A Data Collaborative Case Study

LEVERAGING TELECOM DATA TO AID HUMANITARIAN EFFORTS

Lessons learned from the 2015 Earthquake in Nepal

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EXECUTIVE SUMMARY

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Summary: Following the 2015 earthquake in Nepal, Flowminder, a data analytics nonprofit, and NCell, a mobile operator in Nepal, formed a data collaborative. Using call detail records (CDR, a type of mobile operator data) provided by NCell, Flowminder estimated the number of people displaced by the earthquake and their location. The result of the analysis was provided to various humanitarian agencies responding to the crisis in Nepal to make humanitarian aid delivery more efficient and targeted.

Data Collaboratives Model: Based on our typology of data collaborative practice areas, the initiative follows the **trusted intermediary** model of data collaboration, specifically a **third-party analytics** approach. Third-party analytics projects involve trusted intermediaries—such as Flowminder—who access private-sector data, conduct targeted analysis, and share insights with public or civil sector partners without sharing the underlying data. This approach enables public interest uses of private-sector data while retaining strict access control. It brings outside data expertise that would likely not be available otherwise using direct bilateral collaboration between data holders and users.

Data Stewardship Approach: The data stewards involved in this project exercised the five functions at different points in the collaboration. NCell and Flowminder demonstrated the first function of data stewards when they set up a collaboration in advance of the earthquake. This enabled their teams to exercise the second function: coordinating parties involved in the collaborative response. The third function—data audit and assessment of value and risk—was built into their data sharing mechanism. Flowminder performed the fourth function by disseminating the findings. Finally, the two organizations are still maintaining their collaboration well beyond the 2015 earthquake, demonstrating the fifth function of data stewards.

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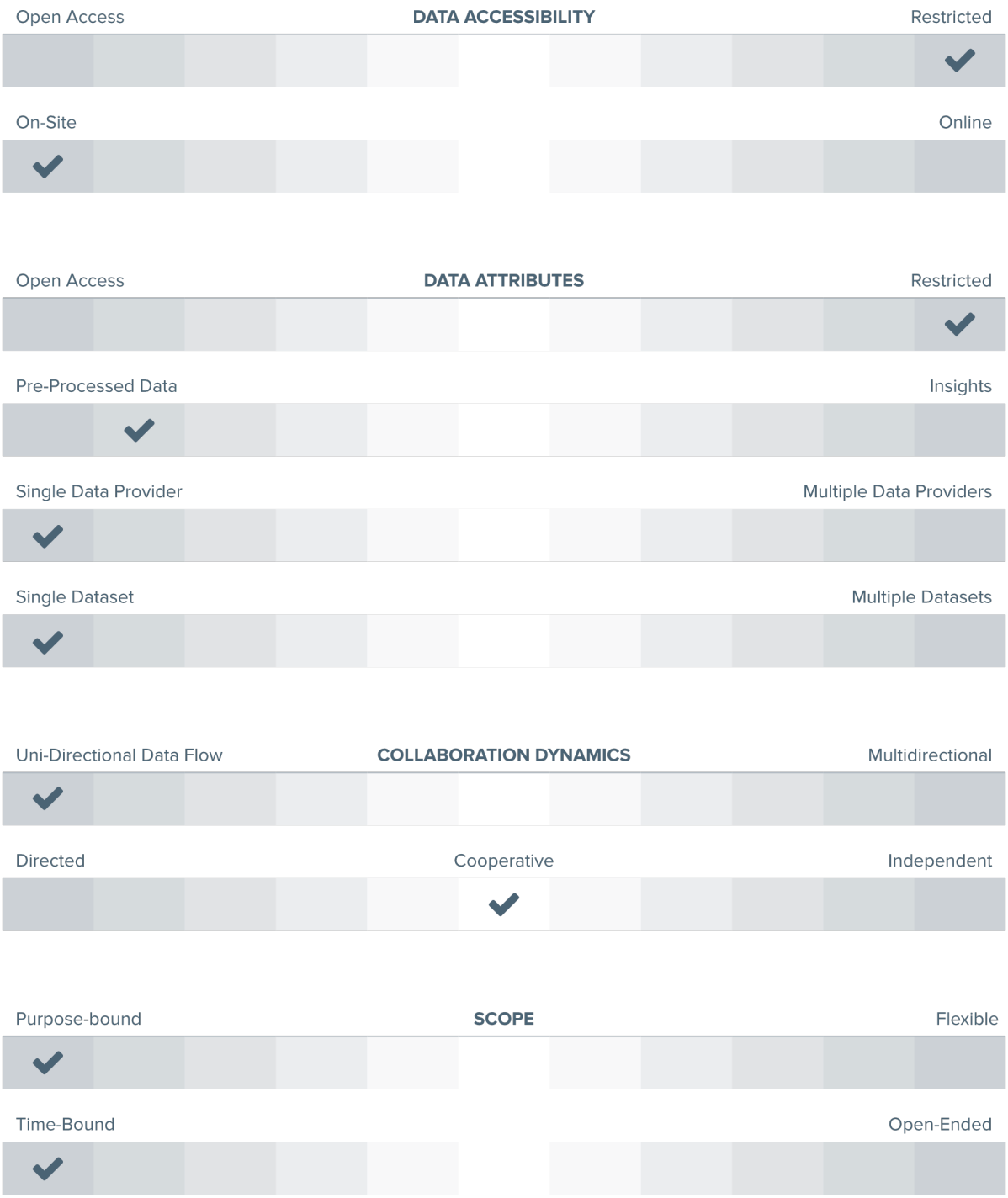
OPERATIONAL VARIABLES



