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Smart Peacekeeping: Toward Tech-Enabled UN Operations

PROVIDING FOR PEACEKEEPING NO. 13

A. WALTER DORN

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Cover Photo: Technicians prepare an unmanned aerial vehicle (UAV) for the official launch ceremony of the UN's first UAVs. Goma, Democratic Republic of Congo, December 3, 2013. UN Photo/S. Liedi.

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Abbreviations

COTS	Commercial Off-the-Shelf
DFS	UN Department of Field Support
DPKO	UN Department of Peacekeeping Operations
DRC	Democratic Republic of the Congo
GIS	Geographic Information System
GOTS	Government Off-the-Shelf
GPS	Global Positioning System
ICT	Information and Communication Technology
IED	Improvised Explosive Device
IR	Infrared
IT	Information Technology
LED	Light-Emitting Diode
MONUSCO	UN Organization Stabilization Mission in the DRC
PCC	Police-Contributing Country
R&D	Research and Development
SMS	Short Message Service
TCC	Troop-Contributing Country
TechCC	Technology-Contributing Country
UAV	Unmanned Aerial Vehicle
UN	United Nations
UNPOL	UN Police
UV	Ultraviolet

Executive Summary

As the world's technological revolution proceeds, the United Nations can benefit immensely from a plethora of technologies to assist its peace operations. Missing such opportunities means missing chances for peace, as has happened far too many times in the past when the United Nations was ill-equipped for difficult mandates. To be effective in the twenty-first century, the world organization needs not only to enhance its own technological capabilities but also to know about the increased technology of conflicting parties and civilians in war-torn areas. Cell phones, smart phones, GPS, and the Internet are increasingly available and are changing the nature of conflict, even in remote areas. If the United Nations remains ill-prepared and unaware, its operations will be victim to potential adversaries and peace-process spoilers, including attackers using remote-controlled improvised explosive devices. Greater technological awareness will help the United Nations avoid attacks and also work with potential partners, like regional organizations and friendly coalitions of varying technological capacity.

Fortunately, significant progress is being made. The United Nations adopted a strategy for technology and innovation for peacekeeping. More importantly, it is showing the will and the means to implement this strategy. Furthermore, the emergence of the technology-contributing country (TechCC) concept offers new possibilities to complement the traditional notion of the troop-contributing country (TCC) and police-contributing country (PCC). TechCCs can greatly assist not only the UN directly but also the developing world, which currently supplies the large majority of uniformed peacekeepers but whose militaries are more low-tech. The proliferation of new technology, including in populations where UN peacekeepers are deployed, also allows the world organization to explore new options to create peace and stability.

UN missions can now reach out in new ways to local peoples because of the revolution in information technology, particularly using cell phones and smartphones. In such "participatory peacekeeping," the UN's security information can be partly crowdsourced by giving the locals a place to send their observations, alerts, and insights. Cooperative monitoring using inputs from the conflicting parties is also possible, where the levels of data sharing with the parties, from raw data to selected results, can be adjusted to meet the interests of peace. The United Nations can serve as an information gatekeeper for peace, building confidence while countering fear and scaremongering. This can allow the United Nations to turn the vicious spiral of conflict, which is based on misinformation and disinformation, into a virtuous cycle of conflict resolution based on validated information. Indeed, the UN's power to protect depends on its power to connect. In an age when peace operations are mandated for the protection of civilians, it is essential to connect with them. Population-centric operations give peace a better chance, continuing even after the peacekeepers have left. The United Nations can help turn the fog of war into the clarity of peace, enabled by new technology.

Of course, innovation is not just about technology but about people and processes as well. Ideas must percolate continually. Research and development (R&D) needs to be carried out. Field testing and pilot projects complete the R&D cycle before procurement and deployment. The United Nations has very little experience in researching, developing, and testing new technologies, except in the area of information and communications technology (where it has developed a world-class capability). In all stages, TechCCs can help the United Nations considerably, both at headquarters and in the field.

The field workers of the United Nations risk their lives for peace. They remain the bedrock of international assistance in conflict areas. However, they must be able to "live, move, and work" effectively and safely. To do this, they have intensive information needs to "see, hear and think." Ongoing technological advances can help immensely in each of these areas. An array of monitoring technologies can help create a "digital peacekeeper" with full access to the suite of sensors and information sources. However, human interactions with the local population remain essential, and human privacy must be respected. Various technologies can be explored to facilitate such interactions, as described herein.

This report provides: (1) an overview of technological possibilities, highlighting recent advances;

(2) specific examples of how some of these capabilities can be used in contemporary peace operations; (3) a framework for thinking about technology, based on the three imperatives to "live, move, and work" in the field; (4) a case study on police technologies; (5) a summary of progress to date; (6) an analysis of some key challenges; and (7) a set of practical recommendations.

The UN is now making the most concerted effort in its history to advance peacekeeping technology. The UN Departments of Peacekeeping Operations and Field Support (DPKO/DFS) created the Partnership for Technology in Peacekeeping in 2014 to facilitate work with a wide range of organizations, including member states, regional organizations, think tanks, and academic/scientific institutions. Fortunately, technology is getting much better, less expensive, and more user-friendly over time, making this initiative a winning proposition. But much more can be done.

The recommendations in this report include both general principles and specific applications. It proposes the following principles:

1. **Seek the buy-in from host countries and local populations** so locals support the technologies.
2. **Use greater feedback and reach-back to UN headquarters and other international supporters**, made easier as technology allows more information processing and support from further away in both directions.
3. **Develop life-cycle equipment management**, encouraging a systematic approach that maximizes technological potential.
4. **Manage expectations** so that some failures can be tolerated along the road to success and so innovation can flourish without unreasonable fears.

Beyond these general principles, many ideas for new activities and processes are proposed and explored:

1. **At UN headquarters**, develop a "solutions farm" and a "tech watch" with "tech scouts," annual reviews (audits) of UN technology and innovation, technology selection criteria, cooperation with R&D institutes, and national testing and evaluation centers.
2. **In the field**, institute testing of new equipment, "proofs of concept" and pilot projects, demonstration kits, technology lessons-learned reporting, and special technological missions.
3. **Engage TCCs and PCCs** by incentivizing them to bring in effective modern equipment (through financial and other incentives), providing them training to foster technological expertise, and encouraging TechCCs to assist TCCs and PCCs.
4. **Engage external actors and vendors** by hosting a technology fair or "rodeo" and supporting a "hackathon" for smartphone and tablet app-developers on useful applications for peacekeeping.

After instituting a major technology upgrade, the United Nations will be much better equipped to handle the challenges of the twenty-first century. A new generation of smart technologies can make peacekeeping more effective. And when smart technology is finally and firmly integrated, the former critics will ask, "How could we have lived without it?"

Technological Revolution

We live in a world of fast-paced technological progress, with new life-changing domains expanding constantly. From the first website in 1991, the Internet grew to 10 million sites in 2000 and to an amazing 1 billion sites in 2015, accessible to more than half of the world's adult population—and new initiatives are aiming to include the other 3 billion.[1] Mobile phones have proliferated so fast and so widely that subscriptions now exceed the number of people on earth, and the developing world reached 70 percent cell phone penetration over the span of one decade in the new century, leapfrogging an entire generation of landline technology.[2] In addition, cell phones have become "smarter" with the incorporation of text message, e-mail, and Internet services, cameras, positioning systems, accelerometers, and a host of other hardware and software. Data transfer on smartphones has skyrocketed: in 2015 alone, over forty times more data was exchanged on mobile devices than on the global Internet in 2000.[3] Online information doubles roughly every two years as computer software and hardware play a constant game of tag. While capabilities have climbed, costs have decreased astonishingly: for example, the price-to-performance ratio for computer storage has improved by an astronomical factor of 10 billion since the early commercial computers.[4] Devices have also become orders of magnitude faster, and smaller, as well as more capable. In the twenty-first century, mobile phones, e-mail, and social media have revolutionized the way people connect, communicate, and store their information.

The information technology (IT) revolution is but one of many areas of scientific and technological advancement. New medical technology is keeping people alive longer and in better health. Engineering and materials science are producing an endless string of inventions in areas ranging from architecture to clothing. Space science is propelling probes to the outer reaches of the solar system and beyond. On earth, solar radiation is increasingly being harvested for energy; the yield from commercial solar cells increased more than fivefold over the past five years.

The military sphere has been one of the drivers of the technological revolution. The spillover of military innovation into the civilian world led to the creation of e-mail—initially designed to allow unfailing communication through alternative nodes in the case of a disruptive (nuclear) war—and also the global positioning system (GPS)—originally designed to guide soldiers and military vehicles, ships, and planes, and now aiding people around the world with personal navigation.

Some technologies properly remain the preserve of the military, such as new explosives technology permitting smaller munitions with greater yields.[5] Precision-guided munitions can be delivered with high accuracy (through GPS, inertial systems, or laser guidance), representing a revolution in military affairs. Such munitions can even be guided from the other side of the planet, posing both new opportunities and new dangers of misuse, escalation, and proliferation. Remotely piloted or unmanned aerial vehicles (UAVs) provide new platforms for both cameras and (controversially) missiles. The revolution in artificial intelligence and robotics makes possible a new generation of devices for field operations, including, ominously, the rise of lethal autonomous robots, unless the countries of the world agree to some form of arms control. Net-centric warfare is already a reality in modern militaries, where commanders, soldiers, sensors, and weapons systems are connected in real time, creating an "Internet of things" on the battlefield linked to command centers far away. New weapons systems are being introduced at a dizzying pace.

1 Internet Live Stats, "Total Number of Websites," available at www.internetlivestats.com/total-number-of-websites/ . For wider Internet access in the world, see initiatives like O3b Networks, "Who We Serve," available at www.o3bnetworks.com/service-coverage/ .

2 International Telecommunications Union, "ICT Facts & Figures," 2015 and earlier years, available at www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2015.pdf .

3 Cisco, "Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2015–2020," February 3, 2015, available at www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white_paper_c11-520862.html .

4 The computer price-to-performance ratio, using storage as a performance indicator, has improved ten orders of magnitude since the first commercial computers in the 1950s. In the early 1950s, the "state-of-the-art computer" had 1 KB of "core storage" and cost over $10,000, whereas today a laptop with 1 terabyte (1,000 billion bytes) of hard disk space can be purchased for under $1,000 (current dollars).

5 This increase in explosive power is sometimes characterized in colloquial expressions: "More bang for the buck" or, in the Russian equivalent, "more rubble for the ruble."

But has the means to promote peace kept pace with the means to wage war? Has humanity made as much progress politically as it has technologically? While not at the extraordinary pace of technological progress, innovation has occurred in some international political and operational fields. Peace operations have expanded to include the deployment of international military, police, and civilian personnel to areas of conflict, with the consent of the main parties to the conflicts, to prevent, mitigate, or terminate the conflict, protect civilians, and assist with post-conflict reconstruction. Such operations, which the United Nations refers to as either peacekeeping operations or special political missions, are a key tool of the international community.

Fortunately, UN peace operations have evolved, though this progress is more evident in broadening mandates than in expanding means. Ongoing challenges remain apparent in many areas, especially the strong dependence of UN missions on conflicting parties to moderate their violent behavior. Peace operations also overly rely on troop and police contributors from the developing world, which are not as technologically advanced.

Peacekeepers are often underequipped, poorly informed, and sometimes not willing to risk their own lives or risk escalation of the conflict. So too often, they refrain from intervening or using the requisite measures, including force, even in the face of terrible atrocities.[6] Fortunately, advances in technology offer new and exciting possibilities for informed action. New technologies can enhance peacekeeping considerably, as described by recent UN panels, including the High-Level Independent Panel on Peace Operations.[7] An expert group dedicated to the topic, the UN's Panel of Experts on Technology and Innovation, pointed out in its 2015 *Performance Peacekeeping* report that technologies can greatly assist with civilian protection and, indeed, the entire range of peacekeeping mandates.[8] Extrapolating from the report, it should be possible to have a revolution in peacekeeping affairs that parallels (and piggybacks on) the revolution in military affairs.

Technology provides new means and enablers for the United Nations, from remote observation to nonlethal weapons. But the UN, unfortunately, is technologically behind advanced militaries, or, as the report states, "well behind the curve."[9] Under-Secretary-General for Peacekeeping Operations Hervé Ladsous lamented: "Clearly we cannot continue to afford to work with 20th century tools in the 21st century."[10]

So a contemporary challenge is to find the best technological devices and systems for peace operations. Granted, the coupling of new technologies and peace operations can be problematic, given the wide range of technological levels among the countries of the world, among deployed contingents, and within the UN Secretariat. Fortunately, the UN's peacekeeping architecture is now more willing than ever to modernize technologically.

