HUMANITARIAN TECHNOLOGY: NEW INNOVATIONS, FAMILIAR CHALLENGES, AND DIFFICULT BALANCES

Policy Report

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EXECUTIVE SUMMARY

Innovation has been elevated to the forefront of discussions on the future of humanitarianism. Data-based, materials, communications, and logistics technologies promise to improve the effectiveness of humanitarian operations. This paper explores four ensuing tensions that need balancing.

Some, including Unmanned Aerial Vehicles (UAVs), additive manufacturing, and certain data-collection technologies, require reviewed regulation to avoid disrupting other public goods or undermining particular values held by local populations.

Several data-based technologies, and the general need to experiment with any innovation, must balance short-term benefits with longer-term risks. This is difficult in humanitarian emergencies given the urgency with which decisions must be taken, and because those deciding are generally not those shouldering the risks. Where judgement is exercised, there must be review and accountability.

Data-collection technologies, UAVs, and biometrics may in some circumstances distribute risk onto populations in need of help for benefits gained primarily by humanitarian organisations and their donors, entrenching a power discrepancy that pervades humanitarianism in general.

Several data-based and communications technologies promise to increase the autonomy of those caught in disasters. In scenarios where speed makes a crucial difference in terms of lives saved, such initiatives are extremely valuable as they help people to mitigate the risks they face before outside help arrives.

The challenges facing new technologies parallel general criticisms levelled at humanitarianism over the last twenty-five years, including that it can exacerbate conflict and poverty, perpetuate political marginalisation, and prioritise agendas of foreign powers rather than those in need. This is likely because those technologies do not engage with these criticisms, which are political rather than technical. This does not necessarily mean those innovations lack merit; however, it does suggest that they are unlikely to meet the high expectations expressed for humanitarian technology. Technologies increasing individual autonomy are an exception. These clearly challenge the potential to instrumentalise centrally-distributed aid and the exacerbation of power imbalances.

With its technological expertise, Singapore can be an important voice in discussions about the humanitarian uses of technology. To ensure this comparative advantage achieves maximal benefit, Singapore ought to stress the nuances outlined in this paper both in its own research into the humanitarian possibilities of new technology, and in regional and global discussions on this issue.

INTRODUCTION

The humanitarian sector is currently undergoing what has been defined as an "innovation turn". It follows almost twenty-five years of often bitter debate over the perceived failure of the humanitarian system to achieve its principal goal of saving lives and alleviating suffering in conflict and disaster settings. These criticisms range from unprofessionalism and inefficiency, to fundamental critiques that programmes exacerbate the conflict and poverty to which they ostensibly seek to respond, perpetuate political marginalisation and even prioritise the agendas of foreign powers over assisting those in need.[1] It also comes during the highest level of humanitarian need since the Second World War.[2] Against this backdrop, there is much optimism surrounding technology,[3] prompting substantial investment to improve aid outcomes and strengthen relationships between formal humanitarian organisations and the private and military sectors where innovation is occurring. Concordantly, "Transformation through Innovation" was a key theme at the 2016 World Humanitarian Summit.

Many new technologies hold significant promise to improve aid delivery. Unmanned Aerial Vehicles (UAVs) are beaming data directly to software programmes to produce real-time maps of disaster-affected areas and populations *in extremis*. Artificial intelligence is combing social media posted from conflict and disaster zones to improve responders' decision-making, and analysing mobile phone data to predict key demographic variables related to vulnerability. The irises and fingerprints of displaced people are

1 See typically Antonio Donini, ed., *The Golden Fleece: Independence and manipulation in humanitarian action*, (London: Kumarian Press, 2012); Ed Schenkenberg van Mierop, "Coming clean on neutrality and independence: The need to assess the application of humanitarian principles," *International Review of the Red Cross*, 97, (2016), 295-318; Hugo Slim, *Humanitarian Ethics: A Guide to the Morality of Aid in War and Disaster*, (London: Hurst & C., 2015); Jan Egeland et al., *To Stay and Deliver*, (UN OCHA: Geneva, 2011); Fiona Fox, "New Humanitarianism: Does it provide a moral banner for the 21st century " Disasters, 25m, no. 4, (2001): 275–289; Stuart Gordon and Antonio Donini, "Romancing the principles and human rights: are humanitarian principles salvageable?" *International Review of the Red Cross*, 97, (2016): 77-109.

2 UN News, "Interview: Global humanitarian needs have never been higher, says UN official," *UN News Centre*, 2 October 2017, https://www.un.org/apps/news/story.asp?NewsID=57784#.WeGrokyB1xh

3 See for example Harvard Humanitarian Initiative, *Disaster Relief 2.0: The Future of Information Sharing in Humanitarian Emergencies*, (Washington DC and Berkshire: UN Foundation and Vodafone Foundation Technology Partnership, 2011); Francesco Mancini, ed., *New Technology and the Prevention of Violence and Conflict*, (New York: International Peace Institute, 2013); American Red Cross, *Drones for Disaster Response and Relief Operations*, April 2015, https://www.issuelab.org/resources/21683/21683.pdf; for a critique of uncritical positivism see Kristin Bergtora Sandvik et al., "Humanitarian Technology: A critical research agenda," *International Review of the Red Cross*, 96, (2014): 219-242

being digitised in the name of distributional effectiveness and accountability, as well as refugee governance. The Internet of Things is improving the transportation of temperature-sensitive vaccines, the treatment of patients with highly infectious diseases, and emergency supply chain management. Additive manufacturing is producing required items on-site, reducing the need to transport them over long distances, and, with computer-aided design, increasing the adaptability of those items. These technologies enter an environment with pre-existing practices and competing obligations. This paper uses several of these examples to explore four resulting tensions: (i) between the humanitarian imperative and other public goods; (ii) between short- and long-term interests of those affected by disaster; (iii) between the needs of disaster-responders and disaster-affected; and (iv) between centralised coordination and individual autonomy. Based on an examination of existing literature and cases found therein, it identifies significant similarities between the challenges stemming from these tensions and broader critiques of humanitarianism, and suggests several related policy considerations. These considerations have particular relevance to Singapore as it seeks to adapt its technological expertise and design capabilities to achieve humanitarian benefits both regionally and beyond.

