"We Live on Hope..."

WANG

Ethical Considerations of Humanitarian Use of Drones in Post-Disaster Nepal

Ning Wang

Digital Object Identifier 10.1109/MTS.2020.3012332
Date of current version: 2 September 2020

As international humanitarian assistance from governments and private donors continued to increase in recent years, the pace of growth, however, has slowed down [1]. For instance, in 2018, while US$17.0 billion out of US$28.1 billion funding was committed to UN-coordinated appeals, there was still a funding shortfall of US$11.1 billion, with only 61% of requirements met [1]. Against this backdrop, international organizations are increasingly implementing innovative solutions to respond the needs of affected communities [2], [3]. Many of these solutions involve the use of digital technologies, such as geographic information systems (GIS), robotics, spatial decision support systems, and unmanned aerial vehicles, also known as drones [4]. Although drones are not the first use of robotics in commercial and industrial settings, the humanitarian use of drones represents the first wave of robotics applied in the aid sector, and is

representative of emerging technologies being used for humanitarian purposes [5]. Examples of successful drone use in this setting include the 2010 Haiti earthquake (damage inspection), 2012 Hurricane Sandy in the U.S.A. (epidemic prevention), 2013 Typhoon Haiyan in the Philippines (rescue logistics), the 2014 Ebola outbreak in West Africa (medical equipment delivery), and the 2015 Nepal earthquake — the site of this case study — when Nepal was stricken by one of the most devastating natural disasters in history, leaving the country with heavy burdens of immediate emergency relief and long-term post-disaster reconstruction [6]–[8].

Several authors have suggested that the use of novel technologies in the aid sector may challenge the principle of humanity, and the related humanitarian principles, such as "Do No Harm" [9]–[11]. The noticeable turn to technology in humanitarian action raises issues related to humanitarianism, sovereignty, as well as equality and access for at-risk populations in disaster zones or remote areas lacking sufficient healthcare services [11], [12]. On a technical level, practical challenges include heightened risks of data safety and security, and the potential malicious use of technology. On a societal level, humanitarian innovation may disrupt relations between different stakeholders, may widen inequality between those with access and those without, and may threaten privacy, disproportionately affecting the vulnerable population.

This paper constitutes one element of a research project that examines technological innovation in the aid sector and how it intersects with moral values, norms, and commitments. As part a series of field studies of different uses of drones by humanitarian organizations, we conducted an in-depth case study following the 2015 Nepal earthquake. An earlier paper presented a detailed narrative account of the case study, in which drones were used to map a landslide area in rural Nepal [13]. The current paper draws upon the empirical findings to develop a normative analysis with the goal of identifying contextualized ethical considerations, and illuminating the wider debate about how ethical technological innovation in the aid sector should be operationalized. The paper comprises two parts: 1) a short summary of the case study of drone mapping in a landslide area in rural Nepal, where the livelihood of the local community was threatened by the 2015 earthquake, and a humanitarian organization, assisted by the use of drones, attempted to find a solution to restore safety; and 2) an in-depth analysis of the ethical challenges that emerged in the context of the case study, relating to five thematic categories: community, technology, data, regulation, and stakeholders. In conclusion, on the normative level, a prudent attitude in adopting novel technology in the aid sector is required; while on the operational level, it is argued that proposals for actionable ethical standards to guide and safeguard sector-wide innovation practices are needed.

Case Study

Drone Mapping Project

On April 25, 2015, a magnitude 7.8 earthquake hit Nepal with a maximum intensity of VIII. Amidst the post-disaster chaos, many humanitarian organizations drew upon technologies to assist their relief work on the ground, opening a gateway for new and emerging technologies to enter the humanitarian space [4]–[6]. This situation was illustrated in an earlier paper, in which a case study of using mapping drones in a landslide area in rural Nepal was described in great detail [13]. In this case study, a humanitarian organization X needed to assess safety for reconstruction work in the landslide area but faced challenging geological conditions, and opted for using drones to capture high-resolution aerial images of the area for further hazard analysis as part of its risk-reduction assessment [13]. To handle the technicalities of the project, X collaborated with an NGO (Partner A), which was actively involved in previous crisis drone-mapping in the Philippines; and a university spinoff (Partner B), specializing in geological risk assessment software engineering [13]. To receive government and community permissions, X obtained a total of six approvals to use drones, from four government authorities at national level and two at district level, taking a total of three months [13]. X also worked actively to gain community consent, whereby information sessions with community members and meetings with community leaders were organized [13]. Eventually, a high-resolution map using the drone images was created, following which Partner A developed a 3D model, and Partner B studied the susceptibility of the landslide to further erosion and submitted a technical report to X [13]. The main conclusion was that, to gain a thorough understanding of the risks, more research and data were needed [13]. Although X was the official owner of the datasets, data ownership was in principle shared by the three project partners, alongside the national government [13]. The community's expectations that the drone data could be used to enable the management of the landslide were not met, while X had to end the project due to the lack of continued funds, among other reasons [13]. There was a general perception within the community that, while the project created value with respect to evidence and awareness-raising, it was inconclusive; and that to make substantial impacts on the local community's livelihood, more efforts would be needed [13].

