IEEE SSIT SOCIETY ON SOCIAL IMPLICATIONS OF TECHNOLOGY

2019 IEEE International Symposium on Technology in Society (ISTAS) Proceedings
Miriam Cunningham and Paul Cunningham (Eds)
ISBN: 978-1-7281-5480-0

"A Success Story that Can Be Sold"?

A Case Study of Humanitarian Use of Drones

Ning Wang
Institute of Biomedical Ethics and History of Medicine (IBME), University of Zurich, Zurich, Switzerland
email: ning.wang@ibme.uzh.ch

Abstract - Increasingly, humanitarian organizations across the globe have been implementing innovative technologies in their practice as they respond to the needs of communities affected by conflicts, disasters, and public health emergencies. However, technological innovation may intersect with moral values, norms, and commitments, and may challenge humanitarian imperatives. Through the examination of an empirical case study on drone mapping, this paper aims to explore three questions: (1) What are the dynamics between aid delivery and technological innovation in the humanitarian enterprise? (2) How are structural problems addressed in an environment in which technology is being portrayed as a force for change? (3) What moral responsibilities towards vulnerable populations should humanitarian stakeholders bear when introducing innovative technologies in humanitarian action. Discussion revolves around the ideology of "technological utopia", and the normative role of technology in the aid sector – to make substantive impacts, or to produce "success stories". In conclusion, a call for rigorous ethical analysis to help foster value sensitive humanitarian innovation (VSHI) is made.

Keywords - Humanitarian technology; community consent; technology assessment; data safety and security; regulation deficit; stakeholder accountability

I. INTRODUCTION

On 25 April 2015, a disastrous earthquake hit Nepal with a magnitude of 7.8 and a maximum intensity of VIII. According to the Nepal Disaster Risk Reduction Portal, approximately 9,000 lives were lost, nearly three times as many injured, and about 3.5 million became homeless [1]. Thousands of houses were destroyed across districts, with entire villages leveled [2]. The country also faced a continued risk of landslides, some caused by the continuous rainfalls of the monsoon season, others resulting directly from the earthquake and its aftershocks, which generated widespread fracturing in the stricken areas [3]. *Nature* magazine forecasted that the frequency and intensity of future landslides in Nepal would increase in the coming decades [4].

In response, the Nepalese government alongside international aid agencies launched relief and rescue missions [5][6]. However, impassable roads and inaccessible communication infrastructure continued to pose considerable challenges to on-ground humanitarian action, complicating the operational environment and hindering the effectiveness of relief efforts [7]. Amidst the post-disaster chaos in Nepal, technology appeared to be remarkably useful, not only in helping the affected populations get on with their daily lives, but also in assisting aid delivery in the aftermath of the earthquake [8][9]. The 2015 Nepal earthquake, following previous natural disasters in other parts of the world, provided a gateway for new and emerging technologies to enter the humanitarian space [10][11].

Within the broader context of technological innovation in the humanitarian sector, this case study examines the ethical challenges associated with using drones in assisting humanitarian action*. The inquiry is set up in two parts: (1) introduction of a case study, in which the findings of a 3-week fieldwork in a landslide area in rural Nepal are presented, describing how the livelihood of the local community was threatened by the 2015 earthquake, and how a humanitarian organization attempted to find a solution to restore safety assisted by the use of new technology; and (2) presentation of a case analysis, in which the ethical challenges that emerged in the context of the case study are outlined, following five thematic aspects, including community, technology, data, regulation, and stakeholders.

II. A DRONE MAPPING PROJECT

A. Project Background

The X organization (hereafter X), one of the world's leading humanitarian organizations in the field of disaster relief and post-disaster reconstruction, was on the ground in Nepal within 48 hours after the earthquake. In one of the districts in which X was mandated to carry out reconstruction work, there was a cluster of houses less than 200 meters from a landslide area, putting the 10-20 households at risk as the landslide erodes. After the earthquake, roads were blocked, agriculture and livestock were affected, and people were apprehensive about continuing to live there given the anticipated loss of livelihood.

