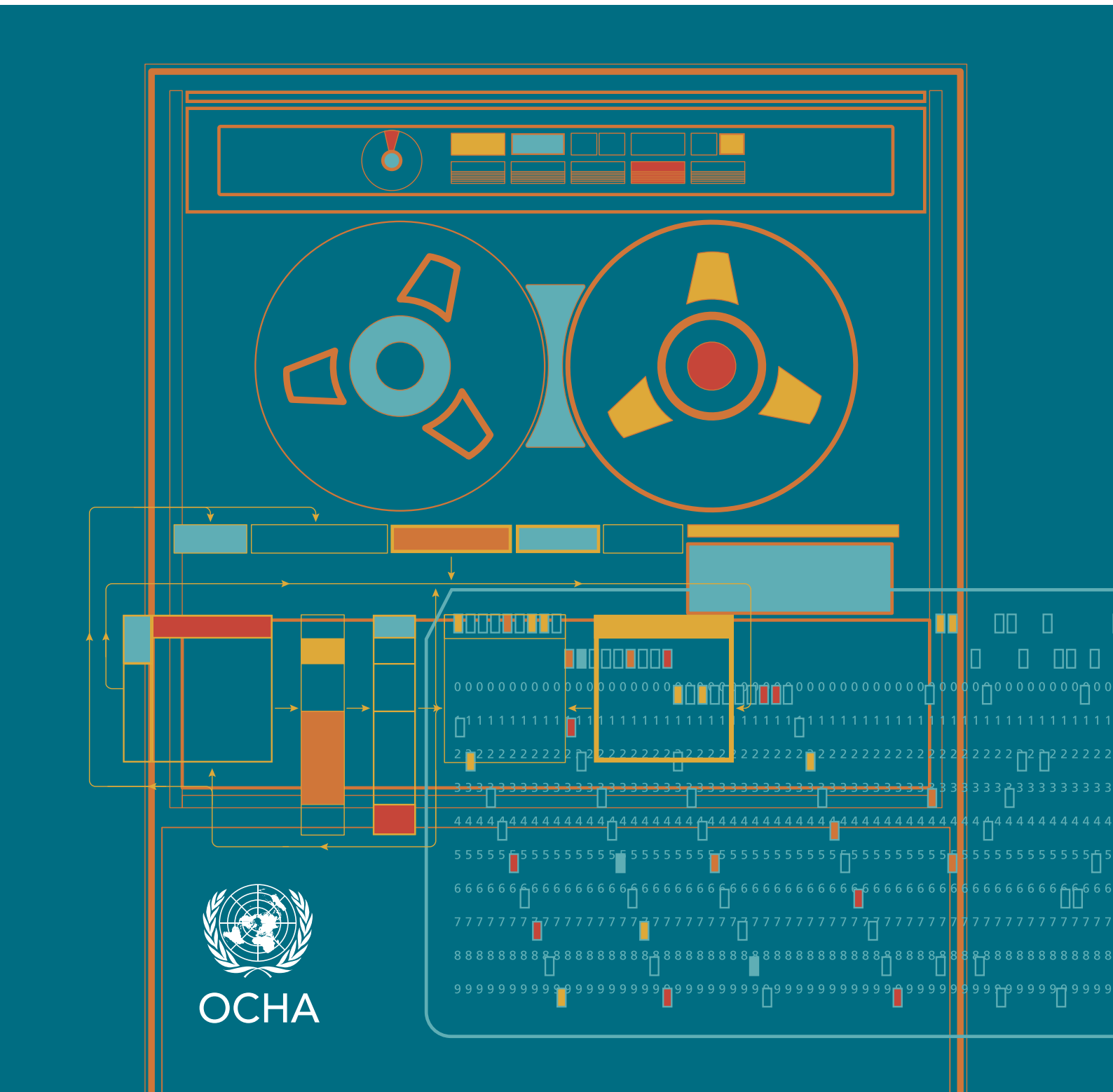
FROM DIGITAL PROMISE TO FRONTLINE PRACTICE:
NEW AND EMERGING TECHNOLOGIES IN HUMANITARIAN ACTION