The leaders of the Departments of Peacekeeping Operations and Field Support (DPKO/DFS) recognize not only the need to achieve greater effect in the field but also their duty to provide the proper means and tools to the people they send to dangerous areas to do life-threatening jobs. UN officials have a responsibility to ensure the safety and security of UN peacekeepers, while these field personnel, in turn, strive to save lives and promote a fragile peace.

An important window of opportunity has opened for technological progress: after the 2015

6 United Nations, *Evaluation of the Implementation and Results of Protection of Civilians Mandates in United Nations Peacekeeping Operations: Report of the Office of Internal Oversight Services*, UN Doc. A/68/787, March 7, 2014, available at https://oios.un.org/resources/ga_report/a-68-787-dpko.pdf .

7 The High-Level Independent Panel on UN Peace Operations endorsed an upgrade of UN technology as proposed by the earlier Panel of Experts on Technology and Innovation in UN Peacekeeping (see section 10, "Technology and Innovation"). United Nations, *Report of the High-Level Independent Panel on Peace Operations on Uniting Our Strengths for Peace: Politics, Partnership and People*, UN Doc. A/70/95-S/2015/446, June 17, 2015, pp. 92–93, available at www.un.org/en/ga/search/view_doc.asp?symbol=A/70/95 .

8 Panel of Experts on Technology and Innovation in UN Peacekeeping, *Performance Peacekeeping*, February 19, 2015, available at www.performancepeacekeeping.org.

9 Panel of Experts on Technology and Innovation in UN Peacekeeping, *Performance Peacekeeping*, p. 3. The United Nations had been encouraged to explore possibilities for peace technologies in two early IPI/IPA reports: International Peace Academy, "Weapons of Peace: How New Technologies Can Revitalize Peacekeeping: A Report of the IPA Task Force on Technology," 1980; and Hugh Hanning, ed., *Peacekeeping and Technology: Concepts for the Future*, International Peace Academy, 1983.

10 Al Jazeera, "UN Peacekeeping Chief Wants More Drones," May 30, 2014, available at http://www.aljazeera.com/news/africa/2014/05/un-peacekeeping-chief-wants-more-drones-201453045212978750.html .

report of the Panel of Experts on Technology and Innovation in UN Peacekeeping, DPKO/DFS began earnestly seeking to implement its recommendations, and a number of countries came forward to help. Some Western states, like the Netherlands and Sweden, have re-engaged in UN peacekeeping after their Afghanistan deployments, bringing new technological prowess to selected missions, like the one in Mali. Others, like the United States, are supporting the advancement of the UN's technological capacity rather than deploying large numbers of troops. At the Leaders' Summit on Peacekeeping (September 28, 2015), the co-chair, President Barack Obama, promised that the United States would help identify "state-of-the-art technology" for the United Nations. Furthermore, a White House memorandum on the same day stated "the United States will seek to become a leading 'technology contributing country' [TechCC] to UN peace operations."[11]

What types of technologies can assist and enable peacekeeping? Through the trinity of "live, move, and work," one can envision technologies that support and sustain the peacekeepers ("live"), transport peacekeepers to areas where they can be most effective ("move"), and help them to keep the peace ("work"), including possibly to use precise force against attackers when necessary. At the same time, the technologies used in all three functions should reduce the environmental impact on the host country and the wider world by helping to "green the blue."

All these functions rely on accurate and current information to help peacekeepers "see, hear and think" as they "live, move, and work." In a world connected through information and communication technology (ICT), the UN's headquarters and missions have to keep pace with developments in the field, including through real-time monitoring. They have to remain constantly vigilant of positive and negative developments, not only in UN deployments but around the world, as events in one area have repercussions in faraway places. And simply gathering information is not enough; it has to be analyzed to create actionable intelligence. So before analyzing the technologies needed to "live, move, and work," we look at the "see, hear and think" (information) technologies needed to make informed decisions. This begins with technologies to help understand the environment more profoundly and increase situational awareness.

Intelligence-Led Operations

VIGILANT EYE OF MONITORING TECH

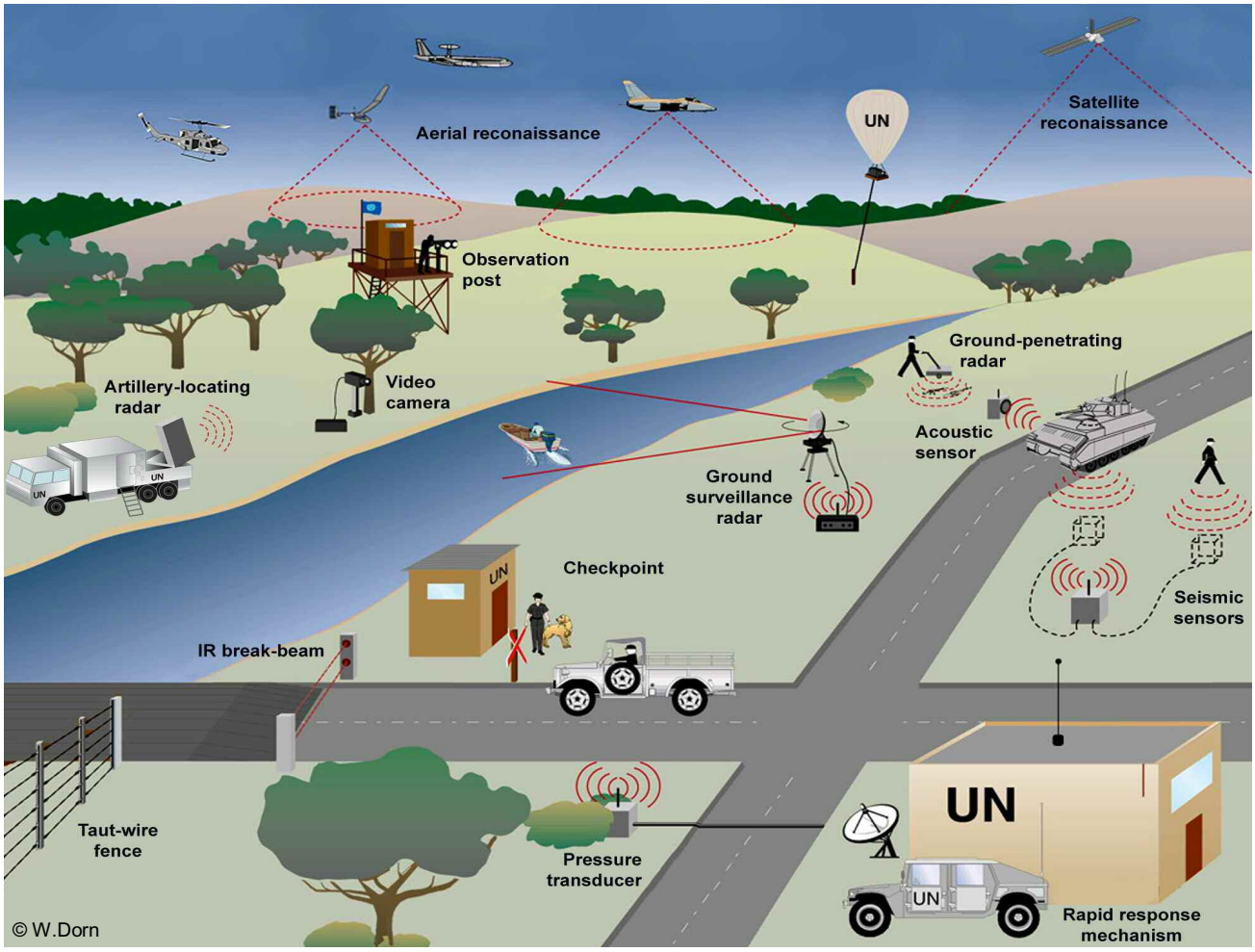
The range of possible monitoring systems to enhance peace operations is enormous. Figure 1 shows platforms in outer space, in the air, on the ground, and even underground. But in its history, the United Nations has deployed fewer than half of these sensors. Most UN observation has been done with the human eyeball, sometimes aided by binoculars. While the human being on the ground will always be important, modern sensors can help considerably, especially as the technologies become better, cheaper, and more integrated into networks.

The technologies in Figure 1 have many benefits for UN missions. They increase the range and accuracy of observation; permit continuous monitoring (at night and in daylight); increase effectiveness of deployed units (including cost-effectiveness, in some cases); decrease obtrusiveness, because UN staff need not be continuously present (thus enhancing staff safety as well); and provide recordings that can be used for later analysis and as evidence in criminal tribunals.

At the top of Figure 1 is satellite reconnaissance. Once the sole preserve of superpowers, high-resolution imagery is now commercially available (down to 0.2 meters) to any person or organization able to purchase the imagery. The prices are falling, as are latency periods and delivery times, meaning that near real-time reconnaissance is now possible for the United Nations. The development of these widespread commercial capacities has superseded the 1978 French proposal to the UN General Assembly for a dedicated International Satellite Monitoring Agency. An office of image analysts with a modest budget to buy near real-time imagery would suffice, though this has not yet been

11 Barack Obama, remarks at UN Peacekeeping Summit, Trusteeship Council Chamber, UN headquarters, New York, NY, September 28, 2015, available at www.whitehouse.gov/the-press-office/2015/09/28/remarks-president-obama-un-peacekeeping-summit ; and White House Office of the Press Secretary, "Memorandum for the Heads of Executive Departments and Agencies: United States Support to United Nations Peace Operations," September 28, 2015, available at www.defense.gov/Portals/1/Documents/pubs/2015peaceoperations.pdf .

Figure 1. Monitoring technology for peace operations



developed within the UN Secretariat.[12]

As of yet, the United Nations has not made the jump from mapping imagery (cartography) to operational imagery, whereby users in dispersed locations can add new information in real time to a common geographic information system (GIS). While the free Google Earth software is widely used at UN headquarters and in field missions, the satellite imagery is typically many months old. Advanced GIS can overlay satellite imagery with current information gained from aerial and ground sources, including images taken with peacekeepers' cameras or unattended cameras or crowdsourced from the local population.[13] Such data fusion can help give advance warning of attacks or rebel movements across the borders with neighboring countries.

Any part of the earth's surface can legally be monitored from outer space without permission from the country being observed. By contrast, observation from the air requires host-state consent, though this is usually granted to UN operations. The United Nations made a large step forward in aerial reconnaissance with the deployment of the first UAVs under UN control in the Democratic Republic of the Congo (DRC) in 2013 (see Box 1). The UN Organization Stabilization Mission in the DRC (MONUSCO) also purchased

12 The European Organization for Nuclear Research (CERN) helped fill a void by creating its Operational Satellite Applications Programme (UNOSAT) in cooperation with the United Nations Institute for Training and Research (UNITAR). UNOSAT offers to purchase and interpret commercial satellite imagery on a fee-for-service basis or using funds provided by donors. Impressive imagery and more information can be found at www.unitar.org/unosat .

13 See Patrick Meier, *Digital Humanitarians: How Big Data Is Changing the Face of Humanitarian Response* (Boca Raton, FL: CRC Press, 2015); Heather Leson, interview by Cat Cochrane, "How a League of Digital Humanitarians are Crowdsourcing Crisis Response," Crowdsourcing Week, March 28, 2016, available at http://crowdsourcingweek.com/blog/advancing-crowdsourcing-digital-step-ladders-engagement .

Box 1. UAVs in the DRC

The UN's mission in the DRC first asked UN headquarters for UAVs following the successful UAV deployment by the European Union Force in support of the UN-aided 2006 Congolese elections. Then a commercial bidding competition was held in 2007, but the results were challenged and not approved by the UN Headquarters Committee on Contracts. Another bidding process was held in 2009, but, after a winner was selected, the mission decided to spend the funds on helicopters instead. It was not until 2012 that the process was successful. A new under-secretary-general for peacekeeping, Hervé Ladsous, pushed for UAVs in the mission and wisely sought and quickly gained Security Council endorsement for a UAV system on a trial basis. The system was successfully procured and deployed to Goma in eastern DRC, with the first official flight in December 2013 (see cover of this report). The UAVs came from Selex ES, the Italian company that had won the bid and flies the UAVs.

Soon after attaining full operating capability in April 2014, the UAVs saved lives. During an exercise in May 2014 to test the ability of the UAVs to work with newly installed radars on the shores of Lake Kivu, the UAV image interpreters spotted a sinking passenger boat. The UAVs then guided Uruguayan patrol boats and UN helicopters to the site in order to pick up as many survivors as possible, saving fifteen lives. This gained the gratitude of the local community and favorable international press.

