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CONFLICT & WAR

RESCUE, HUMANITARIAN, MEDICAL

PLUS: Earthquakes in Italy; Tehran Fire Department; TalkTalk cyber attack; Business resilience & continuity; Social media in emergencies; The growing use of child suicide bombers; Disaster diplomacy; Attacks on healthcare; Drones & capacity building; Safe surgery in crisis zones; Canada wildfire

Editor in Chief
Emily Hough
emily@crisis-response.com

Chief Scientific Editor
Ian Portelli, BCDM, PhD
ian@crisis-response.com

Urban Resilience Editor
Andy Marshall
andy@crisis-response.com

Design and Production
Tim Baggaley
www.graphicviolence.co.uk

Subscriptions and Administration
Emma Wayt
emma.wayt@crisis-response.com

Director
Colin Simpson
colin.simpson@crisis-response.com

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The global picture has darkened considerably on many fronts over 2016.

This year is predicted to be the hottest on record, setting a new high for the third year running. The WMO said in November that human-induced global warming had contributed to at least half the extreme weather events studied. These high temperatures help to fuel climate change and the ensuing deadly consequences many regions are experiencing.

A swarm of lethal earthquakes struck Italy this year (p14); Japan and New Zealand were similarly afflicted, thankfully with fewer fatalities.

Also released in November, the *Global Terrorism Index* (*GTI*) noted a ten per cent decrease in terrorist acts in 2015, but it was still the second deadliest year on record – what will the figures be for 2016? The *GTI* said there were 5,556 fewer deaths in Iraq and Nigeria, attributed to Boko Haram and ISIL becoming weaker in these countries. But constriction of one part often leads to expansion into another: terrorism is leaching into other areas. On p46 we explore the growing use of children as suicide bombers. Although this may indicate a certain weakening of these terrorist groups, it is nevertheless a distressing and perturbing trend.

And of course major conflicts claim far more lives than terrorism. The feature starting on p50 explores the consequences for humanitarian actors attempting to operate in such hostile arenas. This segues into our feature looking at attacks on healthcare (p63).

We had hoped that by the time the journal was published a more positive picture would be emerging. But *CRJ* went to press in the week that east Aleppo lost its last functioning hospital after a relentless wave of airstrikes.

More positively, this issue also covers IT innovations developed to assist IDPs and refugees (p80); new medical equipment and research that can help in crisis areas (p74 and p78); and how robotics and drones are building capacity and fostering resilience (p84).

In a world where international humanitarian law is blatantly disregarded, where efforts to curb climate change often appear to be a Sisyphean task, and where civilians and those trying to assist them come under deliberate attack, maybe there are a few glimmers of hope amid the darkening shadows.

Emily Hough

Social automation, local humanitarians and crisis response

WeRobotics helps local communities in developing countries to harness the power of robots, to build capacity, foster resilience and incubate new businesses, as **Andrew Schroeder** explains

The mid-sized town of Bukoba (population roughly 100,000) sits on the shores of Lake Victoria in north-western Tanzania, near the Ugandan border. The city lies in a natural bowl, ringed by green hills. Its inhabitants' main livelihoods are fishing and agriculture. The local government of Kagera district is housed here. Nearby lie game reserves.

Also scattered about are dozens of badly damaged buildings, cracked and crumbled by the 5.9 earthquake that struck the area on September 10, 2016.

While in some parts of the world an earthquake of this magnitude barely rates as a crisis, in Tanzania such occurrences are rare and the consequences are dire. Nineteen people lost their lives and hundreds more were injured. Physical structures are fragile and non-resilient to seismic stress. Schools, health clinics and other public buildings were hit especially hard.

Systems are not in place to respond and recover efficiently to short-term disasters through local resources. Media attention, which usually drives the influx of disaster aid, was ephemeral. Government and non-profits have to innovate to stay ahead of the crisis.

To fill some of the gaps in knowledge required for resilient recovery, a team from WeRobotics was asked by the Tanzanian Ministry of Home Affairs to travel to Bukoba to use aerial robots, or 'drones', in the rebuilding effort.

WeRobotics is a new global non-profit initiative to build local capacity in robotics applications to scale the impact of social good projects. About a month after the earthquake, the WeRobotics team and colleagues from the State University of Zanzibar (SUZA), part of a collaborative effort to co-create a new institution called Tanzania Flying Labs, arrived in Bukoba. At times one could be forgiven for thinking they were just standing around talking and taking snapshots with their iPhones while wandering through the town.