Operational variables for "Using Telecom Data to Aid Humanitarian Efforts after the 2015 Earthquake in Nepal" data collaborative. Detailed description of each variable can be found here.

Setting the Scene

Nepal sits on one of the most seismically active regions in the world, a place where the Indian and Eurasian plates continuously collide.[1] It contains some of the most difficult and mountainous terrain in the world. On April 25, 2015, a magnitude 7.8 earthquake devastated Nepal, killing at least 8,891 people and destroying or damaging 893,509 buildings. The earthquake was followed by hundreds of aftershocks and a 7.3 magnitude earthquake 17 days later. At its peak, the emergency displaced some 188,900 people.[2]

In the immediate aftermath of the crisis, humanitarian organizations had little information about these effects, which made aid delivery difficult. As noted by Razia V. N. Oden, et al, four key challenges in disaster response, include "coordination among groups involved in the response, communication among these groups, timely information exchange, and effective information technology support for emergency responders in the field."[3]

In prior crises, researchers have used mobile call detail record (CDR) data to address these gaps.[4] CDRs consist of metadata such as duration of a call, timestamp, and the cell tower that a phone is connected to when a call is made or received. CDRs have been used to model disease

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[1] Maya Wei-Haas, "Devastating Earthquakes Are Priming the Himalaya for a Mega-Disaster," National Geographic, January 17, 2019, https://www.nationalgeographic.com/science/2019/01/earthquakes-priming-himalaya-disaster/.

[2] "Nepal Earthquake Humanitarian Response April to September 2015" (UN OCHA, 2015), https://www.humanitarianresponse.info/sites/www.humanitarianresponse.info/files/documents/files/nepal_earthquake_humanitarian_response_report_lr_0.pdf.

[3] Razia V.N. Oden et al., "Four Key Challenges in Disaster Response," *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* 56, no. 1 (September 1, 2012): 488–92, https://doi.org/10.1177/1071181312561050.

[4] Linus Bengtsson et al., "Improved Response to Disasters and Outbreaks by Tracking Population Movements with Mobile Phone Network Data: A Post-Earthquake Geospatial Study in Haiti," *PLOS Medicine* 8, no. 8 (August 30, 2011): e1001083, https://doi.org/10.1371/journal.pmed.1001083.

spread,[5] gender mobility,[6] and pollution spread.[7] The potential utility of mobile phone data is especially high in places such as Nepal where the rate of mobile penetration is high.[8] Ncell, itself, has 41% of telephone operators market share in Nepal.[9]

Establishing the Data Collaborative

The Sweden-based nonprofit data analytics organization Flowminder began a collaboration with Ncell in 2014 to improve disaster preparedness in Nepal given its vulnerabilities.[10] By chance, the two organizations established a rapid-response capacity as part of this collaboration one week before the earthquake.[11]

After the event, Flowminder researchers analyzed CDR data from 12 million de-identified SIM cards provided by NCell.[12] This work involved a three-step process. First, Flowminder and NCell established a secure remote connection to a dedicated analytics server located with an Ncell data centre. Authorized Flowminder staff deployed custom analytics software to the server. Second, the analytics software enabled the researchers to compute aggregates whilst ensuring that the individual-level CDR data remained within the server on Ncell premises. Third, Flowminder retrieved the aggregated results using the secure remote connection.

From this data, the researchers identified displacements driven by the earthquake by estimating movements before the earthquake and then comparing it to the movement after the earthquake. The researchers subsequently visualized their work, which emergency relief agencies used to better locate victims of the earthquake.

