.

Review of State-of-the-Art Data and Systems

Relevant data will be collected from different sources including common humanitarian platforms, Nepalese authorities, online data stores from NGOs etc. The data sets are reviewed based on their capability to address decision makers' information needs. Analogue, existing systems that can be accessed and used by decision makers to meet information needs are assessed.

Implementation Plan

The determined information needs and the reviewed data and systems uncover what gaps exist, i.e. what needs are still unmet. The observed discrepancies will argue for a more tailored ICT-based solution. Based on these observations, we define software requirements and create a development plan. The development will take place over several weeks with certain milestones. At each milestone, the new version will be tested by the selected target group, who gives feedback and thereby informs the next phase of development. An open source development approach will be used to facilitate the involvement of the target group in a flexible manner (Currion et al., 2009).

Evaluation Plan

Aside from the technical feasibility, i.e. the possibilities to connect and integrate various data sources and information platforms, this study will also examine the socio-technical challenges involved in designing, building and integrating such a software for humanitarian operations in the field. In order to capture these lessons learned, as well as to assess the overall impact of the developed platform, an impact evaluation approach is used. This approach will not only examine the overall impact as a single indicator, but rather serve as a guideline for capturing and categorizing the observations made during the development and implementation process in accordance with case-study research (Yin, 1994).

PRELIMINARY RESULTS

This chapter summarizes the preliminary results of this work in progress. We first outline our findings regarding concrete information needs of decision makers. Then, we present the results of our data and systems' review. Consequently, we outline our implementation process so far and describe the planned evaluation.

Identified Information Needs

A first step to develop a system to support in-field humanitarian operations using the data available in the various platforms, is to understand their information needs. These information needs will inform the majority of the functional requirements of the platform. In order to become a feasible and workable set of functional requirements, we examine these information needs in the scope of our case study. This will not only ensure am internally consistent and compatible set of requirements but also that these requirements, and the resulting prototype can be evaluated in a practical context. Within this scope we determine the information needs in several steps. Initially we examine existing literature and case studies related to the context of the case study to get an understanding of the actors and their (high-level) information needs. Following this desk research we verify these requirements with the results from previous field research. As a last step we further operationalize the information needs into requirements through interactive workshops in the field.

The research conducted by Baharmand et al. in 2015, focuses on the same geographical region as our research (Baharmand et al., 2015). In their work the authors examined the challenges in information management at the local level. Specifically they highlight the possibilities to improve the role of the communities and local actors by

enabling better access to information available in the humanitarian community. In this research a similar approach is chosen: working from the decisions made in the field towards the information needs to support these decisions in several steps. This approach was also recently used in a field study conducted as part of the COMRADES project. In one of the project deliverables, "Socio-Technical Requirements" (Comes et al., 2017), decisions and related information needs of the community in the Gorkha district were examined.

From this desk research, identified information needs include:

- Situational awareness: Through the research the need for a '3W-like' overview (who is doing what where) is often mentioned. Being aware of what organizations are operating in a specific area, what their actions and projects are and their contact information.
- Needs assessment: Furthermore, the research shows the need for an integrated, detailed overview of the needs across different sectors (assessment information). While this information does exist, it is scattered across different systems and sources. This makes it challenging to provide a single integrated, localized overview.
- Operational circumstances: Finally, the need for a localized status on the operational circumstances are mentioned. This overview includes the available resources in the region that could be utilized, but also the logistical options to deliver aid and mobilize the resources (resource and logistics mapping).

In the upcoming research these information needs will be further explored, discussed and operationalized through interactive workshops following the examples of the previous studies highlighted above. However, these initial findings already give an insight in the possible requirements for a system addressing the localized in-field information needs. These initial findings enable us to already to examine how existing data sources match with these information needs, and the technical possibilities to transform this data into a usable format and information overview relevant to the local actors.

Reviewed Data and Systems

In this section we present our findings on existing data and systems that are relevant in addressing in-field decision makers' information needs.