BALANCING AID OPERATIONS AND OTHER PUBLIC GOODS

Several new technologies being deployed in humanitarian settings raise important regulatory questions for governments due to their potential to impact other public goods for which states are responsible. These necessitate an informed and considered effort to balance humanitarian objectives with competing imperatives including public safety, security, and protection of public and private property. Two prime areas in which this applies are airspace and medical standards.

UAVs in the Nepal 2015 earthquakes[4]
At the time of Nepal's twin earthquakes in 2015, there were no local laws governing the use of UAVs and concerns about responsible deployment quickly arose. Despite positive non-governmental organisation communication about their use for identifying resources and survivors, the Nepali authorities ultimately placed severe ad hoc restrictions on UAVs following fears they were flying too close to security installations and historical sites, and posed risk to approaching aircraft. Those regulations included restricting flying time to fifteen minutes and travelling no further than 300 metres from the pilot, and introduced no-fly zones over houses. These significantly undermined the realisation of UAVs' potential.

Some of these technologies are substantial pieces of hardware. For example, several models of UAVs are large enough to cause significant damage to people and property should they malfunction or be used irresponsibly. They are used for a range of tasks, including heavy lift operations, personnel transportation, and high altitude reconnaissance. A report by the American Red Cross separates UAVs into five groups.[5] Of these, UAVs in groups three, four, and five weigh in excess of 600 kilograms, twice as much as a typical motorcycle. This has raised regulatory concerns about maintenance and air worthiness.

Some new technologies' relationships with existing regulatory frameworks require clarification. For example, integration of UAVs into "non-

4 Gopal Sharma, "Armed with drones, aid workers seek faster response to earthquakes, floods," *Reuters*, 16 May 2016, http://www.reuters.com/article/us-humanitarian-summit-nepal-drones-idUSKCN0Y7003; Hannan Lewsely, "Eye in the sky," *The Nepali Times*, 10 December 2015, http://nepalitimes.com/article/nation/nepal-government-crack-down-on-drones,2716

5 American Red Cross, *Drones*, 41-5

segregated airspace" which is shared with manned aircraft requires special consideration. Some experts believe this depends on the UAV's "sense and avoid" abilities, tying this element of regulation back to the overall regulatory decision about what constitutes airworthiness.[6] Similarly, additive manufacturing – also known as 3D printing – has been used to create oxygen splitters, medical waste containers, and even customised prosthetic limbs.[7] Both of these sectors – medical and airspace – are stringently regulated by states for public safety and security. For new technologies to contribute to disaster response to their full potential, any regulatory questions relating to their use must be identified and clarified before those technologies are deployed.

Several examples of regulatory codes already exist. Most countries have instituted quality control regulations for medical paraphernalia, but need to clarify how they intend to apply this to additive manufacturing of such items. For UAVs, two prominent examples are the NATO (North Atlantic Treaty Organization) Unmanned Aircraft Systems Airworthiness standards,[8] and the European Aviation Safety Agency Policy Statement on Airworthiness Certification of Unmanned Aircraft Systems.[9] The UAViators Code of Conduct – produced by a community of private UAV users interested in the use of UAVs in disaster response – provides an excellent baseline for policy-makers considering the conduct of UAV operators.[10]

Efforts at regulation have faced two significant challenges. First, commentators note a tendency to use different classification criteria in establishing regulations.[11] This complicates compliance, especially for international organisations seeking to deploy assets in different jurisdictions.

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[6] J. Everaerts, "The Use of Unmanned Aerial Vehicles (UAVs) for Remote Sensing and Mapping," *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences 37*, (2008): 1188; E. Pereira et al., "Unmanned Air Vehicles for Coastal and Environmental Research," *Journal of Coastal Research*, Special Issue 56, (2009): 1560.

[7] Eric James and Daniel Gilman, *Shrinking the Supply Chain: Hyperlocal Manufacturing and 3D printing in Humanitarian Response*, (Geneva: OCHA, 2015), 7 https://docs.unocha.org/sites/dms/Documents/OCHA_OP14_3D%20printing_online.pdf

[8] John E Mayer, "State of the art of Airworthiness Certification," *NATO Public Release*, (2008), https://www.sto.nato.int/publications/STO%20Meeting%20Proceedings/STO-MP-AVT-273/MP-AVT-273-08.pdf.

[9] European Aviation Safety Agency, *Policy Statement on Airworthiness Certification of Unmanned Aircraft Systems*, (2009), accessed 17 October 2017 https://www.easa.europa.eu/system/files/dfu/E.Y013-01_%20UAS_%20Policy.pdf

[10] UAViators, *Humanitarian UAV Code of Conduct & Guidelines*, undated, https://docs.google.com/document/d/1Uez75_qmIVMxY35OzqMd_HPzSf-Ey43lJ_mye-kEEpQ/edit

[11] See for example on UAVs: André Haider and Laura Smasó, "Integrating Remotely Piloted Aircraft Systems into Non-Segregated Airspace," *The Journal of the JAPCC 20*, (Spring/Summer 2015): 38-45

A standardised classification system would expedite technologies' entry into the country and ultimately their deployment in the field. Second, in places where rules already exist, there is a reflex to over-regulate and create unnecessary burden. The Nepal earthquake example given above illustrates this well, but it also appears in more established UAV regulatory environments like the U.S.[12] Airspace considered sensitive for UAVs, such as around military installations or critical infrastructure, needs to be defined ahead of any disaster, and appropriate balances struck between keeping them secure and properly facilitating disaster response.

Similarly, the level of customisability allowed by additive manufacturing, which is one of its major advantages in disaster settings, makes regulating quality assurance complicated.[13] Without clarity, private companies are reportedly reluctant to use the technology in their own work, a hesitation that could equally encumber disaster responders.[14] Addressing this through appropriate rules and procedures requires adequate consultation with humanitarian and other relevant stakeholders, likely including military, aviation, medical, and civil society representatives.