To ensure that it would be safe to reconstruct houses in this area, X needed to assess the damage and risks to infrastructure, agriculture, and human settlements in the area in the long run. The main objective was to quantify, in monetary terms, how many assets including the agricultural lands were exposed to the landslide threat, and to identify a timeframe within which these lands would be lost, and people would be forced to relocate.

Immediately after the earthquake, a field officer at X's Emergency Response Department (ERD) brought a drone to Nepal, with the intention of using it to assist with disaster relief work. The complicated geological conditions of the landslide challenged X to find innovative ways to manage risks, and they envisioned that drones could potentially be used to provide the kind of information they needed. The rationale was, primarily, that drones could be used to capture high-resolution images to map the landslide area, following which a hazard analysis as part of the risk-reduction assessment could be obtained. The alternative was to use established technologies, i.e., satellite images or ground measurements, both, however, with major limitations in landslide mapping. In terms of the former, firstly, satellite images are taken from a great height, and the resolution and level of detail obtained is low; and secondly, if there is cloud cover over the area, data analysis becomes complex. As regards the latter, in theory, a tripod or prism could be manually installed on the ground; this, however, was nearly impossible in this case given the dangerous terrain. In comparison, drone technology is less weather-dependent, more cost-efficient, and produces richer data in a short period of time, at a reasonable cost, and with reduced safety risks.

B. Project Partners

To kick-start the project, X recruited a local technical officer with prior experience in using drones to coordinate the mapping project and to acquire flight permissions from the government. In terms of budget, the ERD officer shared connections with the technical officer, who then reached out to some funding agencies with a positive response, and received earmarked funds to initiate the project. Due to a lack of in-house technical capacity, X partnered with an NGO (hereafter Partner A), which was actively involved in crisis drone mapping in post-disaster settings, to handle the technicalities of the project. As one of the first organizations that introduced drones to Nepal, Partner A was motivated to showcase how drones could be used in vulnerable situations for humanitarian purposes, and to file strong use cases to convince the government that there were advantages to scaling up the technology. With respect to hazard assessment, X partnered with a university spinoff (hereafter Partner B), specializing in geological risk assessment software engineering, to model the landslide for monitoring and early-warning purposes. Although financially unattractive, Partner B's involvement was motivated by a drive to represent themselves as a pioneer in this type of drone data analysis at the time.

C. Government Permissions

After the earthquake, Nepal implemented strict regulations with regard to the use of drones, due to a growing number of drone flights. As a result, X had to obtain a total of six approvals, involving four governmental authorities at the national level and two at the district level. The approval process was lengthy and demanding for several reasons. First of all, the national government had other priorities as a result of the earthquake, which they perceived as in more urgent need of resolution. Secondly, landslides are common in Nepal, with many more problematic than this one. Thirdly, there was a general concern about national security, as a result of which the officials tended to err on the safe side. Finally, not all officials understood the technology, nor the technicalities of the mapping project, although they were interested in knowing how they could benefit from such a project, and how it could help them in tackling the existing challenges they each faced in their respective roles. X made it explicit that as a shelter-oriented aid agency, they would not want to build shelters in an unsafe area, and so they would need assessments of the geological conditions of the land as part of their risk-reduction work. By sticking to the practicalities of the project, X finally succeeded in getting the flight permissions. Overall, it took X three months to clear all regulatory requirements.

D. Community Consent

Prior to the mapping, X organized a number of meetings with the community members to gain indigenous knowledge about the landslide. X also held an information session, where the technical officer introduced drones, and presented when and why X intended to use drones, and how drones could bring about changes to their lives. The villagers had no prior expectations from the drone use, nor concerns about potential risks associated with the images that would be captured by the drones – all that mattered to them was that they had the safe houses they needed. With a limited understanding of the technology, and a genuine hope for their own safety and betterment, the villagers showed a welcoming and accepting attitude towards the use of drones in their community. To seek final consent from the community, X held a series of talks with the community leaders, without directly involving the villagers given their general illiteracy. X explained that if it turned out to be technically evident that their houses were in a dangerous area, then X could advocate, on behalf of the community, to the national government for their relocation to a safer area using government subsidies. The community leaders recognized the importance of new technology and gave their consent. On this basis, the local government sent a recommendation letter to the involved Ministries supporting the mapping project, which led to the successful acquisition of the flight permissions.