Reviewed Data

Various data sources exist that can be utilized to meet in-field humanitarian decision makers' information needs. In the following we present the sources we selected and explain why they should be integrated in the data-backend of a more tailored humanitarian information system.

International Aid Transparency Initiative (IATI): We select IATI data because it contains information on what humanitarian and development organizations are active in what sectors and regions in Nepal. It is useful for humanitarian decision makers because of its 3W nature and because it can inform on possible organizational partnerships in the response (e.g. joint efforts, shared resources and facilities). IATI's technical XML standardization eases its processing through information systems. The IATI Data Use Strategy for 2017-2019 specifically mentions the importance of further use cases of IATI data, besides donor reporting, to make the international development and humanitarian sector more transparent and accountable (International Aid Transparency Initiative, 2017). Our integration of IATI data constitutes such an additional use case.

Humanitarian Exchange Language (HXL): In comparison to IATI's high political buy-in and complex technical standardization characteristics, the Humanitarian Exchange Language (HXL) is a rather bottom-up initiative that stems from perceived in-field deficiencies in humanitarian coordination, communication and collaboration (Warner et al., 2016). HXL data contains operational information on humanitarian responses: how many people are affected in what region? what do they need? what is the status of the infrastructure? HXL data therefore is an important resource in the effort to create an elaborate picture of the response situation.

Humanitarian Data Exchange (HDX): The Humanitarian Data Exchange stores data in different formats from different humanitarian hotspots worldwide. United Nation bodies, national authorities and NGOs upload baseline data (e.g. demographics, economic and geographic data) and operational data (e.g. number of affected people, assessed needs, infrastructure damage) into the platform. Currently, it stores 316 datasets on Nepal, which makes it a valuable resource for creating an humanitarian overview of the country.

Demographics: Official statistics on Nepal (e.g. census data) are provided by Nepalese government authorities mostly in PDF. NGOs including NepalInData, OpenKnowledgeNepal, Code4Nepal and others, manually transfer and publish these data in easier to access formats like CSV. These official data can be utilized to understand local contexts, dynamics and coping capacities in Nepal.

Logistics: The humanitarian logistics cluster stores baseline logistics information on the Nepalese road network,

ports, aviation, railways, waterways, storage facilities, transportation services, telecommunications, government contacts etc. The data is highly valuable in the planning of logistics of humanitarian response operations.

Indices: Data from the global risk indices INFORM and World Risk Index hold information on the vulnerability and exposure of countries' populations. The data can be utilized to inform disaster response strategies and prioritize actions.

Financial Tracking Service (FTS): The United Nations Office for the Coordination of Humanitarian Affairs operates the humanitarian Financial Tracking Service. Similar to IATI, it is useful to track financial and in-kind flows from donors to implementing organizations with short descriptions about the purpose of each flow. FTS data thereby helps to understand who is doing what in the response. However, the level of granularity is often not high enough to extract information that is directly actionable and meaningful for in-field decision makers.

We conclude, various data that can be used to address in-field disaster decision makers' information needs exist in different formats, stemming from diverse sources. Each dataset provides individual aspects that can partly answer decision makers questions during disaster response. It is however the combination and integration of all of these datasets that promises the greatest information support. In this work in progress we will therefore implement a data unification process into the proposed software prototype. The unified data model will facilitate the intelligent selection of the right data, at the right time, in the right context.

Reviewed Systems

To understand the current state of information systems that can support humanitarian decision makers in the selected case, we reviewed systems that are applied in at least one of the following fields: IATI, HDX, HXL, disaster decision support and data portals dealing with Nepal. We use the term 'system' synonymous for different kinds of software: websites, portals, platforms, information systems, desktop applications, web services, mobile apps, software libraries and data stores. Our findings are summarized in table 1.