Research Methods

Research Design

The case study was carried out in Nepal in January 2019, as part of a larger program on "value sensitive humanitarian innovation (VSHI)" consisting of multiple case studies. The research was conducted within a constructivist paradigm, in which human experience is understood as subjective, local, socially and experientially based, and culturally and historically specific [14]. Study design drew upon case study methodology, and we employed *qualitative description* as our methodological framework, which aims to gain first-hand knowledge of stakeholders' experiences, and describe their views and perceptions of a particular topic in a language similar to their own [15], [16]. The objective of a qualitative description is to stay especially close to the data itself, developing a low-inference analysis by directly organizing and synthesizing data without further interpretation [16].

Participant Recruitment

We recruited interview participants using two approaches. First, guided by an Interview Plan, we sent email invitations to targeted stakeholder representatives, which were jointly identified by the research team and our local partner in Nepal. We initially recruited six individual participants, including four humanitarian workers (at international, national, and field levels), one technician, and one government official (elected community leader); as well as two focus groups of local community members (twelve villagers in total). All initial participants were involved in, experienced, or witnessed the drone mapping project.

Second, following *snowball sampling logic*, we recruited further participants through recommendations of previous participants, to expand the scope of investigation and gain complementary and contextualized data. The further recruitment included two aviation regulators and one academic with expertise in geospatial information systems, none of whom were directly involved in the mapping project, but all of whom had extensive knowledge and experience in drone mapping in Nepal. The final sample of 21 participants consisted of a diverse representation of stakeholder groups engaged in the drone mapping project, meeting our goal of acquiring maximum variation sampling to explore the common and unique perspectives on the subject [17].

Data Collection

Our main data collection was semi-structured qualitative interviews with recruited participants upon their provision of written informed consent. Other sources included texts (e.g., the report Partner B provided to X), and observations by the author (e.g., how X interacted with the community members), who carried out the field study in Nepal as the principal researcher. Two types of interviews were conducted — those that followed an Interview Guide, which was developed prior to the field study based on expert knowledge; and free-style thematic discussions, which involved more in-depth explorations of selected topics (e.g., the post-earthquake regulatory environment in Nepal, the technicalities of drone mapping, etc.). Ten interviews were conducted between January 16 and January 31, 2019 (eight individual and two focus group interviews). All interviews were conducted face-to-face and were audio-recorded, ranging from 39-151 min in duration (average 86 min). The individual interviews were conducted in English; and the focus group interviews with the community members were conducted in the local dialect, with translation provided by our local partner.

Data Analysis

Based on the interview recordings, and with reference to the available texts and observations, we developed Interview Synopses, which were then compared with interview notes taken by the author during the interviews. Through this process, core concepts were clustered in categories and extrapolated by themes for further analysis. Ten interview synopses were developed with the support of a research assistant, based on which a comprehensive descriptive summary of the interviews was developed by the author. The summary was then sent to an anonymous reviewer, who was involved in the mapping project but not interviewed (due to potential conflict of interest), to ensure that it was factually accurate and complete. This analysis was then used as the basis for developing a detailed narrative account of the case study, which was presented in an earlier paper [13]. In the current paper, I build on the empirical findings from the case study to elaborate on an in-depth ethical analysis.

Ethical Analysis

From the ethical perspective, while no severe ethical tensions, trade-offs, or dilemmas are observed in this case study, there are ethical considerations related to consent, expectations, priorities, and responsibilities among the involved stakeholders. Through an inductive analysis of the empirical data acquired through the fieldwork, five categories of ethical considerations were identified. In the sections that follow, I present a normative analysis of how these categories were manifest in the drone mapping case, and consider them in relation to relevant ethical concepts and the wider academic literature.

Community: Consent and Care

X followed a deliberative consent process by providing necessary information to the community members through information sessions, and by acquiring consent from the community leaders elected to guard the villagers' interests. Although their rights over the land were respected, the community members are still in a vulnerable situation. This is because while X did the right thing to gain community consent for conducting activities over their land by following the procedure; normatively, the core issue is not solely how community consent was acquired, but what led to such consent, and what resulted from such consent. In other words, two additional aspects need to be considered, i.e., the sources and the consequences of the acquired community consent [13].

The first aspect relates to where the consent comes from. Firstly, throughout the interviews, "trust" was repeatedly mentioned by stakeholders, including both community members and those who were involved in working with the community. In fact, according to our interviews, this trust had little to do with the mapping project itself; rather, it was built upon prior experiences between X and the community, and an idealistic understanding about aid agencies altruistically delivering aid to beneficiaries. This implies that, to some extent, trust was pregiven regardless of the specificities of the mapping project, as opposed to newly established taking into account the risks and benefits of the project. Trust is a complex philosophical conception, as the very nature of trust inevitably involves risk (associated with optimism), vulnerability (in particular to betrayal), and even harm (as a result of selective interpretations) [18]–[20].