E. The Mapping

The main objective of the mapping was to find out how many cracks or fault lines there were in the landslide, how vulnerable the area was, and when the landslide would reach the villagers living in the nearby area. Since it was a new experience for X, the technical aspects of the project were challenging, especially given that the operation would take place in a remote mountainous area in Nepal. The flight planning was pre-programmed using 3D flight simulation software, during which the technicians envisioned a possible drone crash in two scenarios, i.e., battery failure, or takeoff/landing errors, and took measures to prevent these instances from occurring. Despite careful preparation, two crashes took place during the mapping, resulting in damage to two drones. Both crashes were believed to be caused by technical errors, both times the villagers

witnessed the crash, and both times the villagers volunteered to help retrieve the drone from the landslide, without being asked to, nor expecting anything in return. As X had only an aerial camera and GPS, the technicians were able to collect just about a hundred images and created a high-resolution map. Based on the topographical data, Partner A developed a 3D model and gave X the dataset. Partner B then studied the susceptibility of the landslide to erosion and submitted a technical report to X. The main conclusion was that, to gain a thorough understanding of the hazards and risks of the landslide, more research was needed, and more data must be collected, which required more funding. The report was not shown to the community for two reasons: (1) X believed that they needed a more concrete proposal on the evolution of the landslide based on more mappings; and (2) there were no recommendations in the report of feasible control measures to manage the landslide.

F. The Outcome

With respect to the datasets, although X considered making them open data, they have not been published on any open platform to date. The core data are stored with X, as they are the official owner of the datasets. In practice, however, ownership is shared between all three project partners. Additionally, as part of the regulatory requirements of Nepal, X was bound to submit the raw data to the local government (but not the processed output). As there were no compliance mechanisms put in place to regulate the sharing of the data, effectively all four parties had access to the datasets, and could potentially share the data with others. Regarding community benefits, X showed the drone images to the villagers and, for the first time in their lives, they saw their homeland from a different perspective – how close they lived to the landslide, and how much greater their exposure to danger was than they had realized. To some, the clear boundary of the landslide shown in the drone images raised awareness as to how vulnerable they were, which consequently triggered fear. To others, seeing the landslide from a different angle changed nothing, as they had been living with the landslide and grazing their livestock on it, and they knew very well that it was eroding. The community leaders, on the other hand, had high expectations from the drone use, believing that it could solve many long-standing problems of the community, including potential control of the landslide. To some extent, their expectations were not met, and this perception was shared by the community members at large. As the project was self-initiated without designated funds, it concluded around mid-2017 after the initial mapping results were acquired.

III. Ethical Analyis

A. General Observation

Throughout the interviews, a general perception that the project was inconclusive was observed from interviewees, even making allowances for the fact that certain conditions for change were missing, such as the political will from the national government to utilize the mapping results, and the financial resources to continue further collection of drone images. Specifically, from the project management perspective, the project was positively perceived in that it achieved its intended objectives to generate topographic datasets and 3D maps through the use of drones. From the community perspective, however, the project was deemed incomplete, in that no control measures were taken towards the landslide, and the risks and hazardous conditions remain unaddressed to date. Overall, there exist some gaps between the initial commitment and the final outcome, with respect to what X intended to deliver and what they eventually managed to achieve. As it was a pilot project and the first of its kind in Nepal, there was tremendous learning for all project partners, especially cross-sector learning.