OCHA

ACKNOWLEDGEMENTS

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This publication was made possible by the critical advice and support from Connecting Business initiative (Karen Smith), Direct Relief (Dr. Andrew Schroeder), Field Ready (Dara Dotz), Fund for Refugee Initiatives (Sara-Christine Dallain), Google (Ruha Devanesan, Alexander Diaz, Christopher Fearon, Sella Nevo), IBM (Kush Varshney), ID2020 Alliance (Dakota Gruener, Ethan Veneklasen), India Flying Labs (Dr. Ruchi Saxena), International Committee of the Red Cross (Veronique Christory, Ann Deer, Massimo Marelli, Vincent Graf Narbel, Stephanie Ridgway, Mark Silverman), International Organization for Migration (Dr. Alexander Klosovsky), IrisGuard UK Ltd. (Eva Mowbray), Johns Hopkins University Applied Physics Laboratory (Jason A. Lee), KPHR, Inc. (Kyla Reid), Microsoft (Cameron Birge), NetHope (Ray Short), Nexleaf Analytics, Office of the United Nations High Commissioner for Human Rights (Scott Campbell), Overseas Development Institute, Humanitarian Policy Group (Sorcha O'Callaghan, Barnaby Willitts-King), Tableau Foundation (Neal Myrick), United Nations Children's Fund (Kate Alley, Alissa Collins, Mari Denby, Ariana Fowler, Tautvydas Juskauskas, Christina Lomazzo, Toby Wicks), United Nations Executive Office of the Secretary-General (David Michael Kelly), United Nations Foundation, United Nations Global Pulse, United Nations High Commissioner for Refugees (Katie Drew, Christopher Earney, Rebeca Moreno Jiménez, Sofia Kyriazi), United Nations Office of Information and Communications Technology (Mark Dalton, Lambert Hogenhout), United Nations Office of the Special Advisor (Yu Ping Chan, Anoush Tatevossian, Anni Tervo), United Nations World Food Programme (Marco Codastefano, Ria Sen, Emma Wadland), University of Oxford (Tsvetelina Van Benthem), WeRobotics (Sonja Betschart, Patrick Meier), World Bank (Nadia Piffaretti), Yale University (Nathaniel Raymond), Shahrzad Yavari, and our colleagues at OCHA, with special thanks to Andrew Alspach, Simon Bagshaw, Yasin Bennane, Lilian Barajas, Aurelien Buffler, Stuart Campo, Juan Chaves-Gonzalez, Christian Clark, Suzanne Connolly, Kareem Elbayar, Marcus Elten, David Goetghebuer, Ali Gokpinar, Vincent Hubin, Anna Jefferys, Malene Kamp Jensen, Leonardo Milano, Dirk-Jan Omtzigt, Daniel Pfister, April Pham, Kashif Rehman, Sophie Solomon, Sarah Telford, Andrej Verity, Nathalie Weizmann, Kathryn Yarlett, the Global Information Functional Team and the Strategic Communications Branch.

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In celebration of the United Nations' 75th Anniversary, the cover illustration is of the United Nations' first mainframe computer system, an IBM 7044/1401 used in 1965. Prior to this date the IBM mechanical punched card tabulator was used for tabulating and computing summary statistics, with Member States providing data on magnetic tape or punched card format.

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ABBREVIATIONS AND ACRONYMS

$	United States dollar
3D	Three-dimensional
AI	Artificial intelligence
CERF	Central Emergency Response Fund
COVID-19	Coronavirus Disease 2019
DPIA	Data protection impact assessment
ETC	Emergency Telecommunications Cluster
FAO	Food and Agriculture Organization of the United Nations
GIS	Geographic information system
HDX	Humanitarian Data Exchange
HRP	Humanitarian Response Plan
HXL	Humanitarian Exchange Language
IASC	Inter-Agency Standing Committee
ICRC	International Committee of the Red Cross
ICT	Information and communications technology
IFRC	International Federation of Red Cross and Red Crescent Societies
IOM	International Organization for Migration
IoT	Internet of things
IRC	International Rescue Committee
IT	Information technology
ITU	International Telecommunication Union
LDCs	Least developed countries
ML	Machine learning
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
PPP	Public-private partnership
R&D	Research and development
UAV	Unmanned Aerial Vehicle
UN	United Nations
UN Women	United Nations Entity for Gender Equality and the Empowerment of Women
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFPA	United Nations Population Fund
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
WFP	United Nations World Food Programme
WHO	World Health Organization

I

EXECUTIVE SUMMARY: SHIFTING THE PARADIGM

As humanitarian crises become increasingly **complex and protracted**, the number of people in need of humanitarian assistance has soared, from 78 million in 2015 to an unprecedented 235 million in 2021.[1] Humanitarian funding requirements have grown accordingly, from US$16 billion to $35 billion over the same period according to the Global Humanitarian Overview released by the United Nations Office for the Coordination of Humanitarian Affairs (OCHA).[2] In 2020, the Coronavirus Disease 2019 (COVID-19) pandemic alone caused $9.5 billion in humanitarian funding needs.[3]

Owed to donors' unwavering commitment, **humanitarian funding** has risen steadily, with record funding for inter-agency coordinated plans of $19 billion and total reported humanitarian funding of more than $27 billion in 2020.[4] Yet every year a large funding gap remains to meet the needs of the most vulnerable. As Mark Lowcock, Under-Secretary-General of Humanitarian Affairs and Emergency Relief Coordinator, has noted: "It would be nice to think we can fill the gap just by raising more money. But we can't. We also have to make the money we have go further. The best way to do that is to change our current system from one that reacts, to one that anticipates."[5]

> "It would be nice to think we can fill the gap just by raising more money. But we can't. We also have to make the money we have go further. The best way to do that is to change our current system from one that reacts, to one that anticipates.

New and emerging technologies can support this **paradigm shift** from reaction to anticipation by enabling earlier, faster and potentially more effective humanitarian action. Artificial intelligence can facilitate analysis and interpretation of vast and complex humanitarian datasets to improve projections and decision-making. Mobile applications, chatbots and social media can create immediate feedback loops with people affected by humanitarian crises. Unmanned aerial vehicles (UAVs) and remote sensing can speed up the assessment, mapping and monitoring of vulnerabilities. Digital cash can provide rapid and flexible assistance. And biometrics can help establish digital identity and reconnect families. Together these technologies can lead to better access to information, assistance and livelihoods, and facilitate stronger, more relevant needs analysis, a more prioritized and people-centred response, and more meaningful and systematic monitoring.