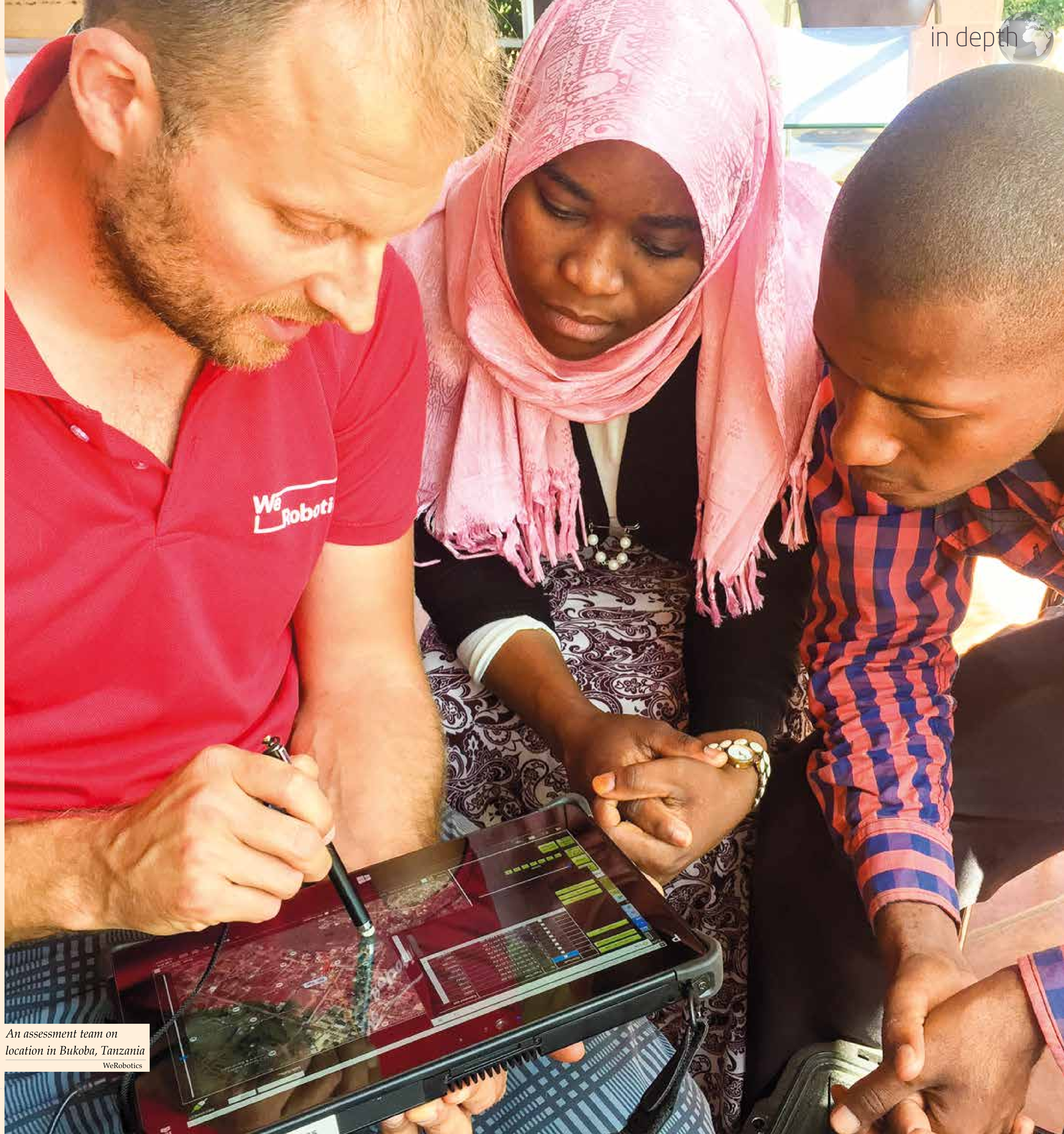
Appearances can be deceiving. The snapshots were geo-tagged photographs designed to ground-truth aerial imagery. The discussions were with members of the community curious to discover what the team was doing. Community members and the WeRobotics-SUZA team were soon in dialogue about the kinds of images and analysis that might be most helpful to the recovery effort. The conversation evolved into an ad hoc public seminar in urban planning and post-disaster priorities. Local knowledge informed the flight planning and data capture, just as the imagery promised to boost local rebuilding.