From the ethical perspective, while the project created value in terms of evidence and awareness, more efforts are needed to make substantial impacts on the local community's livelihood. Procedurally, X fulfilled the national regulatory requirements and acquired all documents for the drone flights. In addition, X also proactively engaged the local community in the project planning, by inviting the villagers to the information session, and by seeking informed consent from the community leaders. On a substantive level, however, little benefit was gained by the local community, which led, at least partially, to the dissatisfaction of the community members. While there is no severe ethical tension, trade-off, or dilemma observed in this case study, it is crucial to acknowledge that there are ethical considerations related to the expectations, priorities, and responsibilities of the involved stakeholder groups.

B. Thematic Analysis

Through an inductive analysis of the case study, five thematic aspects with specific analytic focuses and angles were identified, each of which addresses a distinct set of ethical challenges.

1) Community: Consent and Care

As the case study illustrates, X followed a deliberative informed consent process by providing information to the community members, and by acquiring consent from the community leaders. The community then accepted the use of drones for the proposed purposes, and gave their collective consent to carry out the mapping project in the community. Nonetheless, in spite of their rights over the land being respected and acknowledged, the community members are in a vulnerable situation. This is because while, procedurally, X "did the right thing" by gaining the consent of the community for conducting activities over their land; normatively, the core issue does not lie solely on the *procedure* of consent, but also how community consent was acquired, what led to such consent, and what resulted from such consent. In other words, two questions need to be asked: (1) where the consent comes from in the first place, and (2) where such consent landed eventually.

The first question concerns the *sources* of community consent, in which three factors are at stake, i.e., trust, hope, and literacy. Was the trust pregiven regardless of the specificities of the mapping project, or was it newly established taking into account the risks and benefits of the drone use? Was the hope an over-optimism of the community towards those whom they believed to be change-enablers or life-savers? Was the community members' literacy level, including both general literacy and technological literacy, compatible with the level required for them to understand the potential risks, as well as the value of, and liability for, the consent given? The second

question points to the *consequence*s of community consent, where two aspects are noteworthy, i.e., philanthropic misconception, and duty of care. Did the community at large build their expectations in alignment with the actual objectives of the mapping project? Might there be a philanthropic misconception embedded in the community's general understanding about aid? Is there a special duty of care towards vulnerable populations from the caregivers, for such communities already are vulnerable in the first place, and cannot afford to be made vulnerable on top of it? These delicate but pertinent aspects suggest that rigorous evaluation of the necessity of innovation proposals in the aid sector, before introducing technology in their operations, is crucial.

2) Technology: Risks and Benefits

By and large, risks are inherently embedded in any kinds of technology humans have invented in history. In the mapping case, drones suggested remarkable advantages over other existing mapping options, and it achieved its intended objectives with reduced risks of harm or damage. However, as a tool or an instrument, technology embodies *technical limitations* in terms of mechanical errors or malfunction; and as a convention or an institution, technology invokes *societal implications* in the sense that technology is neither value-neutral nor apolitical. On the technical side, although drone technology is evolving at a rapid pace, it is still largely inhibited by its own limitations including various technical tensions, compromises, and tradeoffs, and so how it can be utilized depends considerably on its future level of development. On the societal side, questions around for what purposes drones are deployed, in what conditions they are intended to be used, and in what contexts their use is justified, should be placed at the center of the risk-benefit analyses to gauge which has more weight.

While drones hold tremendous promise in assisting humanitarian action in counties like Nepal, where infrastructure is poor and resources scarce, it is noteworthy that regardless of the actual and perceived advantages a technology may suggest, technology alone cannot change things for the better. What is more, as a powerful intervention, technology may trigger hidden layers of vulnerability when being introduced without caution, leading to enhanced risks and greater harm. It is, hence, crucial to address potential risks associated with the use of technology in the aid sector. This entails practical implications, i.e., stakeholders need to proactively conduct *risk-benefit assessments*, in light of the particular context in which technology is to be introduced. Uncritical adoption of technology, and leapfrog into finding "magic solutions" to tackle long-standing development challenges, risk blinding practitioners as to where the real matters of concern lie, and how the priority of the agenda should be set. Ultimately, an overwhelming demand for technological innovation may put pressure on a steady and sustainable development of the technology, resulting in a distorted dynamic in society, whereby technological advance appears hasty and aggressive, while its social, economic, and political growth dawdles behind.