Secondly, "hope" was another recurrent word frequently popping up from the interviews, conveying the deep faith and optimism of the community towards those whom they believed to be change-enablers. Within the community, there seemed to be a commonly shared sense of frustration at their inability to self-save, alongside a recognized need for, and dependence on, lifesavers from outside. Torn by perennial threats of social problems mixed with natural disasters, the community members could afford little but a genuine hope. Lastly, the community members' literacy level, including both general and technological literacy, renders it difficult for them to understand the potential risks, begging the question as to what exactly the community members had consented — to what they were able to understand, or to what they were expected to understand? These factors might have created communication gaps between X and the community with respect to the expectations of using drones in the community.

The second aspect concerns where the consent landed eventually. Firstly, based on the aforementioned factors, it is plausible that there might have been a philanthropic misconception embedded in the community's general understanding about the purpose of the mapping project. Philanthropic misconception (akin to "therapeutic misconception" in research ethics) is closely linked to the notion of trust, and in particular its optimistic nature [21], [22]. Such misconception typically occurs when beneficiaries of philanthropic projects entrust those who exhibit good will or benevolence towards them, thereby misunderstanding the purpose of the activity, while overestimating the intended benefits or underestimating the potential risks [22]. In the context of this case study, it seemed that, for the project partners, there were two sets of objectives, i.e., in the short-term, the project was intended to produce a high-resolution map of the landslide using drone images; in the long-run, and granted that all other conditions would be met, the mapping results could potentially contribute to managing the landslide. What is unclear, however, is whether the community at large had built their expectations in alignment with these objectives; and if not, what might have created a mismatch between the two. This implies that the account of philanthropic misconception concerns how goodwill ought to be interpreted, in that reliance on goodwill creates certain expectations, sometimes even normative — rather than merely predictive — expectations [21], [22].

Secondly, a broader question worth asking is what would follow if community expectations fail to be satisfied, and community relations are negatively affected due to misconceptions. Ultimately, this invokes a discussion about the moral responsibility of the aid sector — in particular, the duty of care towards vulnerable communities. The humanitarian sector is sensitive politically, socially, and culturally. The proposals for innovation in this sector, thus, must be guided by rigorous evaluations of the necessity for innovation. In particular, the way in which information is transmitted, the extent to which the conveyed messages may be (mis) interpreted, and the direction towards which expectations are channeled, are all pertinent aspects that humanitarian organizations need to carefully consider before introducing technology in their operations. A benchmark of the humanitarian duty of care should be not introducing new vulnerability, and not exacerbating existing vulnerability.

Technology: Risks and Benefits

Risks are inherently imbedded in any kind of technology. As a tool or an instrument, there are technical limitations in terms of mechanical errors; and as a convention or an institution, there are societal implications in that technology is neither value-neutral nor apolitical, in terms of both its design and its use. As the

case study demonstrates, drone technology holds promise in assisting humanitarian action in counties like Nepal. Nonetheless, technology alone cannot change things for the better. Recognizing technological limitations also entails practical implications, i.e., stakeholders need to proactively conduct risk-benefit assessments within particular contexts, prior to the deployment of new technology in their practice [13].

On the technical side, although drone technology is evolving at a rapid pace, how it can be utilized depends considerably on the level of development of the technology. To illustrate, in terms of quality of information, a collection of sensors may be installed on drones to achieve richer data in mapping, such as laser scanning or environmental sensors. However, there is an inevitable tension between the quality of images collected by the sensors on the one hand, and the increased payload and the decreased battery life of the drone on the other. As regards types of drones, taking the case study as an example, if X had used multi-rotor drones, then the chances of technical failure would have been reduced, as the technicians could have fully controlled the drone. This, however, would have resulted in a technical compromise, whereby the data captured would not have been as accurate as that of fixed-wing drones as a result of flight stability. These technical trade-offs highlight the fact that technology alone cannot provide solutions to social problems as it is inherently inhibited by its own technical limitations.

On the societal side, questions about for what purposes drones are deployed, in what conditions they will be used, and in what contexts their use is justified, should be placed at the center of a risk-benefit analysis. In many disaster settings, drones have effectively helped emergency relief and aid delivery in a timely manner [23]. In other circumstances, however, drones have created public safety concerns associated with near-airport drone flights [24], [25]. As a rule of thumb, deploying technology in the aid sector needs to be backed up with a strong rationale and justified with reference to the added value. This will make a difference in terms of how the general public perceives humanitarian technology — as a positive force for change that enables previously unattainable prospects, or as an anecdote that draws media attention and costs donor funds, yet leaves fundamental problems unresolved. The questions remain, hence, as to why and how technology is being utilized in this space, at what cost, benefiting whom, and whose responsibility it is when things go wrong.