But these advantages come with an array of complex **challenges and risks**. Inadequate data protection can cause harm, intensify insecurities and hinder the principled delivery of humanitarian assistance. Unequal connectivity, access to technology and digital literacy can exacerbate core vulnerabilities and intensify gender biases. Incomplete datasets about affected people can lead to digital discrimination. Technologies can malfunction, break down, and sow mistrust. And technology's potential is only ever as strong as its underlying data set, decision-making process, user distribution, and political buy-in.

OPPORTUNITIES OF NEW AND EMERGING TECHNOLOGIES IN HUMANITARIAN ACTION

KEY OPPORTUNITIES FOR PEOPLE AFFECTED BY HUMANITARIAN CRISES	ACCESS TO INFORMATION AND EARLY WARNING	ACCESS TO ASSISTANCE, SERVICES AND LIVELIHOODS	COMMUNICATION AMONG COMMUNITIES AND WITH HUMANITARIAN ACTORS
KEY OPPORTUNITIES FOR HUMANITARIAN ACTORS	STRONGER, MORE RELEVANT NEEDS ANALYSIS	PRIORITIZED AND PEOPLE-CENTRED RESPONSE	MEANINGFUL AND SYSTEMATIC MONITORING

The **COVID-19** response showcased both the promise and the pitfalls of new and emerging technologies, while simultaneously accelerating their adoption and use. Artificial intelligence facilitated outbreak mapping, diagnosis, and the development of treatments and vaccines.[6] Biometrics, blockchain and digital cash enabled contactless access to aid.[7] UAVs delivered medical supplies and testing samples.[8] Chatbots provided vital information and telehealth support.[9] Digital tools enabled children to continue their education, businesses to remain open, and health professionals to provide care online. At the same time, concern mounted over data protection and privacy, cybersecurity, personal liberty and misinformation.[10] The massive overnight shift to virtual environments, remote education, videoconferencing and e-commerce also raised fundamental questions about technological preparedness and effectiveness, as well as digital inequality.[11]

This study examines opportunities for solving technology-related problems across the humanitarian programme cycle, challenges posed by new and emerging technologies in humanitarian contexts, and enablers of technology in the humanitarian sector. It is divided into three main sections. The first section highlights **key opportunities and challenges** of individual technologies identified as particularly relevant for transforming the delivery of humanitarian assistance in the coming years.

NEW AND EMERGING TECHNOLOGY APPLICATIONS IN HUMANITARIAN ACTION

ARTIFICIAL INTELLIGENCE AND PREDICTIVE ANALYTICS	MOBILE APPLICATIONS, CHATBOTS AND SOCIAL MEDIA	DIGITAL CASH TRANSFERS
CRISIS MAPS AND DASHBOARDS	BIOMETRICS AND DIGITAL ID	UNMANNED AERIAL VEHICLES
BLOCKCHAIN	INTERNET OF THINGS	3D PRINTING

The second section delineates seven interconnected and mutually reinforcing **enablers for the adoption** of new and emerging technologies in humanitarian action. Broadly aligned with the recommended actions in the Secretary-General's Roadmap for Digital Cooperation,[12] these enablers can create the underlying conditions that will allow humanitarian actors to effectively deploy technology solutions.

The third section covers a set of **recommendations** drawn from the framework of enablers that will apply to many of the humanitarian actors designing, carrying out, evaluating or supporting projects, programmes and policies with a technology component. Many of these recommendations also support transformations underway across the sector to make responses more anticipatory, long-term, coordinated, and people centred.

ENABLERS OF NEW AND EMERGING TECHNOLOGIES IN HUMANITARIAN ACTION

INCLUSION AND LOCALIZATION

Bridge the digital divide and pursue local approaches to connect and empower communities and individuals and ensure that no one is left behind

PEOPLE-CENTRED DESIGN AND LEADERSHIP

Pursue demand-driven, contextually tailored strategies to identify the most effective high-tech, "low-tech" or "no-tech" solutions to existing problems

DATA, CAPACITY AND SKILLS

Ensure the "basics" are in place for better data-driven decision-making, including adequate data, IT infrastructure, technical skills and human capacities

DATA RESPONSIBILITY AND THE HUMANITARIAN PRINCIPLES

Do No Harm, respect the humanitarian principles and ensure adequate data responsibility, including data protection

COLLABORATION AND COORDINATION

Form sustained partnerships among humanitarians and across sectors to consolidate efforts, create synergies and leverage resources effectively

LAW AND POLICY

Take a rights-based approach that enables technology deployments while ensuring respect for international law, human rights and ethical standards