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[5] "Using Cell Phone Data to Curb the Spread of Malaria," Harvard T. H. Chan School of Public Health, October 11, 2012, https://www.hsph.harvard.edu/news/press-releases/cell-phone-data-malaria/.

[6] Laetitia Gauvin et al., "Gender Gaps in Urban Mobility," *ArXiv:1906.09092 [Physics]*, June 21, 2019, http://arxiv.org/abs/1906.09092.

[7] Raquel Carretero Juarez, "Using Big Data to Combat Air Pollution in Brazil," Telefonica, March 14, 2018, https://www.telefonica.com/en/web/public-policy/blog/article/-/blogs/using-big-data-to-combat-air-pollution-in-brazil.

[8] Nepal has 39 million mobile phone subscriptions in a country of 28 million people. *See*:"Statistics," The Telecommunication Development Sector (ITU-D), accessed October 29, 2019, https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx; "Population, Total - Nepal | Data," The World Bank, 2018, https://data.worldbank.org/indicator/SP.POP.TOTL?locations=NP. .

[9] "Nepal: Telephone Operator Market Share 2019," Statista, accessed August 5, 2020, https://www.statista.com/statistics/734757/nepal-telephone-operator-market-share/.

[10] "Nepal Earthquake 2015," Flowminder, 2015, https://web.flowminder.org/case-studies/nepal-earthquake-2015.

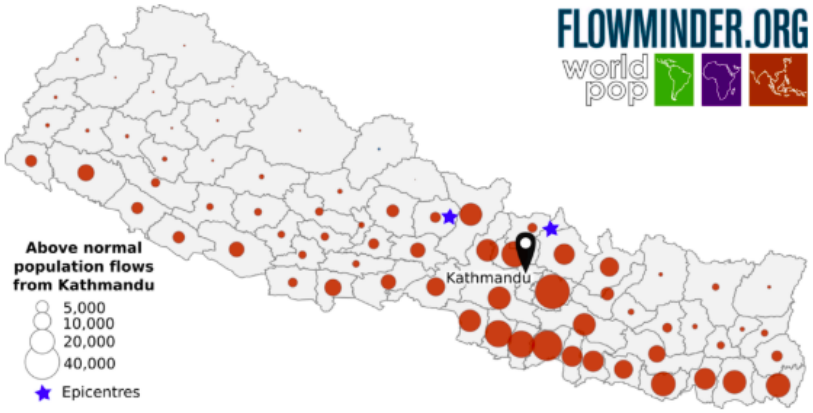
[11] "Nepal Earthquake 2015," *supra* note 8.

[12] Linus Bengtsson and Martin Thom. Interviewed by The GovLab. Phone Call, September 20, 2019.

Outcome and Impact

In a subsequent report produced by Flowminder, the organization estimates 500,000 people left Kathmandu after the earthquake for districts surrounding it. Many others travelled to the Terai areas in the south and southeast of Nepal.[13] Nationally, an estimated 1.8 million people left their home districts after the earthquake.[14]

Within two weeks of the earthquake, the research team sent an analysis of population displacement to humanitarian agencies through a cluster system.[15] Flowminder also disseminated the report independently and through the United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA) to support its emergency assistance programming.[16] Over 1,700 users have downloaded Flowminder's population movement dataset on the Humanitarian Data Exchange.[17]



Anomalous flows from the Kathmandu valley, comparing the 10th-14th May with the 20th-24th April.

[13] "Nepal Earthquake 2015," *supra* note 8.

[14] *Ibid.*

[15] The cluster system is a coordination mechanism for humanitarian organizations in responding to crisis events. Each cluster focuses on one issue— such as wash, sanitation, and hygiene (WASH); shelter; and nutrition clusters—and consists of several humanitarian agencies. See: "What Is the Cluster Approach? | HumanitarianResponse," accessed October 5, 2020, https://www.humanitarianresponse.info/en/about-clusters/what-is-the-cluster-approach.

[16] *Ibid.*

[17] "Population Movements after the Nepal Earthquake v5 up to 19th Aug 2015 - Humanitarian Data Exchange," accessed August 5, 2020, https://data.humdata.org/dataset/population-movements-after-the-nepal-earthquake-v5-up-to-19th-aug-2015.