Table 1. Summary of reviewed Systems

System	URL	Functionality	Type of Data (if identifiable)
Humanitarian Data Exchange	https://data.humdata.org/group/npl	The Humanitarian Data Exchange allows organizations to upload, manage and use humanitarian data. It currently stores 316 datasets on Nepal, incl. baseline data (e.g. demographics, borders) and operational data (e.g. number of affected people by earthquakes, number of destroyed houses). The data can be searched, ordered and filtered by different criteria e.g. publishing organization, data format and data content type. The platform includes a micro-site with data on the 2015 earthquakes (https://data.humdata.org/group/nepal-earthquake).	CSV, XLS, HXL, JSON, spatial data
Nepalese Aid Management Platform	http://amis.mof.gov.np/portal/	The Aid Management Platform of the Nepalese Ministry of Finance makes information on development projects in Nepal publicly accessible. The Platform has a sub-component (http://earthquake.mof.gov.np/portal/) which holds only the information on development projects related to the 2015 earthquakes and makes these publicly available in the same way. Decision makers can get an overview of development actors involved in the 2015 earthquake response and the sectors in which those actors were working.	Official development data
Nepalese Disaster Risk Portal	http://drrportal.gov.np/	The Disaster Risk Portal of the Government of Nepal provides public access to various disaster related information on Nepal. It includes updates on recent incidents (e.g. earthquakes, floods, fires), maps, relief efforts and more. It is a very good resource for decision makers to acquire official disaster related information on Nepal.	Official disaster statistics
SinhupalCheck	https://sindhupalcheck.developmentcheck.org	SindhupalCheck is a platform that collects citizen feedback on post-disaster aid effectiveness. Citizens' opinions on the aid delivered to them is granularly collected and openly published.	Crowdsourced citizen data
NepalMap	https://www.nepalmap.org	NepalMap (by Code4Nepal) is an openly accessible frontend dashboard that allows queries on different Nepalese districts and displays baseline data, e.g. demographics, education, social & human development, based on the queried sub-national districts.	Demographics, education, human & social development
NepalInData	https://nepalindata.com/data/	NepalInData manually copied data from official PDF reports of Nepalese authorities and created an openly accessible query and visualization form for the data. Decision makers can use the tool to retrieve baseline data on various sectors incl. foreign aid, infrastructure, social & human development.	Demographics/Census, MDGs, agricultural, human & social development, economic
IATI portals	https://www.openaid.nl/	Organization tailored dashboard frontend that openly display finance data of IATI reported development activities to the general public. Decision makers can learn what activities were conducted in Nepal, what organizations have been active and in what sectors.	IATI

IATI Studio	https://www.iatistudio.com/	IATI Studio includes a dashboard frontend for all IATI data referenced in the IATI registry, it allows the creation of custom charts based on user selected IATI criteria, the publishing of IATI data and also allows the creation of custom generated micro-sites aimed to ease the work with IATI for non-technical users. Decision makers can use the dashboard and custom chart features to get an overview of financial flows within development projects to particular countries.	IATI
D-Portal	http://d-portal.org/	D-Portal is a dashboard frontend for all IATI data referenced in the IATI registry. Decision makers can review what development organizations were active in Nepal (in some cases on a sub-national level) and within what sectors they have been active..	IATI
NepalMonitor	https://www.nepalmonitor.org/	NepalMonitor is an Ushahidi-based, crowdsourced, geographic information platform. Everyone with access to the platform can submit reports on incidents they witnessed or were directly affected by. Decision makers can get a real time overview of citizen reports and thereby inform themselves about the perceived situations on the ground.	Crowdsourced geographic data

A major concern with the reviewed systems is that they try to answer many questions for a broad and diverse target group. They hold many data sets dealing with very different aspects. They provide filtering methods but only on user input and are not intelligently context-aware for specific user situations. The amount of possible questions users get answers to is not helpful to reduce the demand to mental capacity. And the amount of information and data available needs to be assessed by decision makers, in order to know what data is helpful and what is not. This adds to the information overload which should actually be reduced by decision support systems. Our approach therefore is to prototype a more tailored system, in other words: deliberately limit the scope and use case of the system, i.e. its data and functions. Remarkably, many of the reviewed systems provide web services like APIs to allow other software to connect to them. In our development approach we can therefore integrate those connections.