Finally, regarding risk-benefit assessments, the key is conducting them critically in light of the context in which technology is to be introduced. Since 2015, the number of activities involving drones in Nepal grew at a frenzied pace due to an increasing demand for reconstruction after the earthquake. Consequently, some humanitarian organizations operating in Nepal prematurely followed the trend, and raced into uncritical integration of new technologies in their operations [26]. By projecting themselves as "tech-friendly," these organizations attempted to convey the message to donors and the public that they were committed to finding innovative solutions to tackle longstanding development challenges. Granted that post-disaster relief is time sensitive, and that new technologies are increasingly used in diverse settings including the aid sector; still, the mentality of finding the "silver bullet" risks blinding practitioners as to where the matters of concern lie, and how the priority of the agenda should be set. As observed by scholars, the "technological turn" in the humanitarian space has reshaped perceptions about what aid is, and redefined the meaning of aid provision in the digital age, i.e., technology mediates human relations and understandings of what protection consists of [9]–[12]. In countries like Nepal, an overwhelming emerging demand for technical expertise may put pressure on steady and sustainable technology development, resulting in a distorted dynamic in society, whereby technological advance appears hasty and aggressive, while the society's social, economic, and political growth lags far behind.

Data: Safety and Security

Closely related to the technology aspect, in the case of mapping drones, is the data aspect. If data safety and security are compromised, risks and harms are heightened for those whose data are at stake, potentially rendering the already vulnerable worse off. In our case study, the datasets produced have been stored relatively safely, with defined ownership and controlled access among a small group of partners. However, the possibility of sensitive datasets being disclosed to, or misused by, external parties with non-humanitarian intentions, is not unconceivable. This potential risk suggests that data management measures should be set as a regulatory priority, such that operational guidelines can be developed to reduce potential risks and to prevent breaches of data safety and security from occurring [13].

The risks connected to data include three aspects: data collection, storage, and usage. Regarding data collection, which concerns privacy, those whose images are being captured in the data should be aware of what images are captured, why they are captured, and who is capturing the images. With respect to data storage and data usage, which link to data safety and security, it is crucial to understand where the data are stored, how they are stored, whether there is a data management protocol in place, as well as to know who owns the

data, who can access the data, who has authority to share the data, and what compliance mechanism governs if the data are to be shared. These questions may not seem difficult in principle, yet they continue to pose operational challenges. Ultimately, the question points towards, to what degree and level should we realistically aim for data accuracy — a cluster of households, a visible landmark, the color of the street graffiti, or the freckles on someone's nose?

In the mapping project of the case study, the images collected by the drone were left in the hands of all who had worked on, or been given access to, the datasets. This implies that, hypothetically, all of them could share the data with external parties. Moreover, there was no effective way to prevent anyone who had access to the datasets from making copies, or modifying or manipulating the data. Had the partner organizations or the technicians involved in the mapping project intended to share the datasets without X's consent, X would not have been able to discover, track, or manage it, as there was no compliance mechanism in place. This, in effect, leaves data safety and security dependent on the professional and personal ethics of those who have access to the data, downplaying the importance of institutional reforms at the structural level which require collective efforts.

The other aspect that concerned the partners of the mapping project was data sharing. Today, there are multiple organizations working on drone mapping in Nepal, sometimes mapping the same areas at the same time, because there is no coordinated data sharing mechanism. Technical experts in our interviews have suggested local governments take the initiative to set out mapping needs, then identify the agencies working on projects in that area to join forces in their initiatives. However, one obstacle is the lack of a digital management system at the national level. To date, all mapping data in Nepal are collected and managed in traditional ways, with no digital repository that allows for the monitoring and tracking of existing datasets. One way to move forward is to create and utilize open data platforms that will be publicly available and accessible, so that no repetitive data are generated as a result of lack of access. Reality, however, suggests that in the absence of adequate infrastructure, open data may be a far-fetched ideal in resource-poor countries like Nepal.

Regulation: Authority and Procedure

It is a common concern among drone stakeholders that the lack of effective regulatory mechanisms creates ambiguity in operations. In the case of drones, regulatory issues include, e.g., who the lead agencies should be at the national and international levels, how compliance and enforcement mechanisms could be established, and what legal and administrative procedures should be set up. Unless these regulatory challenges are addressed, it is unlikely that there will be a safe and healthy environment in which society at large can manage technological risks, and the aid sector can drive its innovation process responsibly. In this sense, the regulation aspect is an overarching layer with a top-down force, which determines the scope and magnitude of the other sets of ethical challenges. In particular, two aspects need to be attended to, i.e., regulatory authority and provisions and procedures (13).