INVESTMENT AND SCALING

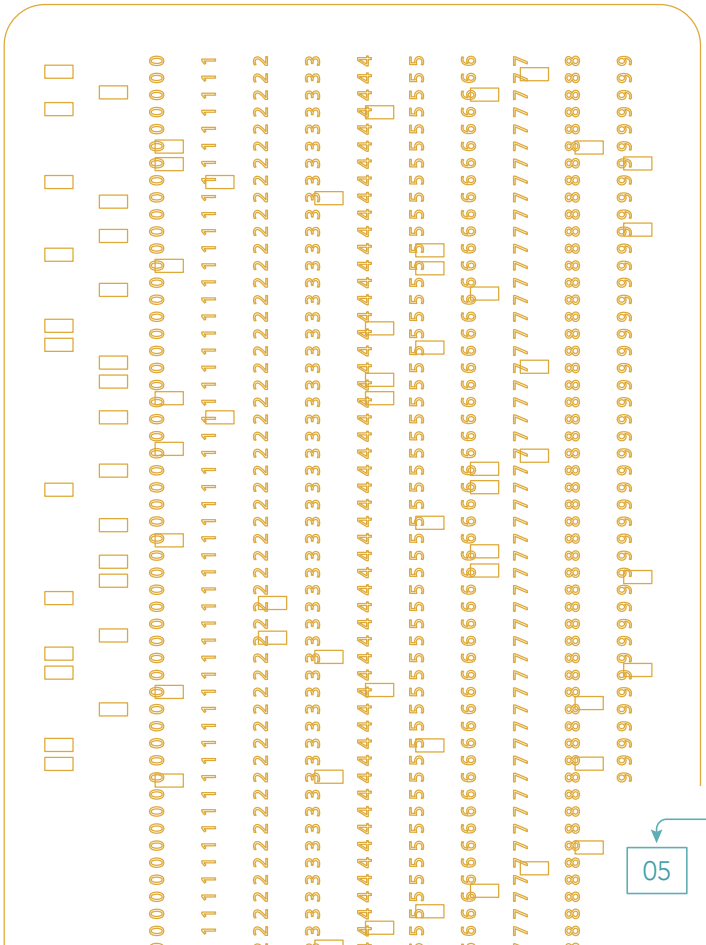
Measure impact and make sustainable investments, including in research and development, to generate scalable, long-term technology gains

The study's **methodology** comprised bilateral interviews with more than 80 humanitarian and technology experts, a horizon scanning exercise, and a literature review. Initial findings were tested and validated through a survey with OCHA field colleagues, confirmatory consultations, and a panel discussion at OCHA's virtual Global Humanitarian Policy Forum 2020, with participants spanning the humanitarian and development communities, government, the private sector, non-profits, civil society and academia.[13] The findings were also presented and tested at the NetHope Virtual Global Summit 2020, which convened the global humanitarian technology community.[14]

As humanitarian action is linked to numerous sectors and Sustainable Development Goals, the following analysis is **not exhaustive**. It does not delve into important advances in fields such as biotechnology, agronomy or clean energy.[15] Further, while "technology" was approached through a broad lens, research and consultations led to a focus on digital technologies—most of them information and communication technologies (ICTs) and many of them interconnected. Not all technologies discussed will be considered "new and emerging" by all from a technological standpoint. However, their rapid and irreversible arrival in the mainstream of the humanitarian toolkit is novel, making their systematic professionalization for the humanitarian sector more relevant than ever.

Finally, although myriad projects are underway, and considerable progress has been achieved – as illustrated by select examples and case studies throughout the study – the field remains nascent, with many projects in pilot stages. **Further research, monitoring and evaluation** is therefore crucial, particularly of the long-term viability, scalability and effectiveness of technologies in different contexts.

The past decade has seen recognition of information as a basic need in humanitarian emergencies, and great efforts towards better data-driven decision-making.[16] In the coming decade, technology can further enable earlier, faster and more effective humanitarian action. But technology is not an end in itself, and its adoption alone cannot shift a paradigm. Rather, investment in technology must go hand-in-hand with efforts to ensure that it is responsible, sustainable and inclusive and that it protects, above all, human life and dignity. Undertaken jointly with affected communities and partners across sectors, such converging efforts could **powerfully enable transformation** in the years to come.