Implementation

Building on the state of research and reviewed data and systems, we have identified that humanitarian in-field decision makers need more tailored information system support to address their information needs during disasters. In the following we outline our prototypically development approach for such a novel system.

Our prototype contains a data-backend, programming logic and two example frontend clients. The data-backend is a PostgreSQL database that stores IATI, HDX and HXL data. The programming logic is a Python web service (API) that connects the data-backend with the front-end clients. The two clients are a JavaScript based website and an Android application. Figure 1 outlines the architecture of the prototype. Via the client, the user sends a request to the API. He can type in a set of keywords (figure 2), submit the request and the prototype backend receives the keywords. In a separate process, the backend has already collected IATI, HXL and HDX data and stored it into its database (evidence base). Corresponding to the received keywords, the prototype queries its evidence base: For example, if the user queries “injured”, the prototype will select all HXL data on injured persons and returns it to the client.

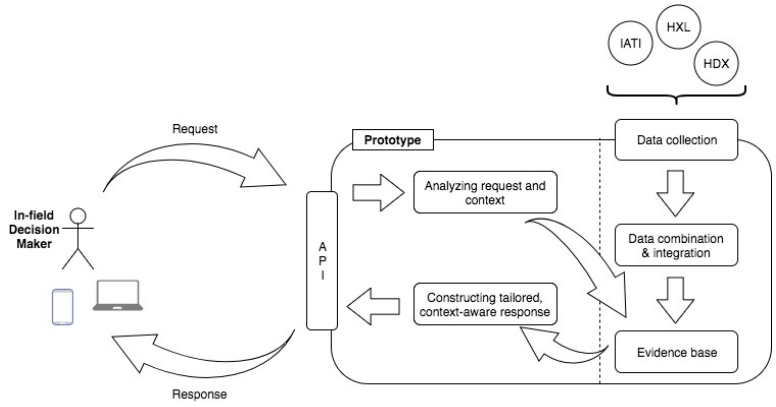

Figure 1. Overview of proposed Prototype

The Python programming logic is developed around the identified information needs of the target group. It accepts user requests in the form of search terms (e.g. "injured", "phones", "near me") and responds with information that it selects from the data-backend. We chose to start with an API because it allows working with data flexibly and is applicable for a variety of use cases: Web platforms, desktop applications, mobile apps, can all communicate with the same API. We chose Python as implementation language for the API because IATI, HDX and HXL have

software libraries in Python that allow us to easily integrate them in our work. Also, Python is widely-applied in data science and often used in IATI software projects.

Table 2 shows example API calls and their results. For example, the first row shows a query that asks for information on what shelter items have been distributed in the Gorkha district.

Table 2. Example API Requests and Responses

API request	API response (JSON)	Description
http://x.x.x.x:8000/shelter/?district=Gorkha&format=json	{"id":75,"district":"Gorkha","blankets":69096,"cgi":14473,"clothes":0,"kitchenSets":12549,"tarpaulin":82768,"tents":7161}	The response lists the numbers of shelter items that were distributed in the district given in the API request.
http://x.x.x.x:8000/hxl/?district=Gorkha&format=json	{"id":154,"district":"Gorkha","population":271061,"peopleInjured":952,"femalesInjured":0,"malesInjured":0,"peopleDead":0,"femalesDead":230,"malesDead":213,"housesDamaged":13917,"housesDestroyed":44610}	The response lists the numbers of fatalities, injured persons, damaged and destroyed houses within the district given in the API request.
http://x.x.x.x:8000/combined/?district=Gorkha&format=json	{"id":154,"district":"Gorkha","blankets":69096,"cgi":14473,"clothes":0,"kitchenSets":12549,"tarpaulin":82768,"tents":7161,"population":271061,"peopleInjured":952,"femalesInjured":0,"malesInjured":0,"peopleDead":0,"femalesDead":230,"malesDead":213,"housesamaged":13917,"housesDestroyed":44610}	The response combines the results from the first and the second API request above.