Regarding regulatory authority, there are two subdimensions, i.e., who the lead agency should be, and at what level it should be set up. In the context of Nepal, as the case study shows, several government authorities were involved in drone flight permissions, which created some obstacles. First, government officials at the Ministries have multiple commitments, and drones oftentimes are not a priority. Second, for many government departments, there is a general lack of in-house expertise in technology. Third, without clarity about the lead agency, authority becomes ambiguous and implementers are at loss to determine by whom and in what format initiatives should be organized. Take the Civil Aviation Authority of Nepal (CAAN) for example: as the only technical agency involved in drone regulations in Nepal, they are mandated to grant permissions only in terms of air traffic concerns, such as on which route and at what height the drone can fly. As regards national security, although CAAN is responsible for protecting sensitive and protected areas, they do not take into account the purpose of the drone flights. Similarly, concerning flight safety, although CAAN holds that drone pilots should be trained and licensed and be aware of the relevant legislation, it is not their duty to provide training and licensing services. While the creation of a lead agency may be a challenge for resource reasons, it is not unattainable to establish an independent agency that can coordinate with other agencies during the process of regulation development.

Alongside the "who" dimension of regulatory authority is the "what level" dimension. In the case study, stakeholders consistently advocated for the establishment of a global authority operating along the lines of the International Civil Aviation Organization (ICAO), which is the existing global regulatory agency for the use of flying objects, including drones. In the absence of a global authority dedicated particularly to drone regulations, national authorities follow the provisions of ICAO at present. However, stakeholders in our interviews expressed a strong preference for a drone-specific regulatory authority at the global level. Although streamlining authority may not be immediately feasible, efforts for bringing uniformity to regulatory initiatives across

the globe are called for. Regarding the nature of such a regulatory agency, stakeholders in our interviews generally favored that its staff members to be technical experts, such that future regulations will be based on technical rather than political parameters. Meanwhile, stakeholders suggested that a national expert committee could help provide inputs to global regulation development, and that if a global consensus for airspace regulation is sought, countries can adapt it to their particular situations and develop their own regulations based on the knowledge and experience acquired at the national level.

With respect to provisions and procedures, the biggest challenge seems to be how stringent compliance and enforcement mechanisms should be, such that they are robust while not hindering the development of the technology or oppress its applications for social good. There are two subdimensions to this challenge, i.e., that of the content, and that of the process. Content-wise, in Nepal, there already exist some regulatory guidelines. For instance, if a drone flies over a sensitive area, such as military installations or near airports, or flies above 300 feet beyond the-visual-line-of-sight (BVLOS), it can be seized and its operator fined. In reality, however, as long as no one reports it, the government can do little, as they do not have a digital tracking system that can monitor drone flights. This indicates how context-insensitive the provisions and procedures are, and how left-behind regulation is compared to the pace of technology development.

Process-wise, as shown in the case study, flight permission applications can be lengthy and complicated. Some stakeholders raised the concern that if it continues to take 4-5 months and 6-7 agencies to get flight permissions, then people will simply try to "cheat the system," and the authorities would have no control over this as, again, there is no digital monitoring system in place. In the mapping project, if there had been a lead agency serving as a central point of contact, it would have considerably shortened the flight permission process. Moreover, it was envisioned that if the Ministries could keep records of the technical specificities of existing drone use, such as ranges of frequency, it would largely simplify the administrative procedure. Another proposal for improving the process was the adoption of a licensing system similar to that of automobile, allowing only certified pilots to fly a drone. Regarding sensitive areas, signal blockers were deemed useful for restricting flights over special locations, and a buffer zone could be put in place around airports. According to technical experts in our interviews, these approaches have been discussed on various occasions with government officials in Nepal. Although none of the proposals are technically demanding or high cost, the challenge seems to be priorities. This implies that continued effort needs to be made to sensitize the authorities on the need to establish regulatory provisions and procedures.

Stakeholders: Responsibility and Accountability

An additional aspect of the humanitarian use of technology lies with stakeholder responsibility and accountability — not only regarding the deployment of technologies, but also towards each other. Like regulation, the stakeholder aspect is an overarching layer situated in the background, but with a bottom-up force. The danger of lacking a deep understanding of responsibility and accountability is that it creates a moral hazard, whereby stakeholders advocate the principle of "Do No Harm," while potentially causing harms to those whom they intend to protect by introducing new actors into the space without caution (15). Humanitarian stakeholders should clearly define their commercial incentives and operational priorities, meanwhile establishing ethical standards to guide and safeguard their innovation practice (13).

In terms of the responsibility of the government, in the context of the case study, this was somewhat ambiguous, due partially to its political priority-setting. For example, at the national level, the National Reconstruction Authority (NRA) acted as the lead agency after the earthquake to restore damaged houses, and conduct research on landslides in Nepal. Yet, when X proposed that the NRA incorporate this landslide area as one of their research sites, the proposal was dismissed — it was not a priority for the NRA as the houses in this area were not already damaged. At the community level, when X raised awareness about the increasing risks of the landslide, some community leaders did not see the immediate necessity for action as the landslide did not cause loss of life — how people's lives will be affected in the future was not seen as a priority for the present time. While humanitarian and development actors may assist in post-disaster reconstruction, their primary role is to coordinate aid delivery and provide technical expertise, rather than involving themselves in every aspect of reconstruction. Ultimately, it should be the local government and local communities who take responsibility to rebuild lives. The local government may lack resources; still, they can take the lead to establish evidence. And once resources are available, action plans can be implemented at the national and local levels.