The UAVs were also used for robust protection tasks, including by the Force Intervention Brigade, the branch of the mission that had a mandate for "offensive operations" to neutralize illegal armed groups.[14] The UAVs spotted illegal checkpoints and illicit mining, surveyed destroyed villages, located rebel camps, and determined the presence of weaponry. During kinetic UN operations to destroy the camps, UAVs provided real-time situational awareness.[15] The airborne devices sent imagery to mobile terminals held by soldiers on the ground. The imagery helped peacekeepers observe the movements of rebel forces and avoid ambushes. Thus the UAVs helped to neutralize various rebel groups that posed a great threat to the eastern DRC.

The mission's UAVs have also been used by UN humanitarian agencies to check far-away villages and UN-supplied camps. However, some of these agencies have raised concerns about the need to maintain "humanitarian space" from military forces and any UAV systems employed by the military.[16] But the UAVs in the DRC have conducted route reconnaissance before the deployment of aid convoys and assisted aid agencies. Local police have also requested that UAVs overfly areas during their operations.

high-resolution "paparazzi-style" cameras to photograph the hideouts of rebels who were attacking the civilian population. MONUSCO also employed armed helicopters with night vision, rockets, and machine guns to help prevent attacks. The helicopters served as a powerful deterrent that, on occasion, fired on rebel belligerents in their jungle hideouts.[17] The success of the UAVs and armed helicopters in the DRC is helping propel their deployment in other missions, especially in Mali and the Central African Republic. The Dutch contingent in Mali has used both UAVs and Apache helicopters with camera pods to great effect. Showing that UAVs are becoming "standard kit," the Swedish contingent in Mali deployed three types of its own UAVs, including mini-UAVs.

Aerostats (tethered balloons) have not been used by the United Nations until now. Such camera-carrying balloons are being deployed to Mali to keep watch over remote airfields, which were subject to attacks and the planting of improvised explosive devices (IEDs). The aerostats used by NATO in Afghanistan employed sensor suites that could detect the direction of gunfire using acoustic

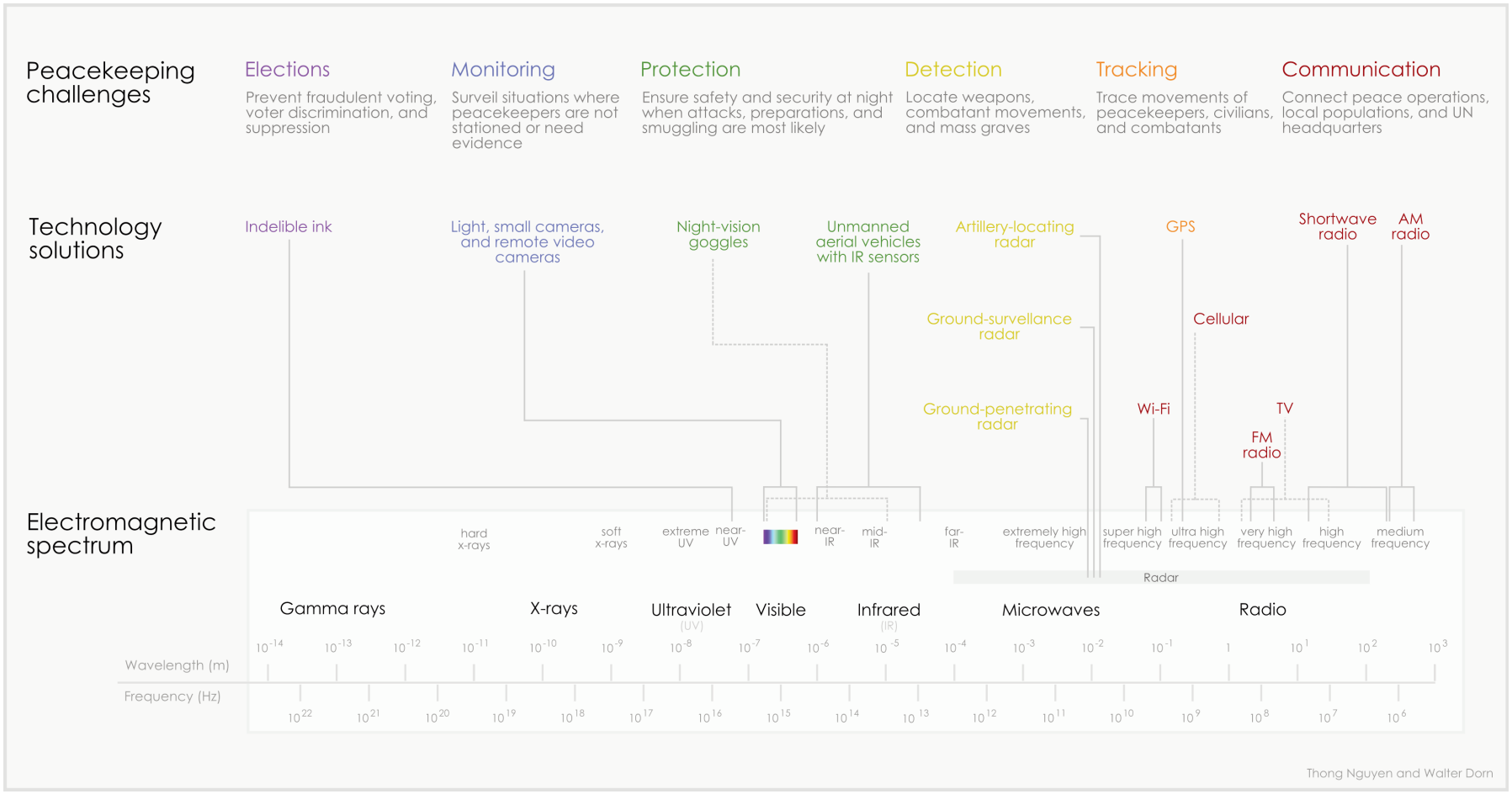
14 UN Security Council Resolution 2098 (March 28, 2013), UN Doc. S/RES/2098.

15 Hervé Ladsous, "Briefing to the Security Council on the Use of Unmanned Aerial Systems in the Democratic Republic of the Congo," May 14, 2014.

16 UN Office for the Coordination of Humanitarian Affairs, "Unmanned Aerial Vehicles in Humanitarian Response," OCHA Policy and Studies Series, no. 10, June 2014, available at https://docs.unocha.org/sites/dms/Documents/Unmanned%20Aerial%20Vehicles%20in%20Humanitarian%20Response%20OCHA%20July%202014.pdf .

17 See A. Walter Dorn, "Combat Air Power in the Congo, 2003–," in *Air Power in UN Operations: Wings for Peace*, edited by A. Walter Dorn (Farnham, UK: Ashgate Publishing, 2014). A GPS box was placed aboard the helicopter to add location information to the camera images using the military grid reference system with one meter precision.

Figure 2. The electromagnetic spectrum, highlighting examples of technologies to assist peacekeeping



sensors and automatically swing onboard cameras in that direction. Dispatched forces could then observe the situation as they moved toward that location. Such forces could also draw information from an array of sensors on the ground, some of which can be dropped from aircraft. The information collected from airborne and ground sensors can help form an "Internet of things" in the UN's areas of operation in the future.

The sensors depicted in Figure 1 sense electromagnetic radiation in one or more of its many forms (see Figure 2). The center of the spectrum (0.4–0.7 micrometers in wavelength, from violet to red) is visible light (more detail below). To the left is radiation of lower wavelength, which has a higher frequency and greater energy.[18] These waves have less utility, since they are ionizing and detrimental to living cells. However, man-made x-rays, generated by insulated sources to protect operators, can be used to look inside cargo to detect contraband. More frequently, they serve medical purposes in UN hospitals.

The UN has used ultraviolet (UV) light in a particularly creative way. During certain UN-sponsored elections, the world organization has sought to prevent people from voting twice by asking voters to mark one of their fingers with indelible ink after casting a ballot. The ink is invisible to prevent the voters from being subject to discrimination, particularly in areas where adverse groups discourage or intimidate people from voting or punish people who vote. However, the ink appears under a UV lamp, so voters' hands are checked before they fill out a ballot at the polling booth, catching any persons seeking to vote a second time.

Technology to detect and capture visible light is the most explored for the obvious reason that the human eye operates in this part of the electromagnetic spectrum. Cameras have undergone a revolution. By moving from film (emulsions) to digital imagery, cameras have become smaller and lighter and include digital-zoom and image-enhancement software. They are frequently integrated with other technologies, such as smartphones. Remote video cameras (like those set up by the UN force in Cyprus[19]) can digitally transmit images of hot spots where no peacekeepers are stationed. Image-intensification technology allows low levels of visible light to be amplified so that faint objects become bright, including at night. Such night-vision devices are often also sensitive to radiation in the near-infrared (IR) part of the spectrum.

The right side of the spectrum (longer wavelength and lower frequency than visible light) has much more to offer for monitoring and surveillance than the left side. The IR region includes what humans experience as heat. Sensors that detect thermal IR radiation allow heat from human bodies and vehicles to be viewed at night. While image intensification devices can work with low ambient visible light, only thermal IR works in pitch blackness (no moon, stars, or nearby illumination). Breaking the night barrier is essential for UN forces, because many nefarious activities in war-torn areas are done using the cover of darkness, including attacks (or preparations for dawn attacks) and smuggling of illicit arms and human beings. Since many atrocities are committed at night, peacekeeping cannot be a daytime-only job. Night-vision goggles or UAVs equipped with IR sensors enable peacekeepers to see and operate much better at night to fight crime and violence.

After substantial research and development, military forces in some advanced countries are equipped with fourth-generation IR devices, which "turn night into day." But the United Nations has had to settle for generation 2+ devices with relatively poor resolution, unless the advanced militaries bring their own higher-generation devices. Unfortunately, some governments have not provided the export permits for better devices to be sold or provided to the United Nations.

Other types of devices can also increase nighttime awareness. For instance, radar can be used in nighttime as well as daytime. Radar (radio detection and ranging) spans a broad range of spectral frequencies (as seen in Figure 2). Radar devices generate electromagnetic radiation and detect how these waves rebound off distant moving objects. European contingents brought advanced radars to the UN's Lebanon mission. The French

18 The frequency (ν), wavelength (λ), and speed of light (c) are connected through the equation $c = \nu\lambda$, where c is a constant (3×10^8 m/s). Also, the energy (E) of the radiation is equal to the frequency (ν) multiplied by Planck's constant (h), so $E = h\nu$.

19 A. Walter Dorn, "Electronic Eyes on the Green Line: Surveillance by the United Nations Peacekeeping Force in Cyprus," *Intelligence and National Security* 29, no. 2 (2014).

artillery-locating radars in Lebanon (illustrated by the vehicle on the far left of Figure 1) helped identify the locations from which mortar rounds, rockets, and missiles were fired. Another radar type, ground-surveillance radar, can detect a person walking more than ten kilometers away at night. Ground-penetrating radar, not yet deployed in UN missions, can help find hidden weapons caches that are in violation of the disarmament provisions in peace agreements or Security Council sanctions. Such ground-penetrating radar devices can also help locate mass graves, allowing bodies to be exhumed and forensic evidence to be gathered for criminal investigations.

The other areas indicated on the spectrum are used for communication. The longer the wavelength, the further the wave can be transmitted. For instance, shortwave and high-frequency signals can go beyond the line of sight, unlike very-high-frequency signals, which are typically used for handheld radios and walkie-talkies, and ultra-high-frequency radiation. Shortwave and high-frequency signals can follow the earth's curvature by bouncing off the atmosphere.

The comparatively narrow cellular and Wi-Fi bands of the spectrum will likely broaden in the future because of their growing use and congestion. Some UN missions are also exploring the use of "TV white space" (little used frequencies allocated to conventional television signals) for extra communications bandwidth. Public radio transmission frequencies have been fixed for almost a century: FM is 88–108 MHz and AM is 530–1700 kHz. But broadcasts from ground transmitters are gradually being replaced by radio signals from satellites and sent through the Internet, whose data can also be conveyed through cell phone frequencies, microwaves, and Wi-Fi (for short ranges). With increased speed (bandwidth), ICT can transmit more and more information, including from social media (e.g., Twitter feeds), with imagery and voice or video transmissions.