Any regulation must bear in mind the need to maintain flexibility. This is necessary first because of the different possible scenarios in which technology could be deployed. According to Matthew DeGarmo of the MITRE Centre for Advanced Aviation System Development, "If only operating a small UAV within visual sight at low altitudes in a rural setting, the certification would likely be low; whereas on the other extreme, a pilot seeking to control multiple UAVs in a complex and heavily trafficked area would need an entirely different set of knowledge and skills."[15] Beyond this, past experience demonstrates that flexibility is critical for realising the potential of new technologies. Volunteer and technical communities (V&TCs) designed and produced far more innovations in the aftermath of the 2010 earthquake in Haiti than aid agencies were able to handle.[16] One key lesson learned was the need for a design cycle capable of fostering the operational flexibility required to incorporate new ideas into programming

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[12] American Red Cross, *Drones*, 5-6

[13] Robert Morrison et al., "Regulatory Considerations in the Design and Manufacturing of Implantable 3D-Printed Medical Devices," *Clinical And Translational Science* 8, (2015): 594–600

[14] Mutahar Shamsi et al, "3d opportunity for healthcare: Demystifying FDA regulations for medical devices," *Deloitte Insights*, 21 February 2017, https://dupress.deloitte.com/dup-us-en/focus/3d-opportunity/additive-manufacturing-fda-regulations-medical-devices.html

[15] Matthew DeGarmo, *Issues Concerning Integration of Unmanned Aerial Vehicles in Civil Airspace*, (Virginia, USA: The MITRE Corporation, 2004), 53

[16] John Crowley and Jennifer Chan, *Disaster Relief 2.0*, (Cambridge, MA: Harvard Humanitarian Initiative, January 2011), 11, https://hhi.harvard.edu/sites/default/files/publications/disaster-relief-2.0.pdf

during a disaster response.[17] The high pressure environment and need for quick decision-making already make it difficult to achieve that flexibility, and technology regulation could complicate it further if not done in a way cognizant of this competing imperative.

The pragmatic importance and moral difficulties of this flexibility are exemplified by the additive manufacture of umbilical cord clamps following the 2010 Haiti earthquake.[18] Aid workers were acutely aware that the conditions in which the clamps were manufactured did not match the level of sterility usually required in the production of these instruments. However, in the absence of those clamps, medical workers were reportedly using string, and even shoelaces, to tie the freshly cut umbilical cords of newborns. The 3D printed clamps improved on this and thus were considered "good enough" in the circumstances despite their failure to meet recognised standards. This notion of "good enough" can be critical in the circumstances of urgency and material scarcity that characterise a humanitarian disaster, and regulation must be flexible enough to allow space for it. However, "good enough" will always be a subjective judgement open to abuse, and regulation must equally be robust enough to mitigate this potential risk. Consider the collection of data through UAVs, or mobile phone records, or medical information, and the implications on privacy: when are privacy protections "good enough?" These balances are evidently extremely difficult to strike, in particular when they are being made by humanitarian workers who themselves will not bear the consequences of "unhygienic" medical instruments or inadequate privacy protocols. But their importance is plain and will grow as this paper discusses other conflicting considerations in the humanitarian application of new technology.

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[17] Crowley, *Disaster Relief*, 44-53. This ultimately gave rise to the Digital Humanitarian Network, which considers itself "a consortium of Volunteer & Technical Communities [aiming] to provide an interface between formal, professional humanitarian organizations and informal yet skilled-and-agile volunteer & technical networks." See, Digital Humanitarian Network, "About the DHN," accessed 17 October 2017, http://digitalhumanitarians.com/about

[18] A. Dara Dotz, "A pilot of 3D printing of medical devices in Haiti," *Technologies for Development*, (May 2015): 33–44

BALANCING SHORT- AND LONG-TERM INTERESTS OF DISASTER-AFFECTED POPULATIONS

Several data-based technologies are helping to inform disaster responders' situational awareness and prioritise their activities. For example, call detail records (CDRs) from mobile phones are used to track people's movements, and even combined with artificial intelligence to predict characteristics such as age, gender, and socio-economic class from usage habits.[19] This has enormous potential to help identify the most vulnerable in a disaster setting, particularly in developing countries where most devices are prepaid, meaning demographic data about the user is not collected at the point of sale. In addition, both open[20] and closed-source[21] data collected from social media platforms and other sources are being made available to aid agencies.[22] Much of that data is subsequently reproduced in interfaces that are public.[23] This facilitates collaboration among V&TCs, which often include members spread around the world who possess substantial technical expertise handling data and reproducing it in ways that quickly assist disaster responders.[24] For example, the MicroMappers V&TC mobilised during Typhoons Haiyan and Hagupit in 2013 and 2014 in the Philippines at the request of the United Nations Office for the Coordination of Humanitarian Affairs (OCHA).[25] MicroMappers rely on software to identify relevant posts on Twitter. These are then processed by remote volunteers through "Clickers" built on an open source micro-tasking platform.[26] Volunteers categorise text and images harvested by the MicroMapper software either as requests for help, infrastructure damage, or displaced populations. These are then displayed on a mapping interface close to real-time using either the geotag automatically included in the post, or other location information within the text.