With respect to the accountability of humanitarian organizations, the center of discussion is why they introduce new technology in their practice in the first place, and how to introduce it to vulnerable populations without causing harm. In the case study, the drone was not brought to Nepal for the specific

purpose of mapping landslides, but with an intention of potentially using it to assist relief work, implying a somewhat undefined vision. Thus it begs the question as to what exactly was the justification to use the drone — was it because of the availability of the technology? Was it guided by the understanding of local needs? Furthermore, after having decided to use the drone to map the landslide, achievement of the objectives still depended on many factors, in particular financial resources and political will; both were obviously challenging in Nepal. This, again, invites questions regarding the rationale of the project — was it overly ambitious, in that the intended outcome was predominantly determined by factors out of the hands of an aid agency? Was it overly optimistic, in that both the vision and the methodology of the project represented the best-case scenario? These reflections point out the importance of self-positioning of humanitarian organizations. Many aid agencies do not have the technical capacity to operate advanced modern technologies themselves, but they have strong relationships with the government and the community, which is appealing to other stakeholders as it may potentially help advance particular interests of their own. The question, ultimately, boils down to who benefits from such endeavors, if eventually there is no positive impact on the lives of the affected communities?

The responsibility of stakeholders does not lie solely on the service providers, but also on the receivers, namely the community. In the case study, the local community was unfamiliar with the drone technology initially; but when it was introduced in the name of helping manage the landslide, they believed that they needed it. Yet, their fundamental need was simply to live safely. Nepal has long been portrayed as a breeding ground for "humanitarian experimentation" in the name of innovation [4], [9]. The use of technology in the humanitarian space is neither good nor bad in itself, it depends on why and how it will be used [27], [28]. The rationale to use technology should not be determined from a donor perspective, whereby they experiment with ideas and test out new tools; but from a need perspective, whereby strategies are reflective and the local community's livelihood is catered to. This not only calls for humanitarian organizations to care for, and advocate on behalf of, the communities, but also encourages the communities to be aware of what is at stake, take ownership of it, and approach government authorities proactively. Although living with hope is praiseworthy, living on hope can be futile.

Finally, to substantively move forward in the process of humanitarian innovation, a pragmatic tool would be action-guiding ethical standards, e.g., on privacy, on data management, on informed consent, on stakeholder engagement, etc. At the outset, such standards need not be lengthy or comprehensive, and may not be immediately enforceable or endorsed by every stakeholder involved. Nonetheless, they create thresholds, form benchmarks, and clarify ambiguity. For instance, case studies encompassing best practices can be an effective instrument to educate regulators, and to help foster regulatory frameworks that are value-sensitive and context-specific. Similarly, multi-stakeholder consultation, including seeking expertise from outside the country and across sectors and disciplines, can contribute to the collection of inputs from diverse perspectives. Furthermore, local beliefs and indigenous knowledge of the affected populations should be respected and included in the standards, in that it is these people who are exposed to risks, harms, and vulnerability, and whom the humanitarian sector strives to protect. If the stakeholder aspect is attended to, the principle of "Do No Harm" will not be rendered a mere slogan or a moral disguise of those who drive the humanitarian innovation enterprise.

Humanitarian technological innovation may disrupt relations between stakeholders, widen inequality between those with access and those without, and threaten privacy.

Categories of Ethical Consideration

In this paper, an in-depth ethical analysis of a case study of using drones to assist post-disaster humanitarian work was presented. Five categories of ethical considerations were identified and are summarized in Table 1, along with lessons learned in relation to each theme. While these themes do not suggest a specific order of criticality, they are presented here with a bottom-up logic for ease of discussion.

To conclude, from the perspective of humanitarian action, it may seem that challenges exhibited in this case study are merely implementation issues "typical" to the aid sector when new technologies are deployed in time-sensitive and resource-constrained environments. However, from the ethical viewpoint, it is precisely this caution-free (mis)conception about "typical" that warrants attention — the seemingly non-harmful use of

TABLE 1. Five categories of ethical considerations.