In field missions, the United Nations takes responsibility for communications between the mission headquarters and various contingents' headquarters. Within their areas of operation, the soldiers in each military contingent must communicate using their own national equipment—radio systems that are generally not compatible between countries. As a result, major communication problems often arise between disparate contingents. Sometimes the UN cannot let contingents operate close to one another because they cannot talk or send text messages. Fortunately, new means are available to integrate different communications systems. For instance, the radio interoperability system, recommended by the US military, can integrate cell phones, Internet-protocol (IP) video cameras and personal computers, and portable and tactical radios to allow for communication across the entire system. Furthermore, the United Nations has installed radios with the terrestrial trunked radio (TETRA) standard in some of its vehicles, allowing UN staff (though not contingent vehicles) to communicate securely using encryption, as well to have their vehicles tracked.[20]

For the UN's own communications, encryption is generally necessary. Otherwise, UN communications can be misused. For instance, in Bosnia in the early 1990s, some peacekeepers were sending unencrypted radio messages to a local UN base, reporting the landing locations of Serb mortar fire. Unbeknownst to them, the Serb militias were eavesdropping and using that information to correct their fire to hit their targets more precisely.

Some advanced contingents are able to track their vehicles in real time, using GPS and displaying locations on a screen as part of a GIS. This added security can be achieved even in remote areas by satellite communication, when tracking devices onboard the vehicles transmit coordinates at set intervals. First, the GPS devices on the vehicles pick up signals (1.2 and 1.5 GHz) constantly broadcast from the GPS satellite constellation. Through a sophisticated form of triangulation, the device can determine the vehicle's location (typically to within five meters, but some devices are capable of greater precision). The vehicle device then transmits the location information to another set of satellites, which convey the information to remote users, and possibly the Internet. The United

20 Terrestrial trunked radio (TETRA) is a secure mobile system for both tracking and radio communication. It is a standard developed by the European Telecommunications Standards Institute (ETSI). For more on tracking, see A. Walter Dorn and Christoph Semken, "Blue Mission Tracking: Real-Time Location of UN Peacekeepers," *International Peacekeeping* 22, no. 5 (2015).

Nations is planning to upgrade its current tracking system, Carlog, which has no satellite upload capability but only downloads the tracking information when the vehicle nears a receiver, usually at base. It is about to enter the era of real-time tracking.

Given that the United Nations operates in some of the most remote and hostile areas of the world, it is doing fairly well with ICT. It is able to set up communications with New York (including video conferencing) within twenty-four hours of deployment, making it one of the world's IT leaders in large-scale field deployments. Given the rapid evolution of commercial ICT, the organization cannot keep up with the cutting edge of technology, but it still benefits from the amazing developments of the digital age.

THE DIGITAL PEACEKEEPER

Beyond missions as a whole, individual peacekeepers—military, police, and civilian—can be equipped with technology and connected to networks, as depicted in the concept of the "digital peacekeeper" from the report of the UN's Panel of Experts on Technology and Innovation in UN Peacekeeping.[21] The information technologies envisioned under this concept, summarized below, are feasible, though some are quite advanced and available only in preliminary form or only to the world's most advanced militaries and police forces. They also require excellent connectivity (fast speed and high bandwidth) in the field. This depiction of the "digital peacekeeper" gives a sense of what is at the cutting edge for the world's most advanced militaries and could become possible for the peacekeepers of tomorrow.

Uniformed peacekeepers, whether soldiers or police, can gain superior situational awareness through integrated sensors on their person (body tech), as well as on remote platforms. The information-sharing interface can be worn as a visor or held as a tablet (including with flexible-screen armbands) to provide quick access to vast resources of data in customized information streams. Such connectivity also allows peacekeepers to share their own information, including imagery, with nearby commanders and distant headquarters. For instance, body cameras worn by peacekeepers can send continuous imagery for real-time analysis by a support office. Backward-looking cameras can provide imagery on a peacekeeper's head-up display to spot anyone sneaking up from behind. The visor can also display key information on demand, including the results from voice-activated database requests or manual Internet searches. Alternatively, the information can be conveyed through computer-generated voice responses.

In foreign lands, peacekeepers can enjoy sequential or simultaneous voice-to-text or voice-to-voice translation using software that is already commercially available. For two-way communication back to base, an "in-ear" speaker can be complemented by an "in-ear" microphone that captures vibrations of the jaw to send peacekeepers' responses, a common feature in the communications equipment of advanced militaries.

Imagery from sensors on remote platforms, such as UAVs, can also be viewed on handheld tablets or smartphones. A mini-UAV can even be carried in a peacekeeper's backpack and launched by hand to get a view over the next hill (or further) and to help spot any ambushes or navigation hazards.

Since all of these technologies require electrical power, environmentally sensitive technologies are needed to reduce the carbon footprint of peacekeepers. To power the electronics on individual suits, compact energy sources could be used, possibly including fuel cells and solar-power packs, with high-efficiency cells on backpacks and tents.

For specialized circumstances, peacekeepers need specialized equipment. At night, they need thermal sensors and image-intensifying cameras. In areas with chemical hazards, they might need chemical sensors to detect poisons in the environment. For decontamination, special chemical protection suits are needed. For peacekeepers in danger of being wounded or facing other medical problems, physiological sensors on a body suit could alert both the peacekeeper and medics (near or far) of problems, enabling a more precise and accurate medical response, if required. For investigations of atrocities or crimes, UN police could

21 This description is based on the three "digital peacekeeper" figures in Panel of Experts on Technology and Innovation in UN Peacekeeping, *Performance Peacekeeping*, pp. 94–96. It also borrows from various national programs, including the United States' Future Force Warrior, the UK's Future Integrated Soldier Technology, France's Fantassin à équipements et liaisons intégrés, and Germany's Infanterist der Zukunft.

deploy with mobile forensics kits and crime-scene-investigation equipment, such as for illumination and DNA sample collection and analysis.

Civilian peacekeepers might not have the weapons of uniformed personnel, but they can also be digitally connected to an operations center and its GIS databases. Head-up displays are possible, though they may not be as robust as those for soldiers. Smartphones, tablets, and other handheld mobile devices may be more convenient to enable real-time information gathering and reporting, with specialized software designed to meet specific duties and responsibilities. Personnel would be trained to use emergency communications equipment from remote locations. For medical emergencies, peacekeepers would have basic trauma packs and special kits.

Back at mission headquarters, all of the information, including from field sensors and, of course, the peacekeepers themselves ("every soldier a sensor") can help create a "common operating picture." This can be used and selectively shared by the commander. Peacekeepers' positions can be tracked on a GIS (a computerized map, editable remotely, providing selectable "layers" of information). Command center personnel can click on a person or vehicle, view data on and from them, and assess threats using the long-range cameras or various platforms on or around the peacekeepers. As part of the mission's command-and-control system, GIS can help commanders dispatch the best units to deal with key situations—possibly the peacekeepers nearest to an incident or best equipped to assist. Data-support crews at mission headquarters can choose which data to send to peacekeepers in need, given the headquarters' access to an abundance of wider information on the operation and the environment. Furthermore, the headquarters staff in the Joint Operations Centre or Joint Mission Analysis Centre could help interpret images, documents, or signs caught on peacekeepers' body cameras.

The new world of "network-enabled" or "net-centric" peacekeeping can make UN operations smarter and more influential. It also can allow greater connection to both UN centers and the local population.

PROTECTION THROUGH CONNECTION

Knowledge is power, and properly used by peacekeepers it can be a power for peace. Under the new concept of "precision peacekeeping," it is easier to send the right peacekeepers to the right places to do the right things. This process is data-intensive and means that peacekeepers must be fed a constant stream of actionable intelligence. The challenge is to select the information most required from the "information ocean" (i.e., who needs to know what?). The UN's multidimensional operations must identify critical knowledge gaps at each level, from soldier in the field to the secretary-general and the Security Council in New York. For this to happen, the operation must have sufficient personnel and institutional structures for gathering, sifting, processing, analyzing, and disseminating data. Commanders must specify their priority information requirements to enable evidence-based, information-led decision making. In modern operations, important information must not only be gathered from the local population but also selectively shared with the locals.

Especially with the rise of UN mandates for the protection of civilians and peacebuilding after war, UN missions need to be population-centric, requiring multidimensional information flows across the wide spectrum of threats and needs of the local people. UN missions have to keep continually aware of the population's views and vulnerabilities, including threats from a wide range of actors—not just armies facing each other (as was the case in traditional peacekeeping) but diverse internal and external threats from many sources. Thus, the United Nations needs "human security intelligence"—analyzed information on the wide range of threats and opportunities, problems and solutions for peoples and populations, including the political, economic, personal, environmental, food, and health dimensions.[22] Gathering such information is a huge task.

Under the new concept of "participatory peacekeeping," the mission engages the local population, allowing them to provide inputs and warnings and take some responsibility for their

22 Fred Bruls and A. Walter Dorn, "Human Security Intelligence: Towards a Comprehensive Understanding of Humanitarian Crises," in *Open Source Intelligence in the Twenty-First Century: New Approaches and Opportunities*, edited by Christopher Hobbs, Matthew Moran, and Daniel Salisbury (New York, NY: Palgrave Macmillan, 2014).

own security. In the digital age, it is possible to create a "coalition of the connected" that includes locals, thereby providing "protection through connection." UN-hired locals or UN international staff can receive and possibly verify early warning from citizen reporting and social media. This needs to be followed by quick responders on the ground.

A pioneering initiative is the Community Alert Network developed by MONUSCO in the DRC. Benefiting from the cell phone revolution, the UN mission distributed mobile phones to key local leaders, who could call the mission upon seeing signs of impending danger—a drastic improvement from earlier times when villagers were told to bang on pots. UN peacekeepers could, hopefully, be dispatched upon being alerted of trouble. Later, after the mission found itself expending too much effort on maintaining and repairing cell phones, it simply issued SIM cards to the locals, who had acquired their own phones.

MONUSCO established early-warning centers at the local, provincial, and national levels to serve as "hotlines" for the community liaison officials. Joint Protection Teams also worked with the local population for better prevention and rapid reaction. Furthermore, Joint Investigation Teams worked with the Congolese government to examine allegations of serious human rights violations after attacks. The Joint Investigation Teams helped to combat impunity by gathering evidence against alleged perpetrators and helped protect victims, witnesses, and human rights defenders.

To be truly successful, UN missions need to shift from reactive to preventive interventions. "Proactive peacekeeping" means intervening based on intelligence, identifying threats early, and planning responses well in advance. This reduces the mission's reaction time and increases its prevention period. It also requires real-time situational awareness for real-time decision making. Thus, UN forces can be better forewarned and prepared to deal with the range of potential situations.

For effective prevention and action, information needs to flow in both directions between the peacekeepers and the "peace-kept." Local populations are more likely to share information with the mission if they receive information from it. The cell phone revolution has made new forms of connectivity and sharing possible, with subscribers in the developing world jumping from 5 to 70 percent of the population since the turn of the century.[23] In some missions, like the one in Haiti, the United Nations has a call-in center to receive reports from locals on threats and criminal activities. Public information campaigns help close the information loop. The United Nations can supply information to the population by radio, television, email, the Internet, and social media, as well as through traditional community meetings and word of mouth. Some alert networks rely on short message service (SMS), which is widespread even in areas without smartphones. Like peacekeepers, locals in war-torn regions need objective and timely information to pierce through the fog of war and rumor. Sharing is key.

Within UN missions and at UN headquarters, the organization still needs to move from information sharing based on the "need to know" to a new mode of "dare to share" (in a responsible manner). Sharing, not hoarding, is collective power—power to do good through knowledge-based action. Of course, increased information sharing and data centralization needs to be balanced with the needs of confidentiality, privacy, partner caveats, and the protection of vulnerable sources and methods.

Knowledge-led operations require effective information sharing to avoid stovepipes and the misplaced, forgotten, and unused information that comes with them. Fortunately, the computer-networking revolution is helping considerably. "Network-enabled peacekeeping" is a proposed model that seeks to optimize connectivity and integration across the range of peacekeeping participants. This new model is possible because of the widespread adoption of new communications tools, big data, advanced analytics, dynamic flows, crowdsourcing, and geo-mapping/GIS. Ideally, a central repository integrates military, police, security, and civilian information from the various UN components and the local population. DPKO is now trying to improve and standardize a

23 Furthermore, "in 2015 there are more than 7 billion mobile cellular subscriptions worldwide, up from less than 1 billion in 2000." International Telecommunications Union, "ICT Facts & Figures," 2015 and earlier versions, available at www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2015.pdf .

platform called SAGE[24] for use across all missions to form a central information hub. This should reduce the inefficient practice of emailing many documents and spreadsheets in different formats (mostly Word and Excel files), which are hard to access later and to analyze as a whole.

To handle "information power," new forms of data management, visualization, and expression are required. Fortunately, many data tools are free or inexpensive and easy to use, like user-friendly apps on smartphones. Some industry standards (like i2 Analyst software) can be costly and involve substantial up-front investments and annual licenses. Some countries are providing the United Nations with special expertise. For instance, Singapore is helping peacekeeping operations with a new information management system to improve situational awareness,[25] and the United States is sharing its GIS expertise. DPKO/DFS are rolling out a Field Analytics Workspace to help managers discover, analyze, visualize, and share data more easily and confidentially.