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[19] Eaman Jahani et al. "Improving official statistics in emerging markets using machine learning and mobile phone data," *EPJ Data Science* 6, (2016): 3

[20] See for example AIDR, "AIDR Overview," accessed 17 October 2017, https://github.com/qcri-social/AIDR/wiki/AIDR-Overview ;

[21] See for example Molly Jackman, "Using data to help communities recover and rebuild," *Facebook newsroom*, 7 June 2017, https://newsroom.fb.com/news/2017/06/using-data-to-help-communities-recover-and-rebuild/

[22] Crowley and Chan, *Disaster Relief* 2.0, 19

[23] See, for example, Ushahidi, "About Ushahidi," accessed 17 October 2017, https://www.ushahidi.com/about

[24] Crowley and Chan, *Disaster Relief* 2.0, 9

[25] Caroline Bannock, "Typhoon Hagupit: UN using crowdsourcing platform to help assess damage," *The Guardian*, 9 December 2014, https://www.theguardian.com/world/2014/dec/09/typhoon-hagupit-un-using-crowdsourcing-platorm-to-help-assess-damage

[26] Patrick Meier, "MicroMappers: Microtasking for Disaster Response," *iRevolutions.org*, 18 September 2013, https://irevolutions.org/2013/09/18/micromappers/

CDRs in the 2014-15 West Africa Ebola outbreak[27]
From 2014-2015, at the height of the West Africa Ebola outbreak, the urgent need to understand the spread of the disease prompted the experimental and unconsented release of CDRs to explore whether they could be used to track the transmission of the virus. CDRs are among the most tightly regulated data worldwide. Since Ebola is not a vector-borne disease like malaria, and necessitates the tracing of every individual with whom an Ebola sufferer has had contact, this data was only useable if correlated with personally identifying information. This increased the violation of privacy and the overall risk to individuals to an extent that would be considered illegal and arguably quite unethical in other parts of the world. Furthermore, this was done in furtherance of what is an entirely unproven method. This example shows how incredibly difficult it can be to balance the need to try and alleviate short-term suffering with longer-term risks to populations.

The advantages of having more data are clear but the benefits in terms of efficiency and effectiveness of disaster response can come with longer-term risks. In Pakistan during the 2010 floods and subsequent food crisis, crisis mappers had to review their plans to create public maps showing aid projects when Taliban forces threatened a campaign to attack foreign aid workers.[28] Dangers exist with closed data too, whose loss is considered even more consequential due to its level of sensitivity. The European Interagency Security Forum has reports of the British and Chinese governments using cyber-based methods to steal information from Médecins du Monde, UNICEF, and the World Health Organization.[29] Files leaked by Edward Snowden, a former contractor working for the U.S. National Security Agency, detail comparable attacks again by governments on humanitarian groups.[30] Several attacks have been recorded in Syria against non-governmental organisations, activists, and civil society organisations.[31] While the nature of

[27] Sean. M. McDonald, "Ebola: A Big Data Disaster. Privacy, Property, and the Law of Disaster Experimentation," CIS Papers 2016.01, March 2016, http://cis-india.org/papers/ebola-a-big-data-disaster

[28] Andrej Zwitter, *Humanitarian Intelligence: A practitioner's guide to crisis analysis and project design*, (London: Rowman & Littlefield, 2016), 45

[29] Rory Byrne, "Trends in intelligence gathering by governments," *Communications technology and humanitarian delivery: challenges and opportunities for security risk management*. Rachel Vazquez Llorente and Imogen Wall, eds, (London: European Interagency Security Forum, 2014), 12-17

[30] James Ball and Nick Hopkins, "GCHQ and NSA targeted charities, Germans Israeli PM and EU chief," *The Guardian*, 20 December 2013, https://www.theguardian.com/uk-news/2013/dec/20/gchq-targeted-aid-agencies-german-government-eu-commissioner

[31] Byrne, "Trends," 12-17

the risks stemming from these data losses depends on the largely unknown agendas of those who stole it, the existence of risk is clear.

The humanitarian sector is working to improve responsible data stewardship. This includes developing a theory of harm to help conceptualise the issue of data security in humanitarian settings,[32] and the creation of a rights-based approach to managing digitised data on vulnerable groups known as *The Signal Code* developed by the Harvard Humanitarian Initiative.[33] The International Committee of the Red Cross has produced a *Handbook on Data Protection in Humanitarian Action,*[34] and UN OCHA has written a report on the importance of mitigating the risk of cyber-theft, suggesting wisely that it may sometimes be better not to collect some data if its benefits are outweighed by the risks of losing it.[35] While these efforts represent clear progress, their impact will be limited without engaging states. Balancing competing short- and long-term interests, and defining when and to what extent individual privacy can be invaded in the name of public good, are both intensely political endeavours. This is particularly important in disaster response since it is generally the most marginalised communities that face the greatest risk from humanitarian disasters due to their limited access to political power, resources, and often information.[36] This increases the likelihood of their interests being sidelined in decision-making. As a result, any work done by the humanitarian community requires tailoring to local contexts. It should also be done in consultation with stakeholders engaged in disaster response and broader civil society in order to ensure a contextually relevant and locally acceptable balance is achieved.

However, herein lies the tension for policy makers and disaster responders. Disasters often necessitate quick decision-making based on imperfect data availability or comprehension. This means responders are still often balancing between the immediate imperative to help and longer-term best

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[32] Kristin Bergtora Sandvik, and Nathaniel A. Raymond, "Beyond the Protective Effect: Towards a Theory of Harm for Information Communication Technologies in Mass Atrocity Response," *Genocide Studies and Prevention: An International Journal* 11, no. 1, (2017): 9-24.

[33] The Signal Code articulates five data-related rights: to information, protection, data privacy and security, data agency, and redress and rectification. See Faine Greenwood et al, *The Signal Code: A Human Rights Approach to Information During Crisis*, (Cambridge, MA: Harvard Humanitarian Initiative, 2017)

[34] Christopher Kuner and Massimo Marelli (eds) *Handbook on Data Protection in Humanitarian Action*, (Geneva: ICRC, 2017) https://shop.icrc.org/e-books/handbook-on-data-protection-in-humanitarian-action.html

[35] Gilman, *Humanitarianism in the age of cyber-warfare*, 14

[36] For an excellent overview of this see John Twigg, *Disaster Risk Reduction: Mitigation and Preparedness in Development and Emergency Planning*, (London: Humanitarian Practice Network, Overseas Development Institute, 2004), 80-103, http://www.ifrc.org/PageFiles/95743/B.a.05.%20Disaster%20risk%20reduction_%20Good%20Practice%20Review_HPN.pdf

interests of others. Those judgment calls need to be noted and subsequently reviewed to ensure accountability and that lessons can be learnt for future disaster responses. Humanitarian organisations should seriously consider the Signal Code's call to create mechanisms to evaluate use of information and communications technologies, and facilitate redress for those whose data has been taken unnecessarily or problematically.[37]

Katja Jacobsen – senior researcher at the Centre for Military Studies at the University of Copenhagen – notes a different trade-off between long-term interests and short-term benefits. She argues that there is a greater willingness and less stringent regulation for conducting tests on populations in need of humanitarian assistance in comparison to the rules governing experimentation on human subjects elsewhere.[38] This is often justified through eminently good intentions such as the urgency of their short-term needs, which can prompt a conclusion that whatever is tested will at least not worsen the situation and may improve aid outcomes or resource efficiency.