Figure 2 show how the Android client makes use of the prototype's API. The client uses search terms that allow users to e.g. rank Nepalese districts by the number of injured people (far left screen), display phone contact information of development organizations active in the response (mid screen) and display operational information of the response depending on the location of the user (far right screen). The prototype queries the IATI, HXL and HDX data stores regularly to provide the latest available data updates. In the direct disaster aftermath, having accurate real-time data is almost impossible. The prototypes' data accuracy depends on the frequency of updates on the HDX and IATI data stores. It is planned that a timestamp of the latest data update is presented to give the user an understanding of how recent the data is.

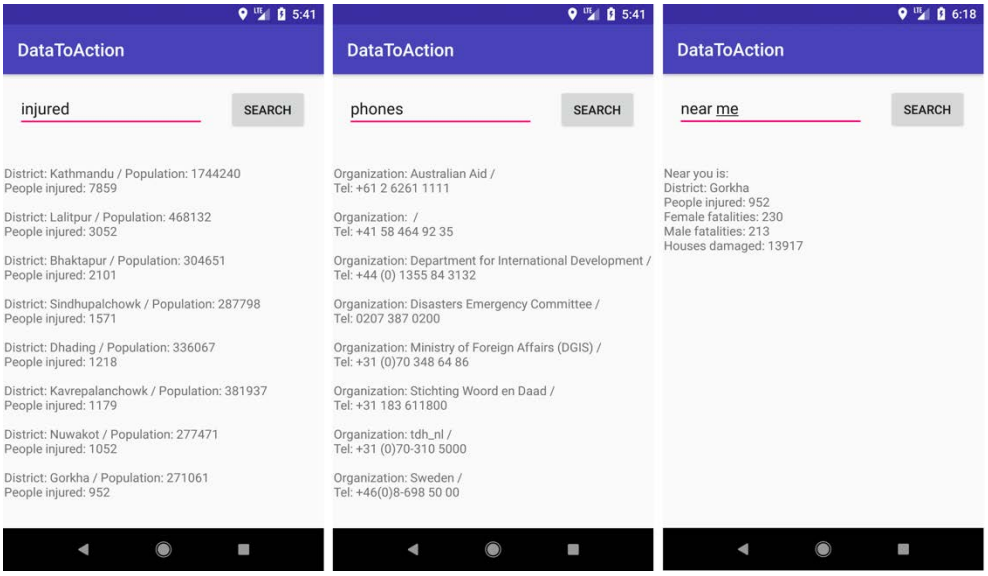

Figure 2. Android Client showing API Results

Evaluation

The development of the prototype is currently ongoing, therefore no evaluation results are presented here. Instead

we outline our envisaged approach to evaluate the system in its future states.

Evaluation methods for information systems is an established field and many different methods exist. Impact evaluation methods aim to measure the change that has occurred between a baseline measurement and the resulting changes in indicators following the implementation of a system (Rawlings and Rubio, 2005). Other methods have a more predictive nature and aim to assess the impact prior to an intervention (Roche, 1999). Specifically looking at information systems, impact can be determined using two main criteria according to Hamilton and Chervany (1981). Firstly, the impact has to be considered with respect to the efforts and investments needed to develop and operate the system: the system efficiency. Secondly, this should be contrasted with the changes in the organizational effectiveness at both the individual users and the overall organization's effectiveness: the system effectiveness. These aspects of information system evaluation have been applied to the humanitarian context in previous research, specifically on services and platforms offered by digital humanitarians (Meesters, 2013). We adapt these various categories to assess the impact of our system as well, as illustrated in figure 3.