3) Data: Privacy, Safety and Security

If the use of drone technology may potentially introduce risks, then the data aspect associated with it may plausibly exacerbate stakeholders' susceptibility to harm. This is because if and when data privacy, safety, and security are compromised, it can heighten risks and intensify harms for those whose data are at stake, rendering the already vulnerable worse-off. While the data collection aspect concerns privacy, in that those who are being captured in the data should be aware of what images are captured, why they are captured, and who is capturing the images; the data storage and data usage dimensions link to data safety and security, in terms of where the data are stored, how they are stored, whether there is a data management procedure in place, as well as questions about who has ownership of the data, who has authority to share the data, who can be granted access to the data, and what compliance mechanism governs if the data are to be shared. In the mapping project, the datasets produced have been stored relatively safely, with defined ownership and controlled access among a small group of partners. Nevertheless, for any data-driven technology, such as drones, data privacy, safety, and security issues are categorically of key ethical concern.

Highlighting the data aspect as one of the most critical factors in this context helps, on the one hand, set data protection as a *regulatory priority*; and on the other hand, develop *operational guidelines* to reduce potential risks, thereby preventing violations of data privacy or breaches of data safety and security from occurring. As the case study indicates, without an enforceable data management system, the possibility of the datasets being potentially disclosed to, or misused by, external parties, is not unconceivable. This, in effect, transmits data safety and security risks onto the professional and personal ethics of those who have access to the data, downplaying institutional arrangements which require collective efforts to tackle. While no actual harm in terms of data safety and security seemed to be created in this mapping project, the identifiable risks and the conceivable harms that might have been triggered cannot be overlooked.

4) Regulation: Authority and Procedure

It is a common concern of the tech community that without effective regulatory mechanisms, both the development and the deployment of new technologies risk being hindered, resulting in two equally chaotic scenarios: anarchy or autocracy. While risks can be intensified when the tech industry is under-regulated, a stifling and over-regulated ambiance does no good to the industry either. The current state of technology development is much faster and far more robust than that of regulation, for a number of structural reasons. In the case of drones, regulatory issues include, e.g., who the lead agencies should be at the national and international levels, how the compliance and enforcement mechanisms could be established, and what legal and administrative procedures would be set up, among others. Unless the regulatory challenges are responded to, it is unlikely that there will be a safe and healthy environment in which society at large can manage technological risks, and in which the humanitarian sector can drive its innovation process. In this sense, the regulation dimension is an overarching layer with a *top-down force*, which determines the scope and magnitude of the first three sets of ethical challenges.

In practice, two aspects need to be attended to. Firstly, regarding *regulatory authority*, there are two subdimensions, namely, who the lead agency should be, and at what level such an authority should be set up. Evidently, the absence of a dedicated global regulatory authority overseeing all drone-

related activities adds ambiguity to the development of drone regulation, rendering stakeholders at risk of irresponsible use or potential harmful consequences. Secondly, with respect to *provisions and procedures*, the biggest challenge is how stringent drone regulations should be, such that they are sensible but do not hinder the development of the technology or oppress its application for social good. There are as well two subdimensions to this challenge, namely, that of the content, and that of the process. As an example, the case study points out how outdated the existing regulations are, how context-insensitive the provisions and procedures are, and how left-behind regulation is in general compared to the pace of technology development. This implies that continued effort needs to be made to sensitize the authorities on the need to establish sensible legal and administrative provisions and procedures.