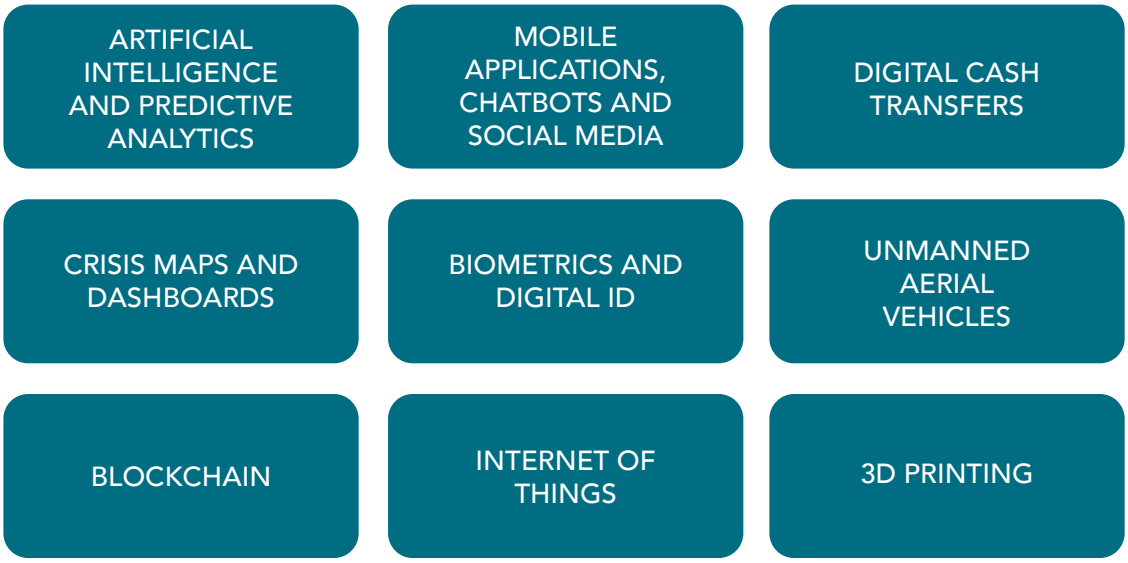
II

NEW AND EMERGING TECHNOLOGIES: PROMISES AND PITFALLS

New and emerging technologies have the potential to support a **paradigm shift** from reaction to anticipation by enabling earlier, faster and potentially more effective humanitarian action. When integrated with robust decision support frameworks, these technologies can lead to better access to information, assistancce and livelihoods. They can also facilitate improvements across the enhanced humanitarian programme cycle including stronger, more relevant needs analysis, a more prioritized and people-centred response, and more meaningful and systematic monitoring.[17]

But these advantages come with an array of complex **challenges and risks**, including growing evidence of harm in certain contexts. These risks must be identified and mitigated to ensure that technology does no harm, leaves no one behind, and protects the life and dignity of those it is intended to serve.

NEW AND EMERGING TECHNOLOGY APPLICATIONS IN HUMANITARIAN ACTION



A. ARTIFICIAL INTELLIGENCE AND PREDICTIVE ANALYTICS

1. What are Artificial Intelligence and Predictive Analytics?

While not universally defined, artificial intelligence (AI) can generally be understood as a computer program that performs tasks associated with human intelligence, such as cognition, planning, reasoning or learning.[18] The applications of AI are vast and include pattern detection within complex datasets, image and voice recognition, and natural language processing.[19] One of AI's most important applications is **machine learning** (ML), in which a machine learns how to perform a task autonomously by studying many different datasets.[20] **Predictive analytics** sift through current and historical data to make predictions about future or otherwise unknown events.[21] Predictive analytics range from statistical models using no AI, to models employing advanced AI and ML.

2. Opportunities

By 2030, AI is estimated to increase global economic activity by roughly US $13 trillion, or 16 per cent of cumulative GDP.[22] In the humanitarian sector, AI facilitates **faster and more anticipatory** action by helping to rapidly analyse, draw conclusions from, and make predictions and decisions based on large and complex datasets. It can improve humanitarians' ability to identify and assess needs; increase preparedness and provide early warnings; plan the response; predict and respond to crises; monitor situations; and review and evaluate performance.

AI can be integrated with myriad other technologies, such as mobile applications and chatbots, crisis maps and dashboards, biometric systems, UAVs and the internet of things, to improve **data analysis** and data-driven decision-making. It can help provide medical and mental healthcare insights by aiding the analysis and interpretation of **health data** for vast populations. AI can support education and training. And it can optimize business, administrative, and human resources processes to free up stretched human capacities.

AI-Supported Disaster Mapping in Mozambique – United Nations World Food Programme[23]

The United Nations World Food Programme (WFP)'s Digital Engine for Emergency Photo-analysis is a deep learning application built to speed up response time in emergencies. It automates the analysis and processing of high-resolution images and converts them into information useful to humanitarians.

The engine's distinguishing characteristics are that it is (1) deployable in emergency settings, i.e., on a common laptop and in no-connectivity environments; (2) user-friendly to non-technical staff; and (3) modular, i.e. adaptable to different objects such as buildings, roads, bridges or standing water. The engine was developed as a fully open-source application to enable engineers to view, adapt and enhance the technology. It is trained on representative datasets to consistently iterate and improve over time.

In coordination with Mozambique's National Institute of Disaster Management, a UAV-coordination and training model was launched in 2017 and tested as of 2018 before the engine was introduced in June 2019. By the time Cyclones Idai and Kenneth struck, capacity-building had enabled a locally led response. The engine rapidly mapped affected areas and critical infrastructure, providing key information that typically takes days or weeks to produce for potential use within the first 72 hours of the emergency. Future applications of the engine are being explored, including a catalogue of models from prior emergencies to scale up immediate analysis in future crises.

Predictive analytics can save lives by facilitating anticipatory action, including the release of prearranged financing to avert or minimize a crisis. Predictive analytics can help predict sudden-onset disasters, such as floods, earthquakes or famines, as well as more long-term challenges, such as the humanitarian implications of climate change.[24]

Flood Forecasting in India and Bangladesh – Google[25]

Every year, flooding causes 6,000-18,000 fatalities and $21-$33 billion in damage globally. Twenty per cent of flood fatalities occur in India. Since 2018, Google has piloted its flood forecasting technology in partnership with the governments of India and Bangladesh. Using AI, ML, satellite imagery and spatial mapping, the technology analyses water levels, terrain, elevations and historical events to predict the time, place and severity of floods. Warnings are disseminated via Google Maps, Search, and Android push notifications that provide real-time information, emergency contacts and safety tips. By September 2020, over 21 million flood warnings were sent, covering more than 200 million people across India and Bangladesh. Google evaluates alert accuracy according to two key metrics that measure whether (1) warnings reached all those affected, and (2) people received unnecessary warnings, with a respective 95 and 80 per cent accuracy in the 2019 monsoon season. As low connectivity is a common challenge, Google.org, the company's philanthropic arm, works with local actors to disseminate warnings via low-tech methods.