	System-efficiency (development)			System-effectiveness (adoption)		
	Level	*Objective*	*Measurement*	*Level*	*Objective*	*Measurement examples*
0	*Systems*	Tech. compliance Design quality Governance	Data accessibility UI, compatibility, robust Privacy, quality assurance			
1	*Resource consumption*	Resources Function design Participation	Development efforts Requirements specification Adoption and involvement	*Information & support*	Info. quality Presentation Info. quantity	Accuracy, relevance, reliability Graphical, accessibility Access to data, more sources
2	*Capability*	Available capacity Job satisfaction	Productivity, response time Performance of users	*Process & user performance*	Automation Decision making Performance	Task automation, data use Understanding, confidence Usefulness, added value
3	*Investments*	Support Investments	Training, documentation Hardware / software costs	*Organizational performance*	Financial Beneficiaries Network	Higher contribution Regulation, transparency Reputation, advocacy

Figure 3. Levels, objectives & measurements for evaluating a management information system (Hamilton and Chervany, 1981)

Data for these different criteria will be collected throughout the project, following the paradigm of 'Action Research' (Brydon-Miller et al., 2003). As 'a reflective process of progressive problem solving' (Stringer, 2013), we will use the development of a prototype to address the challenge of satisficing the information needs of in-field decisions makers as input for our evaluation. The open and flexible development procedure allows us to evaluate new versions successively as the prototype evolves over time. Representatives from our target groups can give feedback during the development phases and thereby influence the requirements for the next iteration. Throughout the iterative development process, using the criteria listed above, we will examine the impact of our development efforts and document our findings.

CONCLUSION

This paper represents a work in progress. However, our preliminary results are summarized in the following.

We see huge demand for addressing information needs of in-field decision makers in disaster response. Requirements for the composition of these information are diverse and context-influenced: who needs what information at what time in what format and quality? We narrow our focus to study the information needs of a small decision maker group and assess how existing solutions perform in meeting their information needs. We reviewed data sets and systems that can be utilized to meet those information requirements. Our preliminary results show that a wide variety of data and systems on the Nepalese context exists. They range from raw census data to sophisticated online information systems. Of course, data is of little use in raw format and needs to be processed and presented in a meaningful, actionable way. Many systems observed are performing well at answering a multitude of questions. However, being presented with options and information not needed at a certain time for a certain decision is adding to information overload and increases demand to mental capacities of in-field humanitarians.

We observe a trend of humanitarian data being collected and transferred upwards to inform headquarters and donors. On the operational level in the field, information needs are still often unmet and more fine-grained: e.g. road statuses and contact information are needed. In this work in progress we develop and evaluate a new information system prototype that uses existing data sources to address these localized information needs better. We conclude that a well-designed information support system needs to be tailored to the user and his situation. It opaquely processes data and analyses the situation in the background. And as a result, it intelligently presents

information that is actionable for the user. Future developments of the prototype will also look into how concrete information needs of disaster-affected communities, in addition to humanitarian decision makers, can be better addressed (Comes et al., 2017).

ACKNOWLEDGEMENTS

This research is funded by HumanityX, an initiative of the Leiden University's Centre for Innovation.

REFERENCES

Baharmand, H., Boersma, K., Meesters, K., Mulder, F., Wolbers, J. (2016). A multidisciplinary perspective on supporting community disaster resilience in Nepal. Proceedings of the International ISCRAM Conference

Brydon-Miller, M., Greenwood, D., & Maguire, P. (2003). Why action research?.

Calderon, A.C., Hinds, J., Johnson, P. (2014). IntCris: A tool for enhanced communication and collective decision-making during crises. ISCRAM 2014 Conference Proceedings - 11th International Conference on Information Systems for Crisis Response and Management, pp. 205-214.

Comes, T., & Van de Walle, B. (2016). Information Systems for Humanitarian Logistics. In G. Kovács, K. Spens, & I. Haavisto (Eds.), *Supply Chain Management for Humanitarians: Tools for Practice* (1st ed., pp. 257–284). Kogan Page.

Comes, T., Meesters, K., & Torjesen, S. (2017). Making sense of crises: the implications of information asymmetries for resilience and social justice in disaster-ridden communities. Sustainable and Resilient Infrastructure, 1-13.

Comes, T., Meesters, K., & Roberts, S. (2017). D2.2 Socio-Technical Community Requirements. http://www.comrades-project.eu technical report.