Rotavirus vaccine testing[39]

In 1999, the Centre for Disease Control in the U.S. identified 15 cases of intussusception – a type of bowel obstruction – in children who had received a new rotavirus vaccine. The vaccine was withdrawn from the U.S. market, and two further rotavirus vaccines in the research pipeline were unable to proceed to human testing until their safety could be confirmed. Rotavirus is a common disease among children in both developed and developing countries, and can cause death without adequate food, water, and hospital treatment. As such, the health security of children in developing locations in particular stood to benefit from a vaccine. Between 1998 and 2008, while the vaccine was still withdrawn from the U.S., the World Health Organization administered several rotavirus vaccine test campaigns in humanitarian settings including Mexico, Brazil, Venezuela, Malawi, Bangladesh, and South Africa. In light of concerns that immune-compromised children might experience particular side-effects from the vaccine, experiments sought to ensure enough HIV-positive and malnourished children received

[37] Greenwood, *Signal Code*, 55

[38] Katja Jacobsen, *The Politics of Humanitarian Technology: Good Intentions, Unintended Consequences*, (London: Routledge, 2015): 119-129; see also Paul Amar, *The Security Archipelago: Human-security States, Sexuality Politics and the End of Neoliberalism*, (Durham, NC: Duke University Press, 2013); and Nicole Grove, "The cartographic ambiguities of HarrassMap: Crowdmapping security and sexual violence in Egypt." *Security Dialogue* 46, no. 4 (2015): 345–364

[39] Jacobsen, *Politics*, 112-129

the vaccination to explore the hypothesis. Experiments also varied the dosage to identify at what point side-effects – including fever – were induced. The data collected during these experiments ultimately fed into the decision of the U.S. Federal Drug Administration to approve one of the vaccine compounds.

These varied norms of experimentation create a discourse in which it becomes more acceptable to expose those caught in humanitarian disasters to risky experimentation. Such a discourse naturalises the view that those lives do not require the same level of protection as others. Importantly, again following Jacobsen, even successful experiments contribute to this discourse. Since outcomes are inevitably uncertain at the time the decision to experiment was made, people were still exposed to risks considered to be unacceptable elsewhere. The political implications of this are already stark, and become even more so when experimentations, such as in the vaccine example and also the experimental use of biometrics, are trialled in humanitarian settings ahead of deployment in developed contexts.[40] Following Marc Duffield, a consistent critic of the humanitarian governance regime, "In practice, the global South currently functions as an unregulated commercial laboratory for the development of smart technologies and data mining experimentation that would be politically difficult in the North."[41] This is a particularly thorny balance. Field-level experimentation is critical to the innovation process; it would be equally immoral to deploy untested technologies in disaster settings. Furthermore, innovation – itself arguably an ethical requirement given the humanitarian aid shortfall – requires permission to fail.

One possible solution is a strict and standardised ethical review process. Some agencies already conduct their own internal ethical reviews before permitting field-level experimentation.[42] Where possible, those reviews should be done in collaboration with state regulatory bodies, noting that in some instances state bodies can be biased or otherwise unreliable.[43] Together, these boards must review whether the experimentation is sufficiently warranted and the risks of testing are reasonable, understood, and appropriately consented to by test subjects.

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[40] Jacobsen, *Politics*, 76-7

[41] Mark Duffield, "The resilience of the ruins: towards a critique of digital humanitarianism," *Resilience: International Policies, Practices and Discourses* 4, no. 3 (2016):158

[42] Doris Schopper et al. "Research Ethics Review in Humanitarian Contexts: The Experience of the Independent Ethics Review Board of Médecins Sans Frontières," PLoS Med 6, no.7, (2009), http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1000115

[43] Ibid.

BALANCING THE NEEDS OF DISASTER RESPONDERS WITH THOSE OF DISASTER-AFFECTED POPULATIONS

Several new technologies promise to simplify the work of humanitarian organisations. Given the overwhelming level of need that aid agencies currently face, this is welcome. However, due to particular experiences of disaster-affected populations, or the politics surrounding their reasons for fleeing, those benefits for aid agencies can bring risks for those they seek to help.

Collecting refugee biometrics in Lebanon and perceptions of safety[44]

In Lebanon, the United Nations High Commissioner for Refugees (UNHCR) has used iris scanning to register and support refugees fleeing Syria. In order to improve coordination with the Lebanese host government, the UN agency discussed sharing its biometric refugee database with them. This prompted serious concerns among refugees that the data would subsequently be shared with the Syrian government. For those who had fled from areas outside of the Syrian government's control, this could have implications on their safety and their willingness to return. At stake here is a balance between gains in accountability and easing administrative burdens, and the actual or perceived security of people receiving aid. It is instructive in this regard that some refugees reportedly chose to forgo aid rather than provide biometric data.

In assessing this example, it is important to consider previous UNHCR practices for registration ahead of status determination. These could be as invasive as searching luggage and clothing, and involve the uncomfortable practice of separately interviewing family members, including sometimes young children, to establish credible evidence of origin, nationality, or other crucial details. Biometrics reduces these practices and benefit refugees and asylum seekers. In so far as it more easily permits the verification of legal identity, it likely also facilitates access to services, education, and other opportunities, and indeed community life, at least within the current refugee governance regime. But the trade-off with security is a complicated one, and agencies face a clear conflict of interest in trying to make this balance given the benefits they accrue, on top of the challenge of understanding the experiences and security concerns of refugees.