Theme	Analytic Focus	Analytic Angle	Ethical Consideration	Lesson Learned
Community	• Consent • Care	• Procedure of consent • Sources of consent • Consequences of consent	• *Trust*: pre-given *vs.* newly established • *Hope*: need for aid & dependence on lifesavers • *Literacy*: what is expected to be understood *vs.* what is actually understood • *Philanthropic misconception*: unrealistic expectations & neglected communication gap • *Duty of care*: being vulnerable *vs.* being made vulnerable	• Identify communication barriers in the consent process • Evaluate the value and validity of consent • Assess the necessity of technological innovation proposals • Ensure new vulnerability is not introduced, and existing vulnerability is not exacerbated
Technology	• Risks • Benefits	• Technological limitations • Societal implications • Risk-benefit assessments	• *Technical tensions, compromises & trade-offs*: quality of information, types of technology, etc. • *Purposes, conditions & contexts*: why, how, at what cost, benefiting whom, whose responsibility, etc. • *Matters of concern*: "silver bullet" *vs.* fundamental problems • *Priority of the agenda*: hasty technological advance *vs.* sluggish social, economic, and political growth	• Technology alone is not the solution • Technology is neither value-neutral nor apolitical • Deploying technology in the aid sector needs strong justifications of rationale and added value • Uncritical integration of new technology in humanitarian action may be harmful
Data	• Safety • Security	• Regulatory priority • Operational guidelines	• *Data collection*: degree & level of data accuracy • *Data storage & usage*: compliance mechanism on data safety & security • *Data sharing:* digital data management system	• Acknowledge inherent risks of data-driven technology • Establish procedures governing data ownership, access, management, and compliance issues • Develop publicly available open data platforms is the vision • Construct open data within existing structural and institutional reality is the challenge
Regulation	• Authority • Procedure	• Top-down force • Regulatory authority • Provisions & procedures	• *Lead agencies*: who & at what level • *Compliance & enforcement mechanisms*: content & process	• An independent agency can help foster future regulations • Future regulations should be based on technical rather than political parameters • Existing regulatory frameworks are context-insensitive *vis-à-vis* technology development • Continued effort needs to be made to sensitize authorities
Stakeholders	• Responsibility • Accountability	• Bottom-up force • Moral hazard • Ethical standards	• *Government*: priority-setting • *Humanitarian organization*: self-positioning • *Community*: needs-oriented • *Ethical standards*: action-guiding	• Local government and community should take the lead • Justification and rationale behind the use of technology are crucial • Understanding and articulation of the local needs are key • Effective tools include best practices, multi-stakeholder consultation, indigenous knowledge, etc.

technology in the aid sector may not provoke immediate harm; the sector-wide attitude towards technology, nonetheless, should not be imprudent. The reasons for this are that this sector serves vulnerable populations, and that the fundamental humanitarian principles are to protect these populations on the basis of their humanity (29). Hence, any proposal for technological innovation in the aid section should keep the humanitarian principles as its prime rationale. Additionally, technology is neither a "magic solution", nor a "troublemaker" — there is nothing inherently good or bad about it; what matters is why and how it is being used (30). Thus, if technological innovation is effective, and the rationale and approach of adopting it are ethically justified, then it indeed can and should be deployed in the aid sector. As proposed in this paper, ultimately, the key lies with ensuring rigorous reflections about the ethical challenges technological innovation may invoke, developing responsive methodologies to assess its potential for harms relative to potential for benefits, and establishing actionable ethical guidance to identify, address, and tackle such challenges. Following these insights, future work should strive to shed light on the establishment of a humanitarian innovation framework and toolkits that are value-sensitive and context-specific.

Acknowledgment

This work was financially supported in part by the Swiss Network for International Studies (SNIS), Grant No. C18006, and in part by the Swiss National Science Foundation (SNSF), Grant No. P1ZHP1-181401.

Author Information

Ning Wang is affiliated with the Institute of Biomedical Ethics and History of Medicine (IBME), University of Zurich, 8006 Zurich, Switzerland. Email: ning.wang@ ibme.uzh.ch.