Anticipatory Action, Peer Review and Capacity-Building on Predictive Analytics – OCHA[26]

In July 2020, OCHA's Central Emergency Response Fund (CERF) allocated and released funding before a possible disaster for the first time, after predictive analytics frameworks forecast famine in Somalia and flooding in Bangladesh.[27] *In Bangladesh, OCHA collaborated with the Resident Coordinator, the Food and Agriculture Organization of the United Nations (FAO), the United Nations Population Fund (UNFPA), WFP, the International Red Cross and Red Crescent Movement, and government and implementing partners to distribute aid to monsoon-affected river communities before peak flooding. Within four hours of the activation of a forecasting trigger, the fastest CERF allocation in UN history provided cash, animal feed, water-proof storage drums, and health, dignity and hygiene kits to some 220,000 people, several days before peak floods. Through the CERF, OCHA will allocate up to $140 million for anticipatory humanitarian action by the end of 2021.*

OCHA's Centre for Humanitarian Data has added predictive analytics to its core portfolio, focusing on (1) developing original models and supporting those of partners; (2) offering a peer review process to assess the ethical, technical, and humanitarian relevance of models; and (3) building capacity through events, trainings and case studies. The Centre has also created a catalogue of predictive models in the humanitarian sector.[28] *During the COVID-19 response, the Centre partnered with Johns Hopkins University Applied Physics Laboratory to develop a COVID-19 model that forecasts the number of COVID-19 cases, hospitalisations, and deaths in humanitarian contexts to help decision-makers plan and manage resources.*[29]

Forecast-Based Financing – International Federation of Red Cross and Red Crescent Societies[30]

As of 2020, 15 National Societies of the International Federation of Red Cross and Red Crescent Societies (IFRC) were using various degrees of forecast-based financing, with forecasts triggering early action in countries such as Peru, Vietnam, Bangladesh, Mozambique, Mongolia and the Philippines. In the Philippines, for example, a Typhoon Early Action Protocol was approved in November 2019 with a timeframe of five years. It facilitates anticipatory action in 19 provinces in four parts of the country when forecasts of tropical cyclones based on data of previous typhoons demonstrate a high likelihood of serious shocks in the country. In that event, early actions including early harvesting of matured crops, livestock and assets evacuation and installation of shelter strengthening kits are triggered within 72 hours before landfall. The project is being implemented by the Philippines Red Cross in partnership with the German Red Cross, the Netherlands Red Cross and the IFRC Country Office.

Food Crises Prediction – World Bank[31]

In collaboration with technology partners, Project Artemis was launched in 2018 as an experimental suite of models to predict the risk of food crises and trigger the release of pre-arranged financing to avert them. The pilot model used ML, including deep learning models, to analyse data on violent conflict, market prices and weather events. Artemis was piloted in five countries and run in near real time over the summer of 2019. The project yielded valuable lessons on tailoring the technology to its underlying policy question and data ecosystem. Extensive dialogue with potential users ensured complementarity with existing famine early-warning systems and ascertained the model's most important capabilities, including month-to-month estimates of food crises in different territories. As deep learning approaches did not lower error rates due to limited data availability, the final model used more basic ML, which made it easier to explain conclusions. The model was published by the World Bank and rolled out across 21 countries in September 2020. Its results indicate that, particularly across longer forecasting horizons, Artemis predictions compare favourably to expert-based outlooks.

3. Challenges

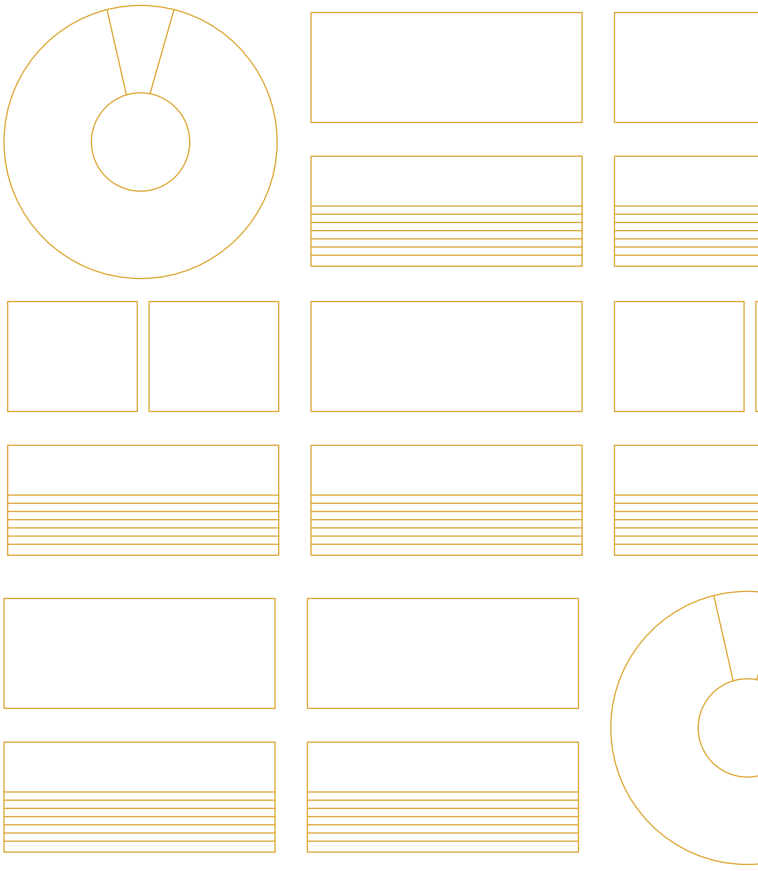
AI and predictive analytics pose a broad range of challenges in humanitarian contexts. First, they may require large quantities of **open data**.[32] Open, accurate and timely data is difficult to obtain in humanitarian settings, where connectivity is sparse, situations are fluid, access and security constraints exist, and time and resources are limited. The origins of open data are not always disclosed, which can lead to incomplete, erroneous or overlapping data sets. As models rely on the quality and quantity of their underlying data, data error profiles will be reflected in any application that uses them. Data interoperability, data standards and consistent data collection are also important, as models are trained on representative datasets to consistently iterate and improve over time.