Risks and Mitigation Strategy

Privacy. To preserve user privacy, the researchers followed the CDR privacy guidelines developed by the GSMA for the Ebola outbreak. The guidelines stress data analysis should only be performed on de-identified data, within the operator's secure premises, and only non-sensitive outputs of the analysis can be provided to approved parties.[18] Following this set of guidelines, the researchers set up "a high-specification Linux analysis server (with 128GB of RAM and over 20TB of disk space) within [Ncell's] data centre."[19] Both parties established a remote connection to this server, analyzed the data within this server and only transferred the aggregated results outside the server.[20]

Lessons Learned – Enablers

Anticipatory disaster preparedness partnership. The collaboration with NCell in advance of the earthquake enabled the data collaborative's ability to rapidly release analysis. Although Flowminder and NCell had not finished setting up disaster preparedness capacity when the earthquake struck, the completed work allowed the team to obtain mobile operator data from Ncell, conduct their analysis, and release it to the public and relevant organizations expeditiously.

Exchange of data and humanitarian expertise. Flowminder researchers pioneered the use of cell phone operator data to help with disaster response in collaboration with the operator Digicel after the earthquake in Haiti in 2010. Flowminder had worked with national governments, United Nations Agencies and other relief agencies during disasters, experience which it drew upon to work with humanitarian organizations in earthquake response.

Lessons Learned – Challenges

Data limitations. The researchers recognized limitations inherent in the CDR data.[21] Different operators may have different metadata formatting, which requires data re-formatting before analysis. In many instances, there are calls created by bots, which are not relevant for the research context. These types of errors require the data to be cleaned before it can be useful.

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[18] "GSMA Guidelines on the Protection of Privacy in the Use of Mobile Phone Data for Responding to the Ebola Outbreak," *Mobile for Development* (blog), November 19, 2014, https://www.gsma.com/mobilefordevelopment/resources/gsma-guidelines-on-the-protection-of-privacy-in-the-use-of-mobile-phone-data-for-responding-to-the-ebola-outbreak/.

[19] Robin Wilson et al., "Rapid and Near Real-Time Assessments of Population Displacement Using Mobile Phone Data Following Disasters: The 2015 Nepal Earthquake," *PLOS Currents Disasters*, February 24, 2016, https://doi.org/10.1371/currents.dis.d073fbece328e4c39087bc086d694b5c.

[20] *Ibid.*

[21] Linus Bengtsson and Martin Thom, *supra* note 11.

Researchers encountered other issues with data quality. CDR data depends on calls/SMSs made or received or mobile data sessions made. Only 50 percent of people in the datasets made calls every other day.[22] Also, the researchers assumed that the towers connected to the mobile device belonged to the administrative area in which they were located. In reality, tower coverage often extends beyond administrative boundaries, increasing the margin of error in the analysis. Finally, researchers noted data from mobile operators depends on their market share and service coverage. In some areas, Ncell did not have sufficient coverage to conduct statistically significant analysis.

Measuring impact. Insights generated from Flowminder's data analysis were communicated to humanitarian organizations working in Nepal following the earthquake.[23] Flowminder's Executive Director Linus Bengtsson, in an interview with The GovLab, reported that the insights were shared with humanitarian clusters within the United Nations system and incorporated by UN agencies into their information dissemination.[24] Yet, there is no study on the direct contribution of this data in delivering aid in Nepal. The field would benefit from more quantified evidence of the value of data stewardship and collaboration in disaster response.

Next Steps

Preparation is key for any disaster response. To this end, Flowminder and NCell's collaboration demonstrate the value of a long-term and continuous collaboration in emergency response. Along with TeliaSonera, these actors received the GSMA's Global Mobile Awards 2016 for category "Mobile in Emergency or Humanitarian Situations" for their efforts following the earthquake in Nepal.[25] Building on this achievement, Flowminder and NCell maintain their disaster preparedness collaboration until today.

From its work, Flowminder is also refining its analytics tool, FlowKit, a free and open-source resource that helps CDR analysis. Flowminder plans to expand the functionalities of the tool to make it more accessible to other users. It also aims to make accessing and analyzing CDR easier while maintaining security of the highly sensitive data itself.

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[22] Robin Wilson, *supra* note 8.

[23] Linus Bengtsson and Martin Thom, *supra* note 11; "Population Movements after the Nepal Earthquake v5 up to 19th Aug 2015 - Humanitarian Data Exchange," *supra* note 16.

[24] *Ibid.*

[25] "Flowminder — Global Mobile Awards 2016: Flowminder Successful," accessed October 31, 2019, https://web.flowminder.org/posts/global-mobile-awards-2016-flowminder-successful.

Lastly, Flowminder, in partnership with organizations such as the International Organization for Migration, have significantly refined the analysis methods and are currently working with the government of Mozambique and Digital Impact Alliance (DIAL), to automate the new methods.[26]

[26] Linus Bengtsson, "Request for Comments - Leveraging Telecom Data to Aid Humanitarian Efforts," September 16, 2020.

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