[44] Gilman, *Cyber-Warfare*, 7; Jacobsen, Politics, 78

The duality of some technologies can make understanding the experiences of communities a particular imperative when considering if and how to deploy those technologies. UN OCHA notes that communities may presume UAVs represent a threat to them, particularly if they have previous experience with militarised UAVs, or if their relations with local actors possessing UAVs have been antagonistic.[45] Research conducted in Pakistan highlights how those living in areas where military drones are active already take precautionary measures like keeping children home from school and limiting time socialising. It also notes important questions relating to the mental health impact of increasing the number of UAVs in such contexts, even for humanitarian purposes.[46] Other writers suggest UAVs in themselves can cause significant levels of stress even without prior experience of their military uses. This is argued to stem from the inherent inability to engage with, and relate to, such machines, which exacerbates feelings of being out of control that can underlie mental trauma.[47] Local experiences and perceptions of technologies must be understood before deploying them in a humanitarian response. This will help mitigate the risk of unwittingly increasing mental health concerns.

This issue arises again with biometric technologies, as the Kenyan case below demonstrates. This stems from the relative importance given to individual privacy and surveillance, which varies between polities globally.

Local values and collecting biometric data in Kenya[48]

In June 2013, UNHCR and the World Food Programme (WFP) began using biometrics to distribute material assistance in Kakuma Camp in the northwestern region of Kenya. The collection of fingerprints was made mandatory for receiving food aid, despite resistance to a previous attempt to deploy a similar system in 2007. This followed abuse of the prior ration card-based system in which some refugees were reported to have several cards, trading the excess aid they subsequently received with others in the camp or among the host community. By tracking and

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45 Daniel Gilman, *Unmanned Aerial Vehicles in Humanitarian Response*, (Geneva: OCHA, 2014), 11, https://docs.unocha.org/sites/dms/Documents/Unmanned%20Aerial%20Vehicles%20in%20Humanitarian%20Response%20OCHA%20July%202014.pdf

46 International Human Rights and Conflict Resolution Clinic (Stanford Law School) and Global Justice Clinic (NYU School of Law), *Living Under Drones: Death, Injury and Trauma to Civilians from US Drone Practices in Pakistan* (September 2012), http://chrgj.org/wp-content/uploads/2012/10/Living-Under-Drones.pdf

47 John R Emery, "The possibilities and pitfalls of humanitarian drones," *Ethics & International Affairs*, 30, no. 2 (Summer 2016): 162-4

48 Kanere, "Classified Fingerprinting," *Kakuma News Reflector, A Refugee Free Press*, 30 November 2013, http://kanere.org/2013/11/30/classified-fingerprinting/

confirming the identities of aid recipients through biometrics, UNHCR is reported to have sought to increase transparency and administrative efficiency. Refugees, however, resisted the programme again, reporting that they felt harassed and demeaned by the process.

Such mandatory data collection raises the additional issue of consent. Noting particularly the vulnerability of people caught in humanitarian disasters, the Signal Code seeks to create a right to agency over data, acknowledging that the person most likely to understand the risks represented by the collection of certain data about them is that person herself.[49] In one example, Amnesty International's 2007-2008 "Eyes on Darfur" campaign, which sought to raise public visibility of attacks on villages in the south of that Sudanese region, is thought instead to have actually increased the violence in those places it was monitoring.[50] In essence, the government is argued to have perpetrated more attacks on places mentioned by Amnesty in retaliation to its advocacy efforts. It is not unreasonable to assume that the inhabitants of those villages, with their lived experience of relationships with government authorities and their militias, would have predicted such an outcome.

Obtaining informed consent to use data can be complicated. First, there is very little opportunity to gain permission to use remotely collected data, such as that collected by satellite. This underscores the delicacy of the Amnesty example above. Second, if data suggest a need for urgent action – a likely consideration in the humanitarian sector – there may not be time to get necessary consent. Third, how sure are we that those consenting understand enough about digitised data – the ease with each it can be shared and replicated, and the precedents that exist of data being leaked or stolen – to consent to its collection? The implications of gathering vast amounts of digital data are still not fully understood even by those amassing it. Consider the "mosaic effect" phenomenon, in which it has been shown that individuals can be re-identified from a surprisingly small number of disparate anonymised data points.[51] The power of this effect is still not sufficiently understood, leaving critical questions unanswered about the provision of properly informed consent even amongst digitally literate individuals. Decisions on which technology-based systems to use in the administration of aid must be sensitive to these practical and political questions.

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49 Greenwood, *The Signal Code*, 17

50 Grant Gordon, "Monitoring Conflict to Reduce Violence: Evidence from a Satellite Intervention in Darfur," (2016), http://www.grantmgordon.com/wordpress/wp-content/uploads/2010/06/GG-EoD.pdf

51 Daniel J. Solove, "Privacy Self-Management and the Consent Dilemma," *Harvard Law Review* 126, no. 7 (2013): 1880–1903

BALANCING CENTRALISING DISASTER COORDINATION AND FACILITATING INDIVIDUAL AUTONOMY

Several new technologies have the exciting potential to increase the autonomy and decision-making power of individuals caught in disasters. This stems from their ability to make more information available faster and in formats that are easier to assimilate. Open source mapping software like Ushahidi has been used in several crisis responses including following the earthquakes in Haiti in 2010[52] and in Nepal in 2015.[53] Its capacity for providing real-time information on evolving situations puts more critical data within reach of individuals caught in those disasters than any previous disaster communication medium. When speed makes a crucial difference in terms of lives saved, improving the ability of people in danger to mitigate the risk they, their family, and their community face before outside help arrives is extremely valuable.