Further, inadequate measures for ensuring **data responsibility, including data protection**,[33] can exacerbate vulnerabilities and cause harm to civilians. AI may make anonymized data identifiable, or otherwise reveal more information about a person than intended. Voluntary consent to data collection and use may be compromised where people are insufficiently informed; must consent in order to receive aid; or where data is used beyond the original purpose (so-called "function-creep"). Tensions exist between minimizing data collection and retention on the one hand, and, on the other, AI efficacy and bias-reduction, which improve with growing data volumes. And partners and third parties, including malicious actors, may access and use data for non-humanitarian purposes, which can lead to harms including abusive surveillance, discrimination or persecution and compromise the **principled delivery of humanitarian assistance**.

Moreover, AI is only as unbiased as its human designers and underlying data.[34] Incomplete or fragmented datasets and a lack of diversity of data or developers can cause **biases** that exacerbate inequalities and discrimination. AI systems have been criticized, put under moratorium, or banned for reinforcing ethnic and economic inequalities and biases.[35] This risk is exacerbated by the fact that few training data sets are built by humanitarians and based on representative data for a specific context.

AI and ML can also lead to a lack of **predictability, reliability and transparency**.[36] In the absence of sufficient specifications, ML systems may develop their own rules of behaviour, potentially without any explanation. This may make it difficult or even impossible to predict their actions, rely on a specific outcome, or explain a particular output, which can lead to unintended results and accountability gaps.

Finally, AI systems can make **mistakes or be manipulated** to misclassify concepts they are trained to recognize due to lacking understanding of their meaning.[37] This risk was illustrated by tricking an algorithm to classify a 3D-printed turtle as a rifle and a 3D-printed baseball as an espresso.[38] Such misclassification can have serious ramifications in a humanitarian context, particularly an armed conflict.



Artificial Intelligence in the COVID-19 Response

During the COVID-19 response, AI played an important role in disease surveillance and case detection by monitoring online discourse patterns through web scraping and natural language processing. HealthMap, for example, scanned the internet to detect discussion about outbreaks, locate their nexus and verify their accuracy; and sent out alerts as early as 30 December 2019, pre-dating public knowledge of the virus.[39] AI's role was at the same time limited by the need for epidemiological expertise to understand the significance of its findings and take appropriate follow-up actions.

In the medical response, AI was used in fields such as genomics, imaging and drug discovery.[40] InferVision used computer vision to rapidly distinguish between COVID-19 and other respiratory infections on lung scans, with the potential to improve speed and accuracy of diagnoses.[41] Benevolent AI improved the detection of compounds for drug development.[42] And Insilico sped up drug discovery through AI-based analysis of molecular compounds.[43]

On the flip side, AI systems tied to, e.g., facial recognition, heat mapping for temperature monitoring, and phone and license plate surveillance for case tracking, raised concerns over data protection, data privacy, personal liberty and misinformation.[44] And overreliance on automated surveillance systems was criticized as having failed to detect the outbreak of the virus before it had taken on catastrophic dimensions.[45]

B. MOBILE APPLICATIONS, CHATBOTS AND SOCIAL MEDIA

1. What are Mobile Applications, Chatbots and Social Media?

Mobile applications (apps) are software programs that run on mobile devices like smartphones and tablets, with applications ranging from messaging services to AI-based diagnostics tools. Mobile **messaging apps**, unlike SMS-messages sent via telephone networks, use wireless or mobile data networks to transmit information ranging from text to audio and document files.[46] **Social media** is a broad term that can encompass blogs, content communities and social networks like Facebook and Twitter.[47] A **chatbot** is a computer program that recognizes text, voice and/or image-based inputs and responds to a user.[48] Chatbot functions range from answering frequently asked questions without AI, to using AI and ML to learn from interactions and identify specific user-intent.