Since 2006, DPKO has mandated its field missions to establish a Joint Operations Centre for short-term (current-day) information processing and a Joint Mission Analysis Centre (JMAC) for longer-term information analysis. JMACs now routinely contribute to information products such as mission threat assessments, warning notes, incident and trend analyses, and group profiling. They are also making some progress with more ambitious types of analysis, such as scenario building (e.g., best/worst/most probable cases) and risk mapping.

Specific data and analytical tools are needed not only to analyze the environment but also to measure a mission's effectiveness. This involves designing metrics and indicators (e.g., fatalities, data from investigations), as well as conducting surveys and implementing feedback systems within the mission itself and with the local population—again requiring a two-way dialogue.

Unfortunately, combatants are also embracing the information age and are becoming increasingly tech savvy, sometimes seeking to break into the UN's information databanks. Countermeasures are needed to protect the UN's sensitive information. For instance, the Syrian Electronic Army is known to target opponents of the regime. Its members can determine much about the people who document regime abuses and their sources from information made available online. The short-lived United Nations Supervision Mission in Syria (UNSMIS) was subject to attack both physically and, no doubt, electronically. In Eastern Ukraine, the Organization for Security and Co-operation in Europe (OSCE) found that its UAVs were deliberately jammed and left to fly uncontrolled, probably by Russian-aided rebels.[26]

Life Support and Logistics ("Live")

Information power applies to each element of the "live, move, and work" trinity. Before peacekeepers can carry out sophisticated operations ("work"), they need the means to intelligently sustain themselves in remote, conflict-ridden lands ("live"). This involves much more than information technology.

From the vast array of available technologies, some newer technologies useful to sustaining peacekeepers are listed below in a "catalogue of categories." These potentially valuable technologies can help peacekeepers live more safely and suitably in war-torn areas.

- **Accommodation:** bulletproof and blast-proof perimeter walls; lightweight, high-tensile-strength materials to construct both hard-wall and soft-wall structures, including for prefabricated buildings, domed shelters, and tents; durable sandbags and rapid-filling equipment; compressed earth brick makers; software planning tools (e.g., CAD drawing software) to design camp layout; advanced engineering equipment more generally

24 SAGE stands for Situational Awareness Geospatial Enterprise. It is software based on the Ushahidi platform for incident tracking and visualization. SAGE is used in many but not all UN missions and is currently being upgraded. Over the years, different field missions have developed different data management systems—including Integrated Text and Event Management (ITEM) in MONUSCO, Geographic Incident Analysis Tool (GIANT) in Sudan, System of Incident Reports (SOIR) in Lebanon, and SMART in Liberia—sometimes "reinventing the wheel" in different parts of the world. It is therefore appropriate to standardize a platform across missions while allowing sufficient flexibility for them to customize the interface and reporting process.

25 "UN and Singapore Agree to Develop Information Management Tool for Peacekeeping Operations," UN News Centre, December 10, 2015, available at www.un.org/apps/news/story.asp?NewsID=52789#.Vp1yGnz2ZlY .

26 For instance, see the OSCE report on its Special Monitoring Mission (SMM) to Ukraine, August 12, 2015, available at www.osce.org/ukraine-smm/177221 .

- **Communications:** converters to connect users on different devices (phones, radios, computers, etc.) and systems (e.g., of different military contingents); deployable Wi-Fi for camps with voice, video, and data transmission; fiber optics for high-speed, secure communications (where possible); encryption devices to prevent unwanted information disclosure; cell phone apps customized for peacekeeping functions (e.g., situation and flash reporting, evidence gathering, image transmission); solar-powered or windup radios for emergencies and for distribution to the local population; satellite phones and earth stations for the new-generation medium-orbit satellites; extra-bandwidth devices using TV whitespace
- **Energy and power:** high-efficiency solar arrays; wind- and water-powered generators (including micro-hydro generators); power switches to synchronize and optimize renewable energy sources with conventional fuel-powered (oil or gas) generators; silent generators to reduce annoyance and hide temporary camp locations; biogas plants for more permanent sites
- **Environmental sustainability:** testing equipment for air, water, and soil samples; devices to reduce material waste and energy consumption; field recycling systems for solids and liquids; biodegradable materials; high-quality insulation to prevent heat transfer; "smart" thermostats; cheap meters to report energy usage and wastage; low-energy lighting; high-pressure, reduced-flow showers and toilets; mufflers to reduce sound pollution; rainwater collection systems; efficient ablution systems
- **Food and water:** energy-efficient kitchens; lightweight freeze-dried survival foods (for easy storage); hydrologic mapping equipment, like ground-penetrating radar, to determine water well locations; efficient well-drilling devices and pumps (especially so as not to strain already scarce aquifers); water purification systems (including filtration, ultraviolet disinfection, and reverse-osmosis technologies); water-quality analysis kits; desalinization devices
- **Inventory control:** radio frequency identification for item tracking; cloud-based databases; tablets with connection to the databases
- **Lighting:** motion-activated solar-powered illuminators with high-efficiency light-emitting diodes (LEDs, for use in front of UN buildings, refugee tents, and even in village areas where violence is known to occur); solar-powered or windup emergency flashlights
- **Medical care:** ergonomic (single-hand) tourniquets; first-aid and emergency/trauma kits with both low- and high-tech supplies; bio-monitors; ventilators; defibrillators; medevac equipment (life-support systems); patient warmers and cold-pack units; blood-storage fridges; ultrasound and mini x-ray machines; modern surgical tools; telemedicine systems; secure medical info-management systems

Of all these areas, ICT is the one where the United Nations is most advanced. It has developed a world-class system. The Global Service Centre, located in Italy and Spain, supports about 50,000 computers and 1,300 servers through 400 satellite earth stations.[27] To support operations in Africa, a new Technology Centre and a Signal Academy were created at Entebbe Support Base. At UN headquarters, the Information and Communications Technology Division is expanding its Field Technology and Security Operations Section. Despite this progress, UN ICT users in the field often experience problems with low bandwidth and slow connections. Fortunately, commercial ICT is advancing rapidly and offering new solutions—as are the other technologies listed above.

Transportation ("Move")

Once peacekeepers have established their base ("live"), they must move to the areas where they will conduct operations ("work"). These areas can be close or far, but any movement to them should be made as safe and easy as possible. Mobility is key for UN operations, since there are rarely enough peacekeepers to adequately safeguard the large areas covered by most modern peace operations—areas that often span entire countries. In addition, peacekeepers must often move through difficult terrain and sometimes through hostile territory. During travel, many technologies can help. Below

27 Panel of Experts on Technology and Innovation in UN Peacekeeping, *Performance Peacekeeping*, p. 88.

are some important areas and specific technologies for the United Nations to consider including or upgrading.

- **Communications:** satellite phones (for remote locations with no cell phone service); emergency connection, calling, or text messaging on handheld devices; emergency-activated beaconing technology (for lost or crashed vehicles); systems that are interoperable between contingents and units for routine communications and emergency assistance and rescue operations
- **Obstacle avoidance or transcendence** (to overcome difficult terrain and climate, including in the rainy season and at night): appropriate vehicles (including appropriate tires, engines, and lights); engineering kits for route repair and remediation; vehicle extraction and recovery kits; night-vision technologies (e.g., goggles) for driving and flying in remote areas
- **Reconnaissance** (of routes and destinations): cameras on vehicles (feeding into a mission GIS); small tactical UAVs (to precede a convoy); aerostats (persistent surveillance of known choke points and hazards along routes); a standardized reporting system for route obstacles and threats (including IEDs)
- **Power and fuel:** backup fuel and power packs; generators (for emergency overnight stays); multiple-intensity flashlights; energy-efficient devices and vehicles
- **Safety and security** (especially to defeat man-made threats, including mines, explosive remnants of war and IEDs[28]): "bolt-on" armor on vehicles and flak jackets for personnel (lightweight for increased mobility); emergency-evacuation means (including medevac by air on standby); mine-protected vehicles (with v-shaped hulls); electronic countermeasures (e.g., IED jammers); ground-penetrating radar for subsurface mine and IED detection (route clearance); explosives-detection devices (handheld and vehicle-borne); explosive ordnance disposal devices; smart guns; traffic-collision-avoidance systems for aircraft
- **Tracking:** systems allowing peacekeepers and mission headquarters to see their movements (and any others in the system) in real time on a map.

Expanding Functions ("Work")

Once the peacekeepers can sustain themselves and get to the right spot, they must carry out their tasks, especially protecting civilian populations and promoting peace processes. The UN's multidimensional operations of the twenty-first century have wide-ranging responsibilities. The number and scope of mandates can sometimes overwhelm the UN Secretariat and peacekeepers alike, but Security Council directives are important. It would be impossible to explore all the technologies that can serve all of the different types of mandates that exist in modern UN operations. Instead, one major and growing UN activity, UN policing, is analyzed in detail to illustrate the benefits of new technologies. Then the broader range of peacekeeping activities is reviewed to give a sense of the even wider scope of technology.

"POLICEKEEPING" TECH

The role of police in peace operations expanded considerably after the Cold War and then again at the beginning of the twenty-first century. As UN missions struggled to deal with intrastate and intercommunity violence and the challenges of security sector reform, UN police (UNPOL) mandates grew, especially to monitor, support, advise, and operate with local police forces. However, like peacekeeping missions in general, the mandate expansion was not accompanied by a similar expansion in the tools provided. Thus, UNPOL developed a commitment-capability gap.

This is especially true for missions with an executive mandate (as in Kosovo and Timor-Leste, where UNPOL had a mandate to arrest individuals) and those missions that actively assisted local authorities to carry out law enforcement in war-torn lands. Strong UNPOL intervention and assistance is often necessary after the end of armed conflicts when local police forces are unable or unwilling to do the work alone. UNPOL's work can involve jointly patrolling, investigating, gathering

28 Based on recent field experience by advanced militaries, counter-IED work would include both "defeating the device" and "defeating the network," though the UN is more cautious in using and applying the term "defeat." In any case, intelligence is needed to determine the sources and means of financing, preparing, carrying and planting IEDs.

intelligence and evidence, arresting criminals, and conducting special operations, including raids. Important technologies used in contemporary UN policing, though general-type equipment, include some of those already mentioned:

- Optics, such as binoculars and cameras, to enhance daytime human vision
- Night-vision devices and cameras for visibility in low-light situations
- GPS and tracking devices for UN vehicles and personnel

But even in these basic areas, much improvement can be made. For instance, software-assisted image-stabilized binoculars can enhance optics for better long-distance viewing. Endoscopic cameras (also known as videoscopes or snake cameras), used by many modern police forces, can provide views through small apertures and around corners. As previously mentioned, cameras mounted on helmets and vehicles or worn on the body of UN police officers can take continuous video during operations for later analysis, which can improve performance and enhance accountability. Many similar night-vision devices are available: advanced monocular or binocular devices for patrols and sentry duty; helmet-mounted devices for driving in vehicles; weapons-mounted devices for gun sites; and tripod-mounted devices for static observation with heavier thermal-imaging cameras. Finally, tracking technologies should progress from tracking occasional signals to real-time tracking, including of UN police officers, vehicles and heavy equipment, and individuals, like very important persons (VIPs) or even known criminals or prisoners on parole.

Many other technologies already in possession by modern police forces are available for UNPOL to use. For instance, specialized metal detectors can help detect not only mines and IEDs but also stolen valuables and evidence left by criminals at crime scenes. More sophisticated "through-wall" detectors, such as radar scopes, can sense motion (in some cases even heartbeats) through a half-meter of concrete and twenty meters beyond into a room. They can be used for tactical or search-and-rescue operations, including in hostage situations. Hydraulic breaching arms can assist in surmounting barriers to entry.

Crime investigation, whether by the UN alone or in conjunction with local police, also calls for modern technology. Intercepting and recording tactical signals can be important for wiretap operations, including those targeting cell phone conversations and text messaging. However, these operations must be carried out with great care for selected applications only (e.g., hostage rescue) and must gain high-level authorization (e.g., from the mission head). Mature legal systems in democratic countries typically restrict the interception of conversations and require legal or judicial oversight. The United Nations should take similar measures, even for unruly, war-torn parts of the world.