Real-time disaster mapping in Indonesia[54]
PetaBencana is a publicly available crowd-sourced flood mapping platform providing real-time updates regarding flooding situations in Jakarta and other cities in Indonesia. Members of the public provide reports on water levels in their respective neighbourhoods via text messaging through their mobile phones or through social media, which are directly uploaded to the mapping interface. These reports inform residents' decisions on protecting their property (e.g. moving belongings to a higher floor) or whether they should consider temporarily relocating elsewhere. If they do choose to move, it further indicates the best route for doing so. Similarly, the platform assists citizens in Jakarta to identify areas to avoid as they plan their movements in, out, or across the city. This can also assist emergency vehicles moving into affected areas, as other road users will already have been warned away from certain streets.

52 Ushahidi Staff, "Crisis Mapping Haiti: Some Final Reflections," 14 April 2010, https://www.ushahidi.com/blog/2010/04/14/crisis-mapping-haiti-some-final-reflections

53 Angela Oduor Lungati "Status Update regarding Ushahidi Deployments for Nepal," 29 April 2015, https://www.ushahidi.com/blog/2015/04/29/status-update-regarding-ushahidi-deployments-for-nepal

54 OECD, "Case Study: PetaBencana.id," *Embracing Innovation in Government: Global Trends*, (Paris: OECD Publishing, 2017), 23-6, http://www.oecd.org/gov/innovative-government/embracing-innovation-in-government.pdf

New technologies are also being trialled to improve access to information about available services. Research suggests this is a crucial problem in contexts of displacement, especially in non-camp settings where there is extremely limited opportunity to distribute information from a centralised location.[55] Chatbots can run on platforms that refugees are often already using specifically to source information, such as Telegram and Facebook.[56] They can engage in simple conversations that prompt users to frame their needs in standardised formats that allow the software to navigate a logical decision tree. The programme then asks predetermined follow-up questions until the specific needs are determined. At that point, the chatbot can share information regarding services available for that need – perhaps the location of a clinic, a child safe space, or a shelter with open beds. The interactivity of these programmes makes them a far better source of information than previous passive ones, such as organisational literature, online publications, or public announcements.

Collecting and sharing data about available refugee services[57]
The World Food Programme's (WFP) mobile Vulnerability Analysis and Mapping (mVAM) project is currently working on a prototype chatbot capable of both collecting data and dispensing information, called "Food Bot". It currently runs only on Facebook Messenger – a platform selected as it is commonly used by people WFP assists – but in principle, once perfected, can be hosted on other platforms too. In addition to running through a pre-determined set of questions designed to help assess general food security, the chatbot can respond to enquiries from users, provide information to users on WFP programmes, food prices, weather updates, and advise on nutrition and disease prevention.

These new technologies have significant potential to support individual autonomy, but only if electricity and communications networks are available. This cannot be relied upon in a disaster setting. There are two elements to resolving this challenge: one is technical and the other is policy. On the technical side, several temporary solutions are available in the form

55 Ground Truth Solutions, *Refugee, Asylum-seeker and Migrant Perceptions Survey Report*, 25 August 2017, http://groundtruthsolutions.org/wp-content/uploads/2017/08/Ground-Truth-survey-report-Izmir_08_2017.pdf

56 ICRC, The Engine Room and Block Party, *Humanitarian Futures for Messaging Apps*, January 2017, https://shop.icrc.org/humanitarian-futures-for-messaging-apps.html?___store=default

57 Jean-Martin Bauer et al. "Our experiment using Facebook chatbots to improve Humanitarian Assistance," *ICT Works*, 7 August 2017, https://www.ictworks.org/2017/08/31/how-can-chatbots-help-us-respond-to-humanitarian-crisis/

of self-sustaining micro-grids, or easily deployable solar panels to create off-grid electricity generation.[58] Meanwhile, trials with UAVs carrying payloads have demonstrated their ability to repeat broadcast signals over wide areas. Due to their capacity for rapid deployment, and, in the case of rotary-winged UAVs, remain in one place, they are able to relay a steady signal over a substantial area. In one test, UAVs were found capable of broadcasting Wi-Fi signals over an approximate three-mile range.[59] Other possibilities include carrying radio signals to ensure continued transmission of emergency messaging, IP network relays that can allow for data and voice communications, or cellular signals.

Balloon signal relay providing mobile network in Puerto Rico[60]
At the time of writing, Google's parent company, Alphabet, is deploying Project Loon to Puerto Rico following two hurricanes that have left more than 90% of the U.S. territory without mobile phone coverage. Project Loon uses solar powered balloons to relay the mobile phone signals of local carriers, restoring both voice and data services to people's existing mobile devices. Each balloon operates from an altitude of approximately 20 kilometres, from which it can cover an area of 5,000 square kilometres by relaying communications from ground stations connected to any surviving network with the permission of network operators.

Realising the potential benefits of information decentralisation also requires the prioritisation of electrical and communications infrastructure repair, or interim solutions until infrastructure is fixed. This is a policy question. For example, following Typhoon Haiyan in 2013 and Typhoon Lando in 2015 in the Philippines, one Philippine communications company set up several charging stations across disaster-affected areas, allowing people both to charge their devices and make calls for free.[61] This reframes utilities as an emergency need and providers as humanitarian responders. It also incorporates their work as among the first activities to be undertaken in the disaster response phase. This would be an important point to counterbalance

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[58] Joseph Franceschi et al. "Off-grid solar PV power for humanitarian action: from emergency communications to refugee camp micro-grids," *Procedia Engineering* 78 (2014): 229-235

[59] American Red Cross, *Drones for Disaster*, 20

[60] Mark Harris, "Alphabet closer to using balloons for telecom in Puerto Rico," *Wired.com*, 6 October 2017, https://www.wired.com/story/google-closer-to-using-balloons-for-telecom-in-puerto-rico/

[61] Rosette Adel, "Smart sets up free calls, charging stations in Lando-affected areas," *PhilStar*, 20 October 2015, http://www.philstar.com/business/2015/10/20/1512865/smart-sets-free-calls-charging-stations-lando-affected-areas;

the prioritisation of a sufficient communications network specifically for disaster responders.[62] While these two communication imperatives are both significant, it may now be more important to prioritise communications capabilities for disaster-affected groups in light of the capabilities new technology now afford them.