References

(1) Development Initiatives, "Global humanitarian assistance report 2019," Development Initiatives, 2019.
(2) Development Initiatives, "Global humanitarian assistance report 2018," Development Initiatives, 2018.
(3) UNOCHA, "Global humanitarian overview," UNOCHA, 2016.
(4) S. Mesmar, R. Talhouk, C. Akik, P. Olivier, I. H. Elhajj, S. Elbassuoni, S. Armoush, J. Kalot, M. Balaam, A. Germani, and H. Ghattas, "The impact of digital technology on health of populations affected by humanitarian crises: Recent innovations and current gaps," *J. Public Health Policy*, vol. 37, no. S2, pp.167-200, 2016.
(5) Schroeder, and P. Meier, "Automation for the people: opportunities and challenges of humanitarian robotics," *Humanitarian Practice Network*, vol. 66, no. 33, Overseas Development Institute, 2016.
(6) P. Meier, "Humanitarians in the sky: Using UAVs for disaster response," i*Revelution*, Jun, 2014. Available: https://irevolutions.org/2014/06/25/humanitarians-in-the-sky/. Accessed on: Apr. 3, 2019.
(7) P. Meier, "Humanitarian UAV missions: towards best practices," *iRevolutions*, June, 2015. Available: https://irevolutions.org/2015/06/01/humanitarian-uav-missions-towards-best-practices/. Accessed on: Apr. 3, 2019.
(8) New America, "Drones and aerial observations: new technologies for property rights, human rights, and global development, a primer," *New America*, 2015.
(9) K. B. Sandvik, and K. Lohne, "The rise of the humanitarian drone: Giving content to an emerging concept," *Millennium: J. Int. Studies*, vol. 43, no. 1, pp. 45-164, 2014.
(10) K. L. Jacobsen, and K. B. Sandvik, "UNHCR and the pursuit of international protection: accountability through technology?," *Third World Quart.*, vol. 39, no. 8, pp. 1508-1524, 2018.
(11) S. Abdelnour and A. M. Saeed, "Technologizing humanitarian space: Darfur advocacy and the rape-stove panacea," *Int. Political Sociology*, vol. 8, pp. 145–163, 2014.
(12) Donini, and D. Maxwell, "From face-to-face to face-to-screen: remote management, effectiveness and accountability of humanitarian," *Int. Review of the Red Cross*, vol. 95, no. 890, pp. 383-413, 2013.
(13) N. Wang, "A successful story that can be sold"? A case study of humanitarian use of drones," in *Proc. 2019 IEEE Int. Symposium on Technology and Society (ISTAS)*, IEEE, 2019, doi: http://doi.org/10.1109/ISTAS48451.2019.8938015.
(14) Y. Lincoln, E. Guba, "Paradigmatic Controversies, Contradictions, and Emerging Confluences, Revisited," in *The Sage Handbook of Qualitative Research*, 3rd ed., N. K. Denzin, and Y. S. Lincoln, Eds. Thousand Oaks, CA: Sage, 2011, pp. 191-215.
(15) R. Yin, *Case Study Research: Design and Methods*, 5th ed. SAGE, 2013.
(16) M. Sandelowski, "Whatever happened to qualitative description?" *Res. Nursing and Health*, vol. 23, pp. 334-340, 2000.
(17) M. A. Neergaard, F. Olesen, R. S. Andersen, and J. Sondergaard, "Qualitative description – The poor cousin of health research?", *BMC Medical Research Methodology*, vol. 9, p. 52, 2009.
(18) L. C. Becker, "Trust as noncognitive security about motives," *Ethics*, vol. 107, no. 1, pp. 43–61, 1996.
(19) C. Baier, "Trust and antitrust," *Ethics*, vol. 96, pp. 231–260, 1986.
(20) K. Jones, "Trust as an affective attitude," *Ethics*, vol. 107, pp. 4–25, 1996.
(21) Z. Cogley, "Trust and the Trickster Problem," *Analytic Philosophy*, vol. 53, no. 1, pp. 30–47, 2012.
(22) Sandford Encyclopedia of Philosophy, "The ethics of clinical researcher." Available: https://plato.stanford.edu/entries/clinical-research/. Accessed on Feb. 15, 2020.
(23) U.S. Department of Homeland Security, "Detecting heartbeats in rubble: DHS and NASA team up to save victims of disasters." Available: https://www.dhs.gov/detecting-heartbeats-rubble-dhs-and-nasa-team-save-victims-disasters. Accessed on: Apr. 5, 2019.
(24) "Bringing drones down to Earth," *The New Humanitarian*, May, 2015. Available: https://www.thenewhumanitarian.org/analysis/2015/05/12/bringing-drones-down-earth. Accessed on: Apr. 5, 2019.
(25) J. Grierson, "Gatwick returns to normality but drone threat remains," *The Guardian*, Jan. 2019. Available: https://www.theguardian.com/world/2019/jan/04/gatwick-returns-to-normality-but-drone-threat-remains. Accessed on: Apr. 8, 2019.
(26) "Armed with drones, aid workers seek faster response to earthquakes, floods," *Reuters*, May, 2016. Available: https://www.reuters.com/article/us-humanitarian-summit-nepal-drones/armed-with-drones-aid-workers-seek-faster-response-to-earthquakes-floods-idUSKCN0Y7003. Accessed on: Apr. 5, 2019.
(27) J. Sargent, "Deploying the digital aid framework: A non-traditionalist view of the intrinsic nature of e-business solutions for humanitarian relief," in *Proc. 2005 IEEE Int. Conf. e-Business Engineering (ICEBE 2005)*, 2005.
(28) Harvard Humanitarian Initiative, "Disaster relief 2.0: The future of information sharing in humanitarian emergencies," UN Foundation and Vodafone Foundation Technology Partnership, 2011, Washington, DC, and Berkshire.
(29) Sphere Association, *The Sphere Handbook: Humanitarian Charter and Minimum Standards in Humanitarian Response*, 4th ed., Sphere Association, 2018, Geneva, Switzerland. Available: www.spherestandards.org/handbook.
(30) K. B. Sandvik, K. L. Jacobsen, and S. M. McDonald, "Do no harm: A taxonomy of the challenges of humanitarian experimentation," *Int. Review of the Red Cross*, vol. 99, no. 904, pp. 319-344, 2017.