5) Stakeholders: Responsibility and Accountability

Last, but not least, the final aspect of the humanitarian use of technology lies with stakeholder responsibility and accountability – not only in terms of the deployment of technology, but also towards each other. The danger of lacking a deep understanding of responsibility and accountability is that it creates a *moral hazard* whereby stakeholders advocate the humanitarian imperative of "Do No Harm" on the one hand, while adversely causing harms to those whom they intend to protect on the other [13]. Like the regulation aspect, the stakeholder dimension is also an overarching layer situated in the background, whereby the creation of actionable *ethical standards* can help drive it with a *bottom-up force*. Acknowledging that the societal impacts of stakeholders' choices and decisions may unintentionally render affected populations vulnerable can help them navigate through the moral hazards, and find a better position in their moral compass,

Regarding the role of the government, in the context of the case study, the responsibility of the government was somewhat ambiguous, due partially to its political priority-setting. While humanitarian and development actors may assist in post-disaster reconstruction, ultimately, it should be the local government and local communities who take the lead to rebuild lives. With respect to the accountability of humanitarian organizations, the center of discussion in this context is why introduce new technology into their practice in the first place, and how to introduce it to vulnerable populations without causing potential harm to them. This invokes reflections about the rationale and justifications of the project, which points out the importance of self-positioning of humanitarian organizations. Regarding the community, the key point here is how to understand and articulate the local needs, such that projects carried out over their land are not driven by the needs of donors, whereby they experiment with ideas and test out new tools; rather, they should be derived from a need perspective, whereby the local communities' livelihood will be prioritized and catered for. Finally, to substantively move forward in the process of humanitarian innovation, a pragmatic tool would be to establish action-guiding ethical standards, e.g., on privacy, on data management, on informed consent, on stakeholder engagement, etc. 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.

IV. Discussion

In the aftermath of the 2015 earthquake, Nepal witnessed an influx of humanitarian agencies ready to deliver aid and relief on the ground. The considerable operational challenges facing humanitarian organizations range from weather to infrastructure, and to long-standing structural problems. The availability and accessibility of technology, as well as the curiosity and eagerness of humanitarian organizations, aid donors, and government agencies to use it in emergency relief work, transformed Nepal into an incubator of humanitarian innovation. Within this challenging, complex and fast-moving environment, stakeholders could hardly afford critical distance in adopting technologies that hold the promise of saving lives. They were equally inattentive to a subtle tension between technological innovation and hidden vulnerability derived from structural dysfunction mixed with over-optimism about the potential risks of novel technologies.

Disastrous events in any economically and politically fragile society will inevitably bring about a long-drawn-out chain of events, in that one disaster feeds into another for years or even decades [14]. Nepal was no exception. As the case study illustrates, the local community benefited little from the drone mapping of the landslide, despite their trust and hope. This case study demonstrates a lived example where different stakeholders, who previously might have never crossed each other's paths, were brought together in the name of innovation – new technology, new players, new modes of partnership, new sources of funding, new minds, and new perspectives; the only factor that was not new was the decades-old landslide problem needing to be resolved.

At the center of the discussion lies an ideology of *technological utopia*. The post-earthquake Nepal has been repeatedly portrayed by the advocates of technological innovation in the aid sector as "a success story that can be sold". In such narratives, technology is often depicted as the "magic solution" that assisted in resolving problems which the humanitarian and development actors have long struggled over, branding the sector as forwarding-looking innovation pioneer – as opposed to traditional aid provider. Ultimately, the questions boil down to: (1) the role of technology in a sensitive and complex context where diverse factors are at play, all of which may trigger vulnerabilities of those who are affected, and (2) the role of the aid sector in an increasingly technologized ecosystem, the impact of which may suggest novel sets of methodology in aid delivery, and may challenge the fundamental humanitarian imperatives.

V. Conclussion

While drone technology suggests a variety of applications in delivering social good, the use of it in the humanitarian space may cause unintended harm, exposing affected populations to heightened risks and unnoticed vulnerability. Hence, the adoption of new technologies in the aid sector calls for rigorous, deliberative, and nuanced reflections over the ethical challenges it may encounter. In pursuing such endeavors, an effective and sensible approach is one that is value-sensitive and context-specific.

NOTE

* Due to space constraints, the methodology used for data collection in the field work and its subsequent analysis is not set out in this paper. The author welcomes any queries in this regard through direct correspondence.