High up in the sky one could barely make out a small white winged shape gliding along. That distant speck was the Cumulus One, a semi-autonomous aerial robot with a two-hour flight time, carrying a high-resolution camera provided by the Danish company DanOffice and its subsidiary Skywatch, one of WeRobotics' long-standing technology partners. Given that the flight is programmed in advance, once the drone is in the air there's not much else to do besides wait for it to come back down. That's one reason why the team had plenty of time for dialogue, data collection and training.

The fixed-wing Cumulus One is used primarily to make orthorectified 2D mosaic maps. Its onboard camera snaps an image every couple of seconds; the camera and the vehicle are programmed to capture images that overlap one another to a degree (usually about 70 per cent) that depends on how accurate the maps need to be relative to the kind of landscape being covered. A more diverse landscape, with more obvious physical variations, requires less overlap to produce accurate maps.

The drone-captured pictures are processed through photogrammetry software. Pix4D is the most commonly used package, but others include Esri's Drone2Map, AgiSoft's PhotoScan, and the cloud-based DroneDeploy. The photogrammetry process uses common points of interest, or 'tie points', in each picture to stitch them together into a single, larger image. It uses the GPS co-ordinates in those images to fix the whole thing to a specific location in space. Because the pictures are taken from a lower altitude than space-based satellites, beneath the cloud cover, the mosaic image is brilliantly clear and detailed down to several centimetres.

The 2D maps produced by the combination of the Cumulus One and photogrammetric software are invaluable for earthquake response because they allow responders to examine the landscape of an affected area for signs of damage, plan closer inspection or allocate relief and recovery resources based on specific and accurate data.



An assessment team on location in Bukoba, Tanzania
WeRobotics

Under different circumstances, the maps provide views of flooding and wind damage after storms, or wildfire burn perimeters. Taken in advance of such events, they provide guidance to resilience and preparedness efforts. Taken routinely over a certain duration, they provide insights into changing patterns in space and in time, such as the movement of populations in informal settlements, the progress of rebuilding houses, the transit of wildlife or flood waters receding from an inundation zone.

The 2D maps do have limitations, especially for the inspection of earthquake-damaged buildings. The top-down or 'nadir' view only allows for the perception of roof or street level impacts. One can also make 3D maps from fixed-wing drones by utilising the point cloud measurements, but usually over very large areas, not specific structures. To get a up-close picture of the building damage in highly localised areas, one needs oblique or side-angled views that show walls, doorways and windows in detail.

If instead of a fixed-wing, a multicopter drone like DJI's Phantom or the Bebop 2 from Parrot is used to fly in elliptical orbits around a fixed point of interest. Drone imagery can create 3D models of buildings and other infrastructure. These models, depending on the level of resolution and the quality of the photogrammetry, enhance the inspection of impacted structures.

The WeRobotics and SUZA team in Bukoba brought a set of Bebop 2 drones to create these 3D structure models. As the afternoon drew to a close, miniature copters arced around a school building with cracks in its exterior walls. The flight pattern was programmed into a smartphone application, which controlled the movement of the robot. The imagery was imported to a laptop for processing, producing a useful, if not perfect, 3D structure model for examination, in very little time.

In many ways, the robots are the easy part. Give or take repair and maintenance and the occasional upgrade, aerial robots require less technical skill every year to operate. Once one learns the basics of mission planning, the flights become almost trivial. The perpetual challenges in relief and development remain – setting priorities, cultivating community support, creating value-added projects, analysing complex data, sustaining social effort, delivering results, and deploying data to drive rational decisions.

The robots, even ones approaching levels of autonomy only dreamed of in science fiction, do nothing of value on their own. Robots don't set social goals and they don't determine social impact; people do. In that sense, it is only by integrating robotics effectively into human systems and community structures that they acquire the potential to move from gadgetry to good.

The Kathmandu Chrysalis

For myself, and WeRobotics, the road from gadgetry to good ran through Nepal. On April 26, 2015, immediately after the first in a series of massive earthquakes that struck the Himalayan nation of Nepal, I found myself a core team representative of UAViators Humanitarian UAV Network sitting in a UN information technology working group session in Dubai. My role was to discuss the challenges and opportunities of aerial robotics for humanitarians and international non-profits. Unsurprisingly the topic of drone support for humanitarian operations in Nepal arose several times.