Comes, T., Vybornova, O., & Van de Walle, B. (2015). Bringing Structure to the Disaster Data Typhoon: an Analysis of Decision-Makers' Information Needs in the Response to Haiyan. In Proceedings of the AAAI Spring Symposium Series (SSS-15) on Structured Data for Humanitarian Technologies: Perfect Fit or Overkill (pp. 23-25).

Currion, P., da Silva C., and Van de Walle, B. (2007). Open Source Software for Disaster Management, Communications of the ACM 50(3), 61-65.

Gralla, E., Goentzel, J., & Van de Walle, B. (2015). Understanding the information needs of field-based decision-makers in humanitarian response to sudden onset disasters. *Proceedings of the 12th International Conference on Information Systems for Crisis Response and Management (ISCRAM)* (Vol. 2015, pp. 1–7). Information Systems for Crisis Response and Management, ISCRAM.

Guha-Sapir, D., Hoyois, P., & Below, R. (2015). *Annual Disaster Statistical Review 2015: The numbers and trends. Centre for Research on the Epidemiology of Disasters (CRED).* Brussels, Belgium. https://doi.org/10.1093/rof/rfs003

Hall, M. L., Lee, A. C. K., Cartwright, C., Maharatta, S., Karki, J., & Simkhada, P. (2017). The 2015 Nepal earthquake disaster: lessons learned one year on. *Public Health*, *145*, 39–44. https://doi.org/10.1016/j.puhe.2016.12.031

Hamilton, S., & Chervany, N. L. (1981). Evaluating information system effectiveness-Part I: Comparing evaluation approaches. MIS quarterly, 55-69.

INFORM. (2018). INFORM Index 2018. Retrieved January 6, 2018, from http://www.inform-index.org/Countries/Country-profiles

International Aid Transparency Initiative. (2017). *IATI Data Use Strategy 2017 - 2019*.

Knox Clarke, P., & Campbell, L. (2016). *Improving Humanitarian Coordination*. London.

Krich, L., Luther, S., Mucke, P., Prütz, R., Radtke, K., & Schrader, C. (2017). *World Risk Report – Analysis and prospects 2017*.

Meesters, K., Van de Walle, B. (2013). Towards an impact evaluation framework for the collaborative information supply chain in humanitarian crisis response. ISCRAM 2013 Conference Proceedings - 10th International Conference on Information Systems for Crisis Response and Management, pp. 536-545.

Rawlings, L. B., & Rubio, G. M. (2005). Evaluating the impact of conditional cash transfer programs. The World Bank Research Observer, 20(1), 29-55.

Roche, C. J. (1999). Impact assessment for development agencies: Learning to value change. Oxfam.

Stringer, E. T. (2013). Action research. Sage Publications.

Turoff, M., Van de Walle, B., & Chumer, M. (2004). The design of a dynamic emergency response management information system (DERMIS). *Journal of Information Technology Theory and Application*, *5*(4), 1–35. Retrieved from http://aisel.aisnet.org/cgi/viewcontent.cgi?article=1138&context=jitta

Van de Walle, B., & Comes, T. (2015). On the Nature of Information Management in Complex and Natural Disasters. *Procedia Engineering*, *107*, 403–411. https://doi.org/10.1016/j.proeng.2015.06.098

Van de Walle, B., Van Den Eede, G., & Muhren, W. J. (2009). Humanitarian Information Management and Systems. In J. Löffler & M. Klann (Eds.), *Mobile Response - Second International Workshop on Mobile Information Technology for Emergency Response* (pp. 12–21). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-00440-7

Van den Homberg, M., Meesters, K., & Van de Walle, B. (2014). Coordination and Information Management in the Haiyan Response: observations from the field. Procedia Engineering, 78, 49-51.

Warner, A., & Obrecht, A. (2016). *Standardising humanitarian data for a better response : The Humanitarian eXchange Language*. London.

Yin, R. K. (1994). Case study research. Applied Social Research Methods Series, Volume 5. SAGE Publications, London.