By contrast, there are usually few restrictions on voice recording where one of the parties consents to the recording. This allows recording of conversations, both over the telephone (wired and cellular/wireless) and face-to-face between UN police officers and suspected criminals, possibly using body cameras with audio as well as video input. Recording equipment should be available in UN facilities like crisis centers. During negotiations with hostage takers, it is vital to record conversations. In Haiti, which has been plagued by kidnapping for ransom, criminal gangs use cell phones to negotiate their release demands and ransom instructions. The UN's inability to record these conversations—even where one of the parties was the consenting family—deprived the investigating officers of a valuable source of evidence. Voice recognition software, moreover, could help identify the culprits, analyze their demands, and link them to other offences. Furthermore, the United Nations could have used technology to locate cell phone signals to arrest the kidnappers and rescue the victims. Such technologies are relatively easy to acquire but require mission support and political will.

To train, mentor, and assist local police forces, the UN could use technologies such as databases to track the vetting and accreditation of local officers; physical tracking to know the location of police officers—local and UN—while they are on duty; and smart ID cards or biometric devices to confirm and validate the identity of police officers for reasons of administration (such as pay), command and control, or building access. Use-of-force and critical-decision support software can facilitate action. Simulation software (professional video

gaming) can help train officers to a specified standard for complex situations. Multilingual crime-reporting systems, with auto-translation, can also help, including record-keeping software to capture and analyze crime data on affected persons, property, and vehicles. Databases of criminal actions and known criminals can allow the host country and UNPOL to gather, collate, and analyze the required evidence.

Equipment for crime scene investigation (maybe not "CSI: UN," but still with some basic capacity) helps provide probative evidence for use in arrest operations and trials. Mobile labs carried in vehicles or even suitcases can include fingerprint lifters and scanners; forensic photographic equipment with special lighting, casting, and impression equipment; and relatively simple measuring devices (e.g., pocket lasers to determine a room's size). Cell phone analytics can be extremely valuable when a phone has been seized from criminals or illegal militiamen. Databases storing biometric information (including digitized fingerprints, iris scans, and facial-recognition data) can help identify criminals, including with automated fingerprint identification systems, which are becoming cheaper. End-to-end case-tracking systems can "strengthen all phases of law enforcement, from arrest, to investigation, prosecution and punishment."[29]

To investigate areas of active fighting and suspected bomb sites, unmanned ground vehicles can prove very useful, even lifesaving. Some are small enough to be tossed by hand or dropped by UAVs into a threatened area and controlled remotely to get an optimal view of the situation before UN police or soldiers intervene. Robotic cameras connected to a portable network-surveillance system can offer views from a wide variety of locations and angles, particularly useful to peacekeepers approaching suspected IEDs or other dangerous situations.

To enter a fighting zone or deal with hostile crowds, police need not only surveillance equipment but also body armor. This includes the standard bulletproof breastplate, made of advanced ceramics—not the heavy steel plates of yesteryear (still used by some countries). Modern armor is lighter and more flexible so as not to inhibit mobility. It may also include ballistic bicep and groin protection with an ergonomic design. See-through visors provide a degree of face protection.

To deal with violent offenders, hostile crowds, and a host of threats to UN personnel and civilians, nonlethal weapons should be an available option. Such weapons can assist with arrests while posing little or no danger to the local population. Tasers (often with laser sights and LED lights) are now routinely used by police forces in developed countries. With proper training and supervision, they could become a part of the UN's arsenal for peacekeeping (see Box 2). Both lethal and nonlethal weapons can incorporate password protection and biometric identification, such as digital locks, to make sure the intended user is the one operating the device. This can reduce the danger of misuse and theft of weapons.

These are some of the ways technology has already had an impact on policing in modern cities. While UN police can learn much from such experiences, they are only the beginning for applications of new technology in modern multidimensional missions.

MANDATE MULTITUDE

From policing assistance to cease-fire monitoring to the protection of civilians, the Security Council has given UN field missions a multitude of mandates. Many modern technologies can assist with these mandates, overwhelming as they are. Only a few broad areas can be mentioned here, focusing on the areas where the United Nations is deficient.

- **Arms control, disarmament, and demining:** many types of detectors of weapons, landmines, and IEDs, including metal detectors and ground-penetrating radar; robotic clearance and excavation; destruction technologies; firearm safety devices; tags, seals, and tracking devices
- **Cease-fire monitoring:** radars (for ground and air surveillance and artillery tracking) and other sensors (see Figure 1); crowdsourcing with image analysis and data verification; laser range-finders to determine locations of opposing forces

29 Panel of Experts on Technology and Innovation in UN Peacekeeping, *Performance Peacekeeping*, p. 95.

Box 2. Nonlethal weapons

Because peacekeeping is not warfighting, the use of force is much more restricted. Far too often, however, peacekeepers are unable to act even when an urgent response is required because they are rightly afraid to apply the deadly force they possess. The soldiers can try to argue and negotiate with the belligerents and attackers, but in many situations that is unfeasible. Other means are desperately needed. For example, in 2012, Congolese civilians began to plunder shops in northern Goma, while moving southward. The UN force in the Congo (MONUSCO), with a protection of civilians mandate, needed to stop the ransacking of the stores and associated violence. It was feared that the violence would spread to the entire city. The soldiers could not use their weapons because they only possessed deadly guns. Finally, someone suggested that the airport fire truck, normally used to put out potential fires on aircraft, be sent north to spray the looters. This was done and successfully halted the looting.

Crowd control is but one of many scenarios where nonlethal weapons can be useful in peacekeeping. Other scenarios include civilian-on-civilian killing, thieves steeling goods from UN camps, cars racing toward UN checkpoints, child soldiers on a rampage, drugged or delusional individuals, and conflicting parties escalating an armed fight without restraint and without heeding UN warnings.

The range of possible nonlethal (or less-than-lethal) weapons is also large: Tasers; stun (flash-bang) and smoke grenades; rubber bullets (shot from regular rifles or air guns); beanbag rounds; and riot-control agents (such as tear gas or pepper spray for domestic riot control). Low-tech nonlethal weapons can also be used to stop vehicles or persons, such as spikes (caltrops), immobilizers, and entangling nets. (One immobilizer, sticky foam, was used by US Marines during the withdrawal of US forces from Somalia in 1993. Another Marines system called "active denial" heats the skin surface so that individuals or groups must move to exit the "heat ray.") Anti-traction materials can slow attackers or intruders by making it difficult to walk or drive over an area. The effects of these area-denial systems can be colloquially described as "stick'm or slip'm."

UN peacekeepers should be able to pick from the range of lethal and nonlethal weapons to manage violence against themselves and against civilians. This can allow for a more flexible response, though it might make some offenders who have felt the effects of nonlethal weapons angrier and bolder. While UNPOL and its Formed Police Units have some experience with nonlethal weapons, the United Nations lacks policies and procedures for them. UN peacekeepers should have nonlethal weapons capabilities, since they are frequently involved in low-level skirmishes and have an important mandate to protect civilians, even when the source of attack is other civilians.

- **Elections:** invisible ink and revealing UV-lighting devices; electronic voting machines
- **Enforcement and combat:** armor for persons, vehicles, and structures; remote-controlled robots for special operations (e.g., by SWAT teams); sensors (see Figure 1); other weapons (see "Weapons" below)
- **Public information systems:** mobile public radio transmitters; broadcast studios, antennas, and towers; local-area Wi-Fi systems
- **Protection of civilians:** tools for communicating with local populations to issue alerts and allow people to place 911-type calls; nonlethal weapons (see "Enforcement and combat" above)
- **Sanctions and border monitoring:** sensors (see Figure 1) to detect illegal movements of goods and people, including explosives in suitcases; barriers to stop sanctions-busters, including speed bumps and checkpoint gates
- **Safety and security:** aerostats for persistent surveillance around camps and UN sites; masts with pan-tilt-zoom cameras and acoustic sensors; armor for bodies, vehicles, and aircraft; chemical sensors (for explosives, chemical warfare agents, narcotics, and hazardous materials) that sample from swabs or vapor; entry-point barriers and sensors (including closed-circuit televisions and metal detectors); nuclear, biological, and chemical protection (suits, masks, etc.); mobile sensor suits (including visible and infrared cameras or radars on extendable masts); rapidly

deployable secure walls (revetment system with sand, rock, or other filler and armor plates); IED jammers; remote-controlled robots to defuse IEDs; short-range and longer-range UAVs for beyond-perimeter surveillance; tactical UAVs to detect hazards or ambushes; redundant emergency radio, cell phone, and SMS systems that can provide location information; distress-burst GPS (to give geographical coordinates to 911-type responders); anti-theft devices

- **Tracking:** GPS-based platforms (GIS) to track UN personnel, vehicles, and heavy or expensive equipment; incident overlays (showing locations of various types of events) linked to a command-and-control platform; systems that provide alerts if entering forbidden or dangerous territory[30]
- **Training:** online e-learning and course-delivery systems using interactive means (e.g., threaded discussions, virtual classroom interaction); gaming software for peacekeeping scenarios
- **Weapons:** marking, recordkeeping, and tracing of UN small arms and ammunition; armored personnel carriers; aircraft such as attack helicopters with advanced sensor suites and jets for reconnaissance and missile launching; laser designators

Especially for the life-risking work of robust peace enforcement, where peacekeepers must stop blatant and repeated violators and survive attacks, there is great need for robust technology. Technology can save the lives of both the peacekeepers and the "peace-kept."

Progress and Challenges

With this wide-ranging overview of technology, it is reasonable to ask how the United Nations has done in applying modern technology in its peace operations. The answer is poorly, until recent years, when major improvements were initiated.

INSTITUTIONAL ADVANCEMENT

The United Nations is often criticized for being slow to transform, but DPKO has made remarkable progress toward becoming more technologically advanced since 2012. Under-Secretary-General for Peacekeeping Operations Hervé Ladsous, who arrived in 2011, began to push peacekeeping into the twenty-first century. He successfully procured UAVs for the DRC and inaugurated their first official flights in December 2013 while introducing a process for wider technological progress. He created a Panel of Experts on Technology and Innovation in UN Peacekeeping, whose 2015 report, *Performance Peacekeeping*, was endorsed by the UN secretary-general to help catalyze further action.[31] He also established the high-level Steering Group on Technology and Innovation.

Ladsous and his counterpart in DFS also tasked their departments' subunits at UN headquarters with reviewing ways to make greater use of technology, in line with the panel report. In response, the Information and Communications Technology Division boosted its Technology Centre at headquarters, as well as the technology centers for Africa, the Americas, Asia, and Europe. To make sure the technology initiative was not merely a passing fad, as had occurred in 2008,[32] the two departments also adopted a Technology and Innovation Strategy in 2015. The strategy sought to implement the panel of expert's recommendations and "achieve a cultural shift towards innovation."[33] A Technology and Innovation Working Group is coordinating the strategy's implementation over its proposed eighteen-month timeline. Specifically, the strategy seeks to identify the key policy issues for technology and innovation; support field

30 In the UN's Macedonia mission, deployed to stop the violent ethnic conflicts in the former Yugoslavia from spilling across national borders, some 500 US soldiers were equipped with pioneering GPS devices that would beep if they came within two miles of the Serbian border. The US government did not want any of its soldiers straying into Serbian territory where they could be arrested, thus causing an international incident.

31 The secretary-general noted that DPKO/DFS "have put in place a strategy to implement the key recommendations of the recent Panel of Experts on Technology and Innovation in United Nations Peacekeeping." United Nations, *The Future of United Nations Peace Operations: Implementation of the Recommendations of the High-Level Independent Panel on Peace Operations, Report of the Secretary-General*, UN Doc. A/70/357-S/2015/682, September 2, 2015, p. 22. In addition, Ladsous and Atul Khare (head of DFS) informed the C34 (Special Committee on Peacekeeping, where all peacekeeping-contributing countries have a seat) that they fully endorsed the technology report in general. Hervé Ladsous, statement to the Special Committee on Peacekeeping Operations, February 20, 2015, available at www.un.org/en/peacekeeping/documents/150219_Ladsous_C34speech_draftOUSGFINAL.pdf .

32 Under-Secretary-General Jean-Marie Guéhenno, near the end of his term in 2008, endorsed a low-/medium-cost project to support new technology in peacekeeping, but it was not backed with any new resources. While the project resulted in dialogue with selected missions and raised general awareness, it did not result in lasting progress. A summary of the project is provided in A. Walter Dorn, *Keeping Watch: Monitoring, Technology and Innovation in UN Peace Operations* (Tokyo: UN University Press, 2011), pp. 165–174, available at http://www.keepingwatch.net/contents .

33 "Factsheet: DPKO/DFS 2015–16 Implementation Strategy for the Recommendations of the Panel of Experts on Technology and Innovation in UN Peacekeeping," United Nations, January 2016.

operations; develop new capacities to research, develop, and test potentially innovative solutions; empower "business owners" (i.e., UN offices with core responsibilities); and create a means to monitor implementation. The strategy also advanced an informal mechanism to interface with external entities.