"You know," said a UN bureaucrat in emphatic tones as he leaned towards me across the dinner table, "THIS is the one."

"Hmm? Which one is that?" I queried.

"The drone response!" he declared. "Nepal is the response event where drones will finally prove how valuable they are for humanitarians. The scale of the disaster, the terrain, the kind of damage – it all lines up."

My reply was that I certainly wanted to make sure the capacity that's out there was put to good use. But the question remained: What if local folk didn't want them yet? At least not in large numbers?

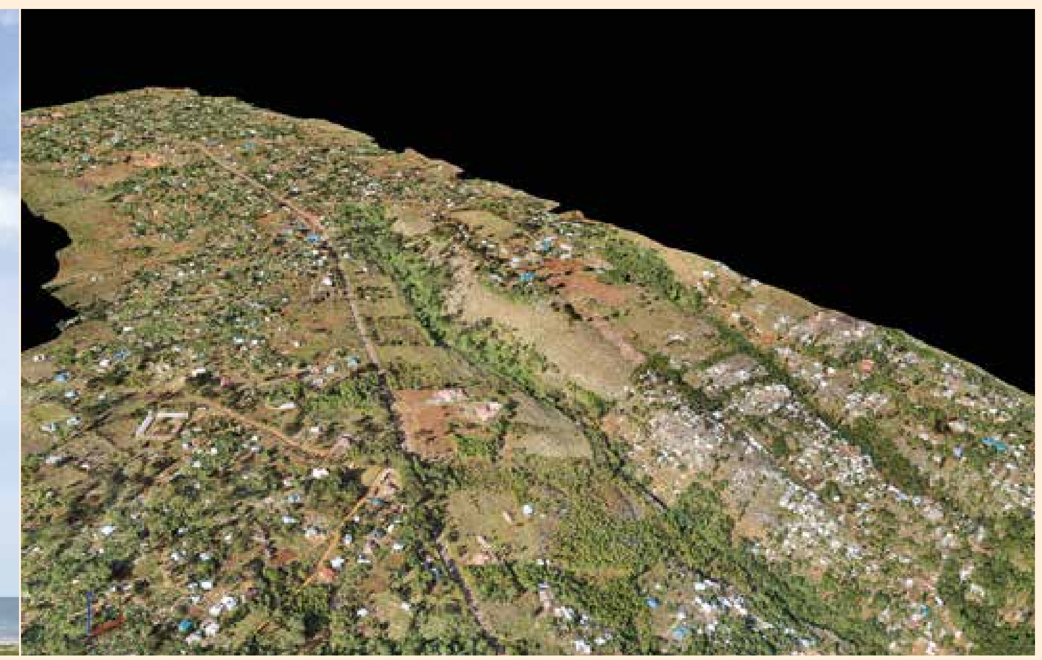
No one had tried to operate at this scale with drones for international crisis response. There could be problems: Social acceptance and regulations were unclear.

Yet he was emphatic: "It's the drone response… Nepal will be the drone response."

As events played out, my dinner companion's words echoed uneasily in my thoughts. His position was not wrong so much as it was incomplete. He focused too much on the technical dimensions of aerial robots, too little on the social dimensions of local understanding, and far too little on what turned out to be perhaps the most important short term issue of regulation.

The idea was hardly distinctive by early 2015 that drones could play important roles in earthquake response. Nor was my Dubai dinner companion alone in basing that understanding on an intersection between the physical properties of the event (scale of impact, extent of damage, remoteness of landscape, etc) and the technical capabilities of drones (high resolution imagery, aerial access to challenging areas, etc).

A couple of years previously, during the response to Typhoon Haiyan in the Philippines, much of the discussion of drones and humanitarianism centred on whether the technology itself was up to the task, or whether the technologies that were already capable would ever be cost-effective. There was little doubt by April 2015 that for some humanitarian applications mainstream, off-the-shelf, commercial drone technology held real potential.



Above: A drone flying over the earthquake damaged area in Bukoba and the imagery produced (right)
WeRobotics

This was very evident in the case of damage assessment in areas where comparable investigations by other means would have been prohibitively dangerous or expensive. Nevertheless, it is also true that the so-called 'drone response' in Nepal did not go terribly well.