[62] Michael Lochinvar Abundo, "Energy in Post-Disaster Scenarios: Insights on appropriate technologies and initiatives," in Alistair D. B. Cook and Ennio V. Picucci (eds), *Humanitarian Technology Survey*, (Report, Singapore: RSIS Centre for NTS Studies, 2017): 20

CONCLUSION

In the context of the current "innovation turn" in humanitarianism, this paper has used existing literature on new technologies in disaster settings to highlight four balances that must be struck when deploying new technologies as part of disaster response. These balances were between the humanitarian imperative and other public goods, between short- and long-term interests of those affected by disaster, between the needs of disaster-responders and disaster-affected, and between centralised coordination and individual autonomy. There are two principal conclusions to highlight.

First, while notable progress has been made, successfully incorporating many of these new technologies into disaster response still requires investment, especially from state regulatory bodies. From the UAV, additive manufacturing, and data technology examples, it is clear that significant work remains to ensure that appropriate regulation is in place to protect other public interests and locally held values. While that remains paramount, those rules must also be clear enough to ease compliance, and light enough to allow the flexibility disaster response requires.

Second, while more field-level research on this is required, the resemblance between the challenges presented by the four balances discussed and the general criticisms levelled at the aid industry over the last twenty-five years is striking. While many promise short-term benefits for those in need of urgent help, some, particularly those raising questions of privacy or experimentation, may also bring problems to those same people over longer time horizons. This recalls older critiques that humanitarian aid can exacerbate economic under-development and political marginalisation.

There are also several familiar conflicts of interest for aid agencies, with some technologies appearing to serve their own and their donors' ends more than those of the people they seek to help. As was highlighted in the case of biometrics and the mental health implications of UAVs, they may even diminish the latter's security or well-being, or otherwise ignore their values and preferences. The natural counter-argument that improvements in efficiency mean more people are registered and more aid reaches those who really need it still entails a questionable balance of competing interests. It also underscores that this balance is made by humanitarians who will not shoulder ensuing risks, and whose work is made easier by the technologies under consideration. This power discrepancy between aid receivers and aid providers, underscored further by the examples with call data records, again fits with familiar criticisms of aid in general.

This reproduction of familiar critiques may not be surprising. New technologies entering humanitarian operations largely do not engage the fundamental problems identified in the humanitarian sector over the last twenty-five years. Improvements in data gathering, processing, and analysis exemplify this. The humanitarian sector is often unable to act on data it already has. At the time of writing, more than half a million Rohingya people have fled from Myanmar into Bangladesh following renewed violence in the Rakhine state. This is a relatively simple datum communicating substantial needs, but it has thus far proven impossible to mount an adequate aid response. Similarly, the inhabitants of Puerto Rico spent almost a week without power and with growing concerns about drinking water, and yet inadequate assistance again was deployed. Yemen is currently facing the world's worst cholera outbreak with more than 600,000 suspected cases, exacerbating a pre-existing nutrition crisis; again vastly inadequate humanitarian assistance has been offered. But these failures are not technological; they are political. Therefore, perhaps it is to be expected that the political challenges facing humanitarianism in general will reproduce themselves in discussions of the humanitarian uses of technology. Importantly, this does not necessarily mean these new technologies lack merit. However, as this paper has highlighted, significant challenges remain, and crucially technologies appear unlikely to achieve the transformational change that some appear to anticipate. This is likely also to apply to other current and future technologies that do not engage with the enduring problems and tensions identified in humanitarianism.

Some new technologies do engage with these core criticisms. Data-based innovations that promise to increase the autonomy and decision-making capacity of disaster-affected people clearly challenge the potential instrumentalisation of centralised aid and the exacerbation of power imbalances. Beyond being valuable in an intrinsic sense through buttressing the individual agency of disaster survivors, these technologies have merit in an instrumental sense through maximising the capacity of survivors to mitigate their own risks and make better informed decisions. Here, this paper suggests, optimism is more warranted.

POLICY CONSIDERATIONS

In regional/multilateral bodies:

- Promoting common measures and classifications for new technologies to ease compliance through expert working groups.

In governments at national level:

- Establishing clear regulations for using new technologies in disaster contexts. This requires consultations with technology experts, humanitarians, military representatives, and members of civil society. This must balance fast and flexible humanitarian deployment with other public goods such as public safety, security, and protection of property.
- Guiding humanitarian responders on the circumstances in which values like individual privacy may be sidelined during disasters. Again, this will require consultations with humanitarian stakeholders, the judiciary, and civil society.
- In emerging innovation hubs like Singapore, the design and testing of new technologies for humanitarian settings should be coupled with research into the particular risks and challenges such contexts pose, building on those identified in this paper.

In humanitarian organisations:

- Setting up accountability mechanisms through which collection and storage of data can be challenged and, if appropriate, rectified.
- Initiating industry-wide qualifications for data handling. These can draw on standards and protocols in the International Committee of the Red Cross's *Handbook on Data Protection in Humanitarian Action*, and the Harvard Humanitarian Initiative's *Signal Code*.
- Instituting a strict and standardised ethical review for testing innovations in humanitarian settings. This must include local regulatory authorities and representatives for the population affected. It must ensure meaningful consent is obtained, and a realistic opportunity to refuse to take part.
- Ensuring that innovations are people-centric. This means not exposing disaster-affected people to added risk, or overruling their values, wishes or experiences, for benefits that predominately fall on donors or humanitarian organisations themselves.
- Obtaining meaningful consent before collecting data. This ensures respect for autonomy, and helps mitigate risks that humanitarian organisations may not appreciate but the population affected does. Concordantly, extreme care must be exercised when using data for which consent could not be asked.

In humanitarian organisations and states:

- Prioritising electrical and communication infrastructure restoration, and implementing interim solutions in disaster response. This maximises the capacity of disaster-affected people to use new data and communications technologies to mitigate the risks they face while waiting for help to arrive.

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