To reach out, in 2014, DPKO/DFS created the Partnership for Technology in Peacekeeping to facilitate work with a wide range of organizations, including member states, regional organizations, think tanks, and academic institutions. The goal is to expand the UN's access to technology, technical expertise, and innovative design support. The partnership includes both a long-term approach and an avenue for quick-win projects ("easy to implement projects that make a real difference in UN Missions").[34] In addition to industrial contacts, the partnership will bring the United Nations into the domain of academic-focused research and development (R&D) and possibly include a technology advisory group. Since not all R&D projects result in practical and deployable technologies, it is admirable that the United Nations is willing to run the risk of failure in some projects, knowing that R&D can result in great gains in others. And even with the R&D losses, there are valuable lessons to be learned along the way.

Under the partnership, the United Nations has already sponsored symposia and workshops and developed memoranda of understanding with various countries.[35] Among the more active countries are the United States and Japan, which are keen to find ways to bring peacekeeping up to the required levels of technological capacity, including in the engineering domain.

TECHNOLOGY-CONTRIBUTING COUNTRIES

A new category of peacekeeping contributor, the "technology-contributing country" (TechCC), is emerging to complement the long-standing notions of the troop-contributing country (TCC) and the police-contributing country (PCC). Under this new concept, the TechCC provides TCCs and PCCs, field missions, and UN headquarters with technological concepts, equipment, advice, and support. While TechCCs can also be TCCs and PCCs, some countries (like the United States) prefer not to deploy large numbers of uniformed personnel but instead seek to provide strategic enablers like technology. The TechCC concept was first introduced by the author and picked up in 2014 by the UN Panel of Experts on Technology and Innovation in UN Peacekeeping, of which he was a part. Several countries, large and small, have subsequently formally adopted this label, from the United States to Singapore.

A number of critiques of the TechCC concept have arisen. Some worry it might exacerbate the problem of "two-tier peacekeeping"—that is, expand the technological gap between "have" and "have-not" countries. In fact, TechCCs should narrow such gaps by providing support to developing countries and UN missions as a whole. As peace operations seek to become better technologically equipped, leading countries are needed to assist and mentor the peacekeepers unaccustomed to advanced technology. Moreover, the concept does not imply that TechCCs only provide technology, not troops or police, to the field. Some countries can offer uniformed personnel and units with technological skills, as the Netherlands and Sweden have done with well-equipped intelligence, surveillance, and reconnaissance units in Mali.

Another concern is that using TechCCs might encourage overreliance on their equipment in the field rather than encouraging TCCs to bring their own technologies or being supplied by the UN. The latter methods are preferable, when the technology is available, but TechCCs can also assist TCCs, PCCs, and the UN by equipping contingents and missions through partnerships either in the field or beforehand at home. This will allow the supported TCC and PCC units to learn more about the technologies as they strive to become more self-reliant. TechCCs can train TCCs and PCCs, and with this greater training and awareness comes greater capacity, helping countries incorporate technology into their contingent-owned equip-

34 E-mail from Dirk Druet, UN DKPO/DFS Policy Planning Team, November 24, 2015.

35 Conferences of the Partnership for Technology in Peacekeeping were held in Brindisi and Vienna in 2014 and 2015. The latter (and later) meeting sought to involve more countries from the Global South to complement the highly industrialized countries. It brought together over thirty member states, institutions, and representatives of academic think tanks to expand awareness and identify key areas for collaboration.

ment. Over time, the traditional troop- and police-contributors from the Global South will become technologically equipped and join the growing list of TechCCs.

Another fear, gained from difficult UN experiences over the years, is that TechCCs will provide the technologies without the resources or expertise to integrate, maintain, and adapt them over time. The lesson for the United Nations is that the provision of technology should be accompanied by longer-term advice and, ideally, the presence of experts on the ground until the know-how is successfully transferred to the United Nations or its contingents.

A final critique is that many of the required technologies are available on the commercial market for less than the amount charged by member states under the UN's typical reimbursement scheme. TechCCs should encourage the United Nations to purchase commercial off-the-shelf (COTS) technology when it is more cost-effective, once it has been demonstrated and tested for field use. Field demonstrations by TechCCs can be extremely useful, since the United Nations cannot, according to its own rules, acquire or test technologies that it has not purchased.

After TechCCs assist in a proof-of-concept stage, the United Nations can go to the market to organically develop and expand its systems, rather than relying only on "supply-driven" provision by defense ministries, including government off-the-shelf (GOTS) equipment. GOTS equipment might be older and unneeded (declared surplus) by the TechCC, though in many cases it might be better than the equipment used by the United Nations. Sometimes UN officials find it problematic to bolt government-supplied equipment onto the UN's unique systems, which usually operate in more resource-poor environments. TechCCs can keep this in mind as they seek to provide the most appropriate tools available, whether they be COTS or GOTS, or newer or older generation equipment. Sometimes GOTS technologies are the only ones available to fill a need, and some governments have excess capacity to share at low or no cost. Governments will also have their experiences to share in addition to the technology itself.

The United Nations might prefer to steer TechCCs in the direction of providing technological expertise, rather than hardware, to identify, develop, and implement solutions that can be sustained by current and potential TCCs and PCCs in partnership with the UN Secretariat. By fostering a sense of ownership among TCCs and PCCs, technological solutions become more sustainable and conducive to further innovation. But the United Nations needs considerable help to conduct proofs of concept, develop prototypes, test equipment, build modular systems, and work collaboratively with the market, which abounds in commercial ingenuity and product diversity. Furthermore, sometimes it is better for the United Nations to ask for a service or a customized capability from a vendor (or a TechCC) to carry out a function rather than specifying the particular technologies the United Nations thinks it needs for that task. This gives more flexibility to the vendor or TechCC to design a system with the best technologies.

In summary, TechCCs can enhance all three of the current means of deploying technology to the field: contingent-owned (national) equipment; UN-owned equipment; and contracted equipment (through a wet or dry lease—that is, with or without maintenance and support).[36] TechCCs can also equip and train contingents, UN officials, and contractors before or during deployment. Many forms of help can be provided: advice, software, physical equipment, setup and integration, training, servicing, and even support over the entire equipment life cycle. Equipment can be donated, loaned, contracted, or sold. Some countries, like the United States, have much to offer.

The United States declared in 2015 its aspiration to become a "leading TechCC." As the premier technology engine in the world, especially in the domain of military technology, this should be welcomed, though with some caution. Because the United States brings so much energy and capacity to the projects it undertakes, the United Nations

36 A fourth source of technology can also be envisioned: local (i.e., the host country or the conflicting parties themselves). These parties can work with the United Nations to share the equipment and the data in a form of cooperative monitoring. Finally, a fifth source could be nongovernmental organizations and the general public, especially in the age of social media, crowdsourcing, and data and image sharing.

must be careful not to become overly dependent but instead seek to "multilateralize" state assistance. Still, the US partnership is already yielding great dividends.

At the levels of the president and secretaries of state and defense, the United States pledged in 2015 to help the United Nations advance technologically. It backed up these executive-level promises with deeds. Early activities and achievements include the following:

- Four modular base camps built for the UN mission in the Central African Republic[37]
- Workshops, including "Table Top Discussions,"[38] where US and UN officials discussed UN needs and US capabilities, and a workshop (by White House invitation) on technologies and crowdsourcing to monitor cease-fires
- A Technology Source Book that describes forty-four "candidate technologies," proven in the field by US forces, that could help UN peace operations and whose categories correspond to current "UN shortfalls" along the lines of those identified in the UN panel of experts' report (see Box 3)

The US Department of Defense created a Peacekeeping Operations Technology Sub-Working Group to facilitate thinking and action on new projects. In conjunction with the Department of Defense, the State Department directed its Global Peace Operations Initiative[39] to boost the technological capabilities of its fifty-plus partner countries and fifty-plus national and regional peace operations training centers. Suggested activities include lectures, demonstrations, field trials, exercises, simulations describing and incorporating technology, and publications.

In addition, a PeaceTech Lab was created in 2015 as part of the US Institute of Peace in Washington, DC, to "devise means of reducing violent conflict around the world." It describes itself as "a collaborative space where experts in technology work with experts in conflict management and with fellows from the conflict zones themselves to imagine, develop, and deploy new tools for the field."[40] It is

Box 3. Technologies recommended by the US government[41]

The US government offered the United Nations a Technology Source Book at the time of the Leaders' Summit on Peacekeeping in September 2015. It describes forty-four "candidate technologies" suitable for UN peace operations that are unclassified, proven in the field by US forces, and commercially available. The Source Book describes the technologies under six categories with several subtypes.

- **Expeditionary basing and logistics:** camps, communications, power, water analysis and purification
- **Information-led operations and situational awareness:** communications, data interface systems and networks, GIS, information sharing, sensor software, UAVs
- **Medical support:** biomonitors, blood storage, cold-pack and warming units, first aid kits, gauze, stretchers with intensive-care devices, tourniquets, ventilators, ultrasound, x-ray, workflow software, online courses
- **Planning:** reach-back for problem analysis, engineering solutions, GIS and information sharing, process and component visualization
- **Survivability and protection of forces and civilians:** barrier walls and entry points, chemical detection, counter-IED, information management, monitoring, unmanned aerial and ground vehicles
- **Training:** records management, simulations

37 The Force Provider camps are easy to deploy, configure, and construct in a range of climates and terrain conditions. Force Provider is described as a "city in a box," with air-beam shelters, showers, latrines, laundry, air conditioning, power generation, and water recycling. They can be hard- or soft-walled. Bob Reinert, "Natick Provides Base Camps for U.N. peacekeepers in Africa," March 4, 2015, available at www.army.mil/article/143854/Natick_provides_base_camps_for_U_N__peacekeepers_in_Africa .

38 US Department of Defense, "DoD Enabling Technologies for UN Peacekeeping Operations, Table Top Discussion Part 1 (10–12 February 2015): Final Report," 2015, contact: DoD_PKO_Tech_WG@mail.mil.

39 US Department of State, "Global Peace Operations Initiative (GPOI), Program Overview," available at www.state.gov/t/pm/ppa/gpoi/ .

40 US Institute of Peace, "The PeaceTech Lab," available at www.usip.org/programs/projects/the-peacetech-lab .

41 US Department of Defense, "Technology Source Book: Enabling Technologies for UN Peacekeeping Operations," September 9, 2015, available at www.walterdorn.net/pdf/Technology-Source-Book-UN-PKO_DoD_v39.pdf .

creating an "open situation center" to gather and share information about crisis and conflict areas. The opportunities for collaboration with the United Nations and its national contributors are great, including sharing ideas, information (data and analysis), and technological skills.

Despite US support, the United Nations must be careful not to become overly dependent on the United States. Over-dependence could contribute to the real or perceived dominance of the United States, causing resentment and suspicion among other countries. As mentioned, the United Nations and the United States must seek to "multilateralize" their partnerships and gain acceptance from the range of peacekeeping contributors. The most important forum for dialogue with TCCs and PCCs is the Special Committee on Peacekeeping, or C34 (so named because it was originally composed of 34 members, but it now includes over 120 states). While generally accepting the utility of technology, the C34 debate has expressed long-standing concerns that foreshadow some problems and obstacles to UN progress.

FEARS, FOUNDED AND UNFOUNDED

In the C34's contentious annual policy debates, the nonaligned movement and certain countries (e.g., Russia) often push for restrictions and conditions on technology use in UN operations, emphasizing the importance of national sovereignty, the consent of the host state, and the confidentiality of UN information.[42] In the Security Council, Russia wanted the UN Secretariat to seek Security Council approval before deploying the UN's first UAVs in the DRC. In order not to encumber DPKO unnecessarily, other countries fought back successfully, especially the European Union member states, the United States, and the CANZ group (Canada, Australia, and New Zealand). To get the most favorable reception in the C34, technology issues are usually placed under the report section on safety and security of UN peacekeepers, since all states want their deployed personnel to be well protected. But other concerns have arisen.

The developing world, which currently provides about three-quarters of the UN's uniformed personnel, has concerns that technology could reduce the number of troops required in peacekeeping and result in less UN reimbursement. In practice, however, technologies should not reduce the total number of peacekeepers but should make them more effective, mobile, and responsive. Certain mundane jobs can be done with fewer personnel using technologies, but the surplus soldiers can then be freed up to do more productive tasks. UN missions are chronically understaffed and rarely able to reach the personnel levels mandated by the Security Council. Technology enables and enhances UN forces. Much like the overblown concerns that machines would push humans out of office work, technologies in the field increase productivity without decreasing overall employment.

Similarly, certain countries worry that UAVs might replace their manned aircraft, particularly the fleet of contracted helicopters that is mostly Russian-built. This is also a misplaced fear. UAVs will complement manned flights and free up manned aircraft for more support, transport, and combat missions for overwhelmed peace operations.