My colleague Patrick Meier, founder and director of UAViators, played the key co-ordinating and information sharing role for humanitarian drone use in Nepal. He framed the challenges facing humanitarian drone operations in Nepal succinctly in a series of blog posts on UAViators.org starting in late April. One blog said: "The past few days have made it clear that we still have a long way to go in the humanitarian UAV space."

Robots don't set social goals and they don't determine social impact – people do

While the technology was indisputably of use in many ways and was actively deployed by at least 15 different international teams for various purposes during the response, serious issues arose again and again with respect to insufficient legal permissions and indeterminate local understanding.

At one point in the beginning of May it looked like the Nepalese government was heading towards a complete shutdown of drone operations across the airspace. This did not occur but, a more stringent set of project and flight authorisation criteria was put in place.

The backlash was not without reason. There were teams who found themselves arrested and detained by local authorities. Some had their equipment seized. The Nepalese government reported persistent issues with operations taking place, despite the absence of formal permissions. Meanwhile, many of those engaged in the response heard regular complaints from people in the affected areas that flights took place redundantly, without community engagement, and with little effort put towards information sharing on the local level. Redundancy of flights and lack of data transparency bred concern and mistrust.

Troubles mounted in the application of drones to the response effort in Nepal, despite the creation of the Humanitarian UAV Code of Conduct, developed in close consultation with representatives of roughly 60 humanitarian and drone technology organisations as a way to provide a concrete guide to effective use of drones in humanitarian response.

The Code of Conduct offered specific guidance on all the main issues that plagued the teams operating on the ground, including whether, how and why to engage affected communities before carrying out flights or collecting data. The trouble lay in getting people to adhere to it and encourage adherence in others.

Patrick reflected, in somewhat exasperated tones, on the reality of on-the-ground activity versus 'best practice' standards in humanitarian drones in Nepal, inter-agency co-ordination and the Code of Conduct in May, 2015: "Yes, we now have a Code of Conduct, which was drafted by several humanitarian professionals, UAV pilots and experts and academics. However, this doesn't mean that every civilian UAV pilot in Nepal has taken the time to read this document, let alone knows that this document exists.

"As such, most UAV pilots may not even realise that they require legal permission from the government in order to operate, or that they should carry some form of insurance. Even professional pilots may not think to inform the local police that they have formal authorisation to operate; or know how to communicate with Air Traffic Control or with the military for flight permissions. "UAViators can't force anyone in Nepal to comply with national regulations or the Code. The network can only encourage UAV pilots to follow best practices. The majority of the problems vis-a-vis the use of UAVs in Nepal would have been avoided had the majority of UAV users followed the Humanitarian UAV Code of Conduct," he wrote.

In the absence of an agency with strong ties to the Nepali government and the international community, co-ordination and communications proved extremely difficult. Often, communities were not engaged, information was not shared, and goodwill was squandered. Even when strong results were achieved technically, they were often counterbalanced by misunderstandings and regulatory confusion. Co-ordination descended into cacophony and dismay over missed opportunities to create lasting and meaningful social impact.

Over the summer of 2015, at a set of training events for UAViators, Patrick and I reflected on what went right and wrong in Nepal. Unquestionably, some important work was accomplished in the areas of SAR, damage assessment and rapid situational awareness. Groups like Medair from Switzerland and Global Medic from Canada achieved impressive results. However, those specific accomplishments came at a more general cost.

Could the miscommunication have been averted if one of the more established actors had taken on a direct co-ordinating role right from the start? Did specific actors cross lines of propriety that changed the context for everyone? Was there a basic disconnect between private actors with technological experience but little background in disaster response, and humanitarian actors with the opposite strengths and weaknesses? Was the technology itself, for certain applications and situations, simply not ready for prime time?

Parts of all of these questions pointed towards important lessons in technology and humanitarian response. There was a need for established actors to leverage their authority in this space. Technology implementers and humanitarian agencies could do much more to get on the same page conceptually. But none of these observations hit the centre of the bullseye. Taken as a whole, they did not promise a sufficiently new approach to the problems that surfaced in Nepal and elsewhere. We realised that rather than dwelling on the actions of any particular actor, we should recognise that something more fundamental was missing.

That something was locality, which will be discussed in Part II of this series. C·RJ

Author
Andrew Schroeder, *PhD, MPP, is Co-founder and Chief Operating Officer of WeRobotics.org*