ACKNOWLEDGMENT

In developing the ideas presented in this paper, the author received insightful feedback from Dr. Markus Christen (University of Zurich, Switzerland), Dr. Matthew Hunt (McGill University, Canada), Prof. Thomas Burri (University of St. Gallen, Switzerland), Prof. Robert Sparrow (Monash University, Australia), and Prof. Florencia Luna (FLASCO, Argentina), to all of whom I am immensely indebted. I am also grateful to Dr. Roberto Andorno (University of Zurich, Switzerland), and Prof. Katina Michael (Arizona State University, UAS), whose comments helped improve the manuscript. I finally thank Dr. Heather Collister for assistance with the interview data, and local stakeholders for fact validation, during the data analysis process. My deepest gratitude goes to the project partners who supported me in my fieldwork, without whom this case study would not have been conceived in the first place.

REFERENCES

[1] Nepal Disaster Risk Reduction Portal, "Incident report of earthquake 2015." Available: https://web.archive.org/web/20150629024928/http://drrportal.gov.np/incidentreport. Accessed on: Apr. 5, 2019.

[2] "Nepal earthquake: Dozens die in new tremor near Everest," *BBC*, May 2015. Available: https://www.bbc.com/news/world-asia-32701385. Accessed on: Apr. 5, 2019.

[3] "Taplejung landslide death toll reaches 53," *The Kathmandu Post*, Jun. 2015. Available: http://kathmandupost.ekantipur.com/news/2015-06-11/taplejung-landslide-death-toll-reaches-53.html. Accessed on: Apr. 5, 2019.

[4] J. Qiu, "Killer landslides: The lasting legacy of Nepal's quake," *Nature*, Apr. 2016. Available: https://www.nature.com/news/killer-landslides-the-lasting-legacy-of-nepal-s-quake-1.19803. Accessed on: Apr. 5, 2019.

[5] Médecins Sans Frontières, "MSF is sending medical and non-medical teams to assist victims of the Nepal earthquake." Available: https://www.msf.org/nepal-msf-sending-medical-and-non-medical-teams-assist-victims-nepal-earthquake. Accessed on: Apr. 5, 2019.

[6] International Committee of the Red Cross, "Nepal earthquake: Red Cross steps up emergency response." Available: https://www.icrc.org/en/document/nepal-earthquake. Accessed on: Apr. 5, 2019.

[7] Nepal National Planning Commission, "Nepal earthquake 2015: Post-disaster needs assessment." Available: https://www.npc.gov.np/images/category/PDNA_volume_BFinalVersion.pdf. Accessed on: Apr. 5, 2019.

[8] NASA, "New system put into service to process Nepal earthquake data." Available: https://science.nasa.gov/technology/technology-stories/new-system-process-nepal-earthquake. Accessed on: Apr. 5, 2019.

[9] 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.

[10] "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.

[11] "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.

[12] D. MacKenzie, and J. Wajcman, *The Social Shaping of Technology*. Milton Keynes: Open University Press, 1999.

[13] K. B. Sandvik, K. L. Jacobsen, and S. M. McDonald, "Do no harm: A taxonomy of the challenges of humanitarian experimentation," *International Review of the Red Cross*, vol. 99, no. 904, pp. 319-344, 2017, DOI: https://doi.org/10.1017/S181638311700042X.

[14] S. Chughtai, "Nepal was made vulnerable by more than its violent geology," *The Guardian*, April, 2015. Available: https://www.theguardian.com/commentisfree/2015/apr/26/nepal-earthquake-poverty-infrastructure-aid. Accessed on: Apr. 8, 2019.

Cite this Article

N. Wang, "A Successful Story that Can Be Sold"? A Case Study of Humanitarian Use of Drones, *Proceedings of 2019 IEEE International Symposium on Technology and Society (ISTAS)*, IEEE, 2019, DOI: http://doi.org/10.1109/ISTAS48451.2019.8938015.