Some countries fear new UN technologies will increase the digital divide between the developed and developing world (as mentioned in the section on TechCCs). However, the developing world is increasingly adopting these new technologies, especially as human-device interfaces have become more user-friendly. Sharing technological know-how through the United Nations will benefit the Global South.[43] As the United Nations seeks to mainstream technology, field personnel from both the Global North and South will gain experience. Already, military personnel serving the United Nations individually (i.e., not as troops in preformed units) are evaluated on their "technological awareness" in addition to the other "mission core competencies" (communication, teamwork,

42 These concerns are reflected in the passages of the C34 annual reports. Excerpts of the passages relating to technology are found in A. Walter Dorn, *Keeping Watch*. The 2015 references can be found in United Nations, *Report of the Special Committee on Peacekeeping Operations, 2015 Substantive Session (New York, 17 February–13 March 2015)*, UN Doc. A/69/19, March 17, 2015, paras. 46–47.

43 For instance, cellular and touch-screen devices are expanding quickly in virtually all communities worldwide. Cellular and smartphone subscriptions are now rising faster in the developing world than in the developed world (where they have reached near saturation). In sub-Saharan Africa, the subscription rate is reaching 90 subscriptions per 100 people. John Karlsrud, "Peacekeeping 4.0: Harnessing the Potential of Big Data, Social Media, and Cyber-technology," in *Cyberspace and International Relations*, edited by Jan-Frederik Kremer and Benedikt Müller (Berlin: Springer, 2013).

planning, and organizing).[44] However, the expected technological awareness is mostly limited to working on computers using basic software.

UN missions have a history of poor interoperability between contingents, whether they come from the developed or the developing world. Embarrassing communication problems are frequent, even during combat with rebel forces. For instance, the Force Intervention Brigade in MONUSCO has three contingents (from Malawi, South Africa, and Tanzania) that cannot communicate by radio with each other in the field, so they are kept in separate areas of responsibility. Similarly, communication from aircraft to ground troops is not usually possible unless the troops and aircraft are from the same country. For close air support when peacekeepers are under attack, reliable communication is essential, and potentially lifesaving. The United Nations is trying to enhance ICT capacity by establishing a new Signal Academy, based in Entebbe, Uganda, to offer pre-deployment training to military signals units from TCCs.

Not only member states, but also UN staff have expressed concerns about introducing new technologies. Some UN officials fear added complexity, especially since some previous systems were found to be too difficult to navigate and were not working well after their launch (e.g., the Umoja software).[45] But proper software design and user training should reduce this problem. Also, staff may need to devote additional time to learning new systems before discovering time economies and greater capacities with new software. Fortunately, technology is increasingly user-friendly, generally requiring less training and less time on the idiosyncrasies of the man-machine interface. Though civilians traditionally were much less dependent on technology than militaries, this is changing in our world's more knowledge-based economy. As general tech-familiarity grows, so too can the capacity to discern the best technologies for UN missions, while always keeping in mind the rights and needs of the local population.

The challenge of data confidentiality and personal privacy in the digital age is common in countries the world over. The United Nations has to deal with this as well. The world organization is developing policies on personal privacy, especially as its sensors (e.g., on UAVs) can now gain enormous volumes of information about the behaviors of local peoples. It will be necessary to establish rules for "shutter control" and image deletion so that cameras are turned off or prohibited from viewing or keeping recordings of activities that are well within the domain of personal privacy.

Similarly, host countries have concerns that the United Nations may be prying into their affairs and discovering embarrassing or criminal acts, such as atrocities committed by their troops or UN sanctions busting by persons within or associated with the government.[46] While the United Nations is not expected to engage in espionage, countries need to be assured that the UN's imagery is used only for mandate implementation under strict supervision. For instance, the UAVs in the Eastern DRC cannot approach within two nautical miles of the borders of neighboring states without approval from the mission's top official (the special representative of the secretary-general). In any case, host states must be aware that they have agreed, in the status of forces or status of mission agreement, that the UN has the right to deploy the equipment needed to fulfill its mandate.

For sensitive activities like electronic interception or signals intelligence, the United Nations must have clear rules, well within national and international law, and abide by them. For instance, UN eavesdropping on cell phone conversations in the general population, while technologically easy with a scanner, is an anathema. Only tactical signals intelligence for well-defined targets and purposes (e.g., finding hostages) should be allowed, and approvals must come from a high level, possibly the special representative of the secretary-general.

44 The soldier's performance evaluation defines technological awareness as: "Keeps abreast of available technology. Understands applicability and limitations of technology to the work of the Office. Actively seeks to apply technology to appropriate tasks." UN DPKO, "Performance Evaluation Form for the United Nations Military Personnel Deployed as Observer/Staff Officer and Expert on Mission."

45 Umoja is a massive ($300 million) business transformation project using SAP software for administrative and support functions, including finance, supply chain and procurement, human resources, central support services, and program/project management. Its implementation has caused much frustration among field staff and been plagued by delays and cost overruns.

46 In 2014, President Salva Kiir of South Sudan spurned the suggestion that the United Nations Mission in South Sudan (UNMISS) deploy UAVs. He told a high-ranking UN official that he would not allow the UN mission to spy on his troops. Author's conversation with a UN official, UN headquarters, Fall 2014.

Cybersecurity more generally is a great concern in the age of computer hacking. Especially in conflict zones, combatants can seek and use electronic information to their advantage. As mentioned, the Syrian Electronic Army is known to target individuals using atrocity reports provided online by witnesses. The United Nations has to develop means of data protection for both its information sources and its computerized information storage. It must also actively prevent and expose hacking, including with counterintelligence measures.

One well-founded concern is technology failure. Technologies can offer many benefits, but they make life more complex. When devices or systems break down, they can expose over-dependence. If this jeopardizes the ability to live, move, and work, especially in harsh environments, it can place peacekeepers' lives or the mission at risk. Therefore, it is valuable to have backup or redundant systems so that failures in one system can be superseded by others or creative work-arounds found.

Finally, as the United Nations adopts new technologies, it must select the most appropriate ones, not necessarily the most advanced. The world organization should beware that the newest and "shiniest" technologies on the market might be unproven and overly expensive. Fortunately, technology tends to decrease in cost over time while increasing in capability. As mentioned, choosing between COTS and GOTS technology must be made judiciously, looking for a proven track record of effectiveness, durability, and ease of maintenance.

Recommendations

In the past half-decade, many recommendations have been made to increase the UN's technological capabilities. The book *Keeping Watch* offers five general recommendations and over thirty specific recommendations on use of technologies in the monitoring field alone.[47] The Panel of Experts on Technology and Innovation in UN Peacekeeping offered over 120 recommendations across a range of technologies and functions. The US Department of Defense, in its Technology Source Book, has suggested forty-four unclassified "candidate technologies" for UN operations—technologies it has found effective in its own experience. In the commercial domain, the number of potential types and subtypes of technology is in the tens of thousands. So a comprehensive list of technologies is not attempted here. Furthermore, because prioritization is dependent on mission mandate and circumstances, priorities will not be set. But some principles can help guide the UN's technological evolution:

1. **Seek the buy-in of host countries and local populations.** For population-centric operations, dual-use of technology could help the local population as well as the UN mission, thereby securing a sense of local ownership and a measure of local self-protection. At the end of a peacekeeping operation, such technology can be turned over to the host country.
2. **Use greater feedback and reach-back to UN headquarters and other international supporters.** Greater global connectivity allows greater reach-back to UN headquarters and various support units anywhere in the world. Stronger information and feedback loops are now possible. For instance, a back office for analysis of the field information can help digest the enormous information flow from new technologies and sources.
3. **Develop life-cycle equipment management.** Beyond procurement, it is important to cover the entire life cycle of the equipment (decision, purchase/procurement, integration, maintenance, repair, storage, disposal, etc.). The three basic methods of equipment management are internal UN mechanisms (especially in DFS), vendor or contractor support, or TechCC (member state) support, with combinations of these also possible. DFS and contingent-owned equipment procedures could be reviewed to make the entire life-cycle process more timely and effective.
4. **Manage expectations.** Innovation can be a slow and halting process, with failures along the way. Expectations should be kept realistic. Sufficient

47 A. Walter Dorn, *Keeping Watch*, pp. 192–204.

trials should be conducted before announcing a product to ensure it is ready to be deployed or declared to be at full operating capacity.

To handle technological evolution in peace operations, new systems and processes are needed within the United Nations. To sustain the current momentum, steps should be taken to ensure that technological innovation is a lasting process, not merely a passing fad. This is best done by establishing new structures and procedures, as well as by fostering a greater culture of technological innovation in the world organization.

On the structural level, the United Nations could either create or foster a technology center or a technology projects office, which could serve as a nucleus before a technology project is expanded, outsourced, or scaled up. Rather than renaming the Information and Communications Technology Division so that it encompasses more than ICT, the United Nations could create a new section or division. The new body should be led at a senior level. A high-level advocate is needed for technology and innovation, a position that may become even more important once the current DPKO head (Hervé Ladsous), who provides excellent leadership, leaves office. One potential model is the UN Children Emergency Fund's (UNICEF) innovation office, whose head reports directly to UNICEF's executive director.

Beyond the structural level, there are many good ideas for new activities and processes to explore.

1. **At UN headquarters:**
   - Institute an ongoing "tech watch" using "tech scouts" for new and potentially valuable technologies;
   - Conduct an annual review (audit) of UN technological innovation;
   - Develop a range of technology selection criteria[48] to choose which COTS or GOTS technologies and systems to deploy;
   - Work with national testing and evaluation centers and R&D institutes;
   - Develop tactics, techniques, and procedures for various tech-enabled functions; and
   - Create a "solutions farm" for innovative approaches to problems.
2. **In the field:**
   - Test new equipment and systems;
   - Carry out "proof-of-concept" experiments;
   - Launch pilot projects with willing TCCs and PCCs and conduct after-action reviews;
   - Deploy demonstration kits to showcase the capabilities of technology in actual operations;
   - Foster awareness in field missions on procurement procedures for technologies (many field personnel may simply not know how to obtain equipment, especially advanced equipment);
   - Gain experience and evaluate "what worked and what did not," including lessons learned in other countries and organizations; and
   - Most ambitiously, create special technological missions or special technical missions for areas of conflict, including violent conflicts (e.g., Syria), where it is not possible to establish a larger manned operation that would pose large safety risks to personnel.
3. **To engage TCCs and PCCs:**
   - Incentivize them to bring in effective modern equipment (e.g., by providing bonus contingent-owned equipment reimbursements for superior-performance equipment and environmental friendliness);[49]
   - Provide them training to foster military, police, and civilian expertise; and
   - Encourage TechCCs to assist TCCs and PCCs.
4. **To engage external actors and vendors:**
   - Host or support a technology fair or "rodeo";

48 Criteria (desirable characteristics) for selection would include whether the technology is: appropriate; affordable/cost-effective; sustainable/durable; useful (especially life-saving); easy to use and operate; simple to maintain; convenient; usable with available power; supported by the local population and host country; replicable in other areas (for pilot projects); exportable under export control regimes (e.g., the International Traffic in Arms Regulations for US technology); importable under host-country regulations; and helpful in making peacekeeping more effective, more efficient, and safer. The UN-AU Mission in Darfur's (UNAMID) list of "principles" for technology are: simplicity; robustness (including against adverse climate); reliability; minimal maintenance; small logistics tail; inexpensiveness; and low training requirement. The DPKO list from a Security Council Working Group meeting (July 29, 2014) includes these factors: mandate relevancy; consent of host state; and respect for confidentiality.

49 Providing extra reimbursements to tech-enabled TCCs and PCCs might cause resentment by countries without such technologies but would incentivize modernization and help more advanced countries to contribute forces.

and

- Support a "hackathon" for smartphone and tablet app developers on potential applications for peacekeeping.

It is important that the field operators, including TCCs and PCCs, take some ownership of the issue and explore the wide range of possibilities. Once the notion of technological innovation is mainstreamed, field innovation can help carry the momentum into the future. For further synergies, the United Nations could expand the initiative beyond DPKO/DFS to the entire UN system. That way, UN agencies, funds, and programs can together build a technological foundation for the twenty-first century.[50] Then, when smart technology is finally and firmly integrated, the former critics will ask, "How could we have lived without it?"

50 Global Pulse is one such example. With a motto of "Harnessing big data for development and humanitarian action," it fosters innovation in the UN system using sources such as online content (including social media), "data exhaust" and "data philanthropy" (especially anonymized data from businesses and other organizations), crowdsourced reports from citizens, and physical sensors.

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