2. Opportunities

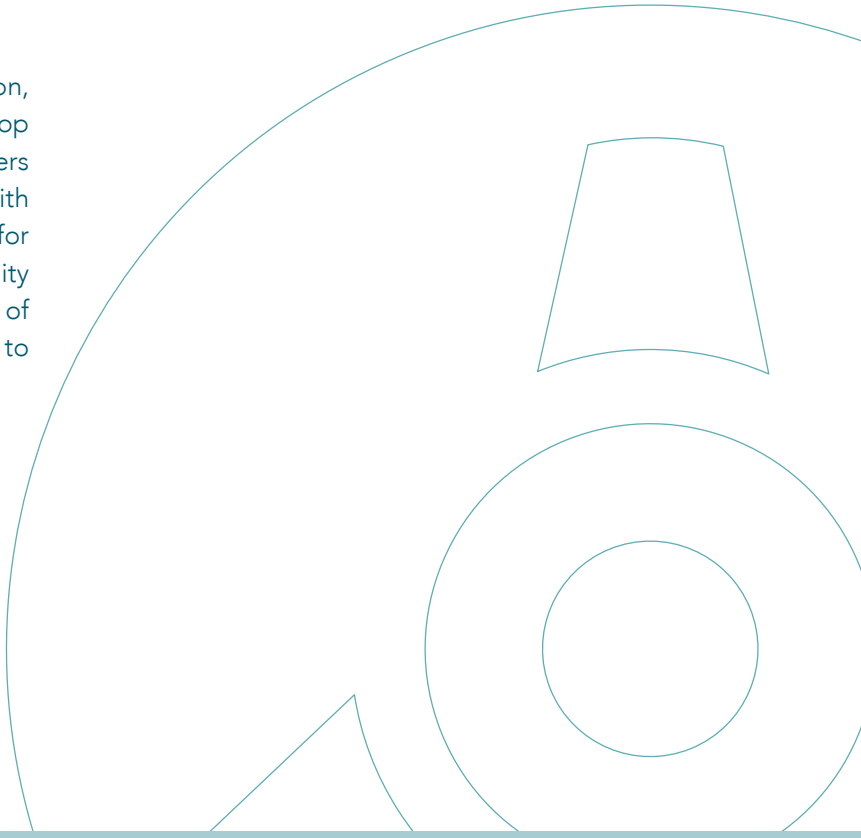
Mobile apps, chatbots and social media continue to proliferate in tandem with mobile technology and network coverage. These technologies can improve communication between affected people and humanitarian actors (a field known as **Communication with Communities**, or CWC[49]) and enable **earlier, faster and more informed action** by humanitarians and affected individuals alike.

Mobile apps[50] and **social media**[51] can lead to better data-driven decision-making across the humanitarian programme cycle. They can quickly capture information about incidents and needs of affected populations to better anticipate, understand and respond to crises. They can communicate with vast numbers of people to crowdsource information and paint a more holistic picture of a crisis as it unfolds. They can expedite the transmission of life-saving messages, even to inaccessible areas. Fundamentally, they can serve as a lifeline for those affected, enhance community engagement and acceptance, and lead to a more people-centred, coordinated, accountable and effective response.

Mobile Apps and Social Media in the European Refugee Crisis[52]

Mobile apps and social media served as survival tools during mixed migration flows to Europe in 2015 and 2016. People on the move relied on mobile apps like WhatsApp, Viber and Google Maps, and on social media platforms like Facebook and Twitter to learn about migration routes and countries of destination, access safety and rescue services, and maintain contact with loved ones and fellow migrants and refugees. Information-sharing via these platforms could verify rumours and protect people on the move from exploitation by smugglers. Mobile apps such as Refugee Aid and Refugee Info were created to provide trusted information. However, bad actors could also advertise their services through mobile technology, while a lack of connectivity often prevented people from obtaining the consistent, timely and dependable information found to improve their resilience.

Similarly, **chatbots**[53] can provide essential information, education, and health-support; create a feedback loop with humanitarians; connect communities to responders and services; combat misinformation; and assist with monitoring and evaluation. Better accessibility for persons with disabilities and others, increased facility for multilingualism, and reduction of complexity of menus and interfaces, give chatbots the potential to revolutionize how humans interact with computers.



CHATBOTS IN HUMANITARIAN RESPONSE

Food Bot and the AIDA Chatbot Builder – WFP and InSTEDD[54]

Food Bot was developed to exchange food security-related information with beneficiaries. When the needs of WFP country teams and beneficiaries proved too diverse to be met by one generic chatbot, a builder platform, AIDA, was designed to facilitate the quick and user-friendly design and deployment of custom chatbots.

Chatbots in the COVID-19 Response – World Health Organization and United Nations Children's Fund[55]

COVID-19 accelerated the use of chatbots, including in humanitarian contexts, due to their ability to rapidly bring critical, tailored information to vast populations. The World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) were among those organizations that launched chatbots via messaging platforms like WhatsApp, Facebook and Viber to provide people and governments with reliable information, tackle misinformation, provide health support, and assess needs.

Streamlining Data Entry Tasks to Increase Focus on People in Need – New York Foundling and Microsoft[56]

To ease the burden of documentation for social workers, the Foundling developed a streamlined data entry chatbot to replace its paper-and-pencil spreadsheet system. The Foundling estimated that this reduced the time spent on data entry by 90 per cent and freed up 100,000 hours a year to spend on client needs.

3. Challenges

Mobile apps, chatbots and social media present myriad challenges and risks.[57] Where AI is used, it poses the challenges described in Section II.A, and even without AI, **data responsibility, including data protection**,[58] challenges exist. These platforms generate vast amounts of personal and sensitive data and metadata (i.e., data about data[59]), often without users' full understanding of the extent or risks of such data collection, or strong security protections against outside interference. Private sector partners, such as technology companies or mobile network operators, may control information and use (or be required to provide) it for non-humanitarian purposes. Data may be legally protected from government access while stored by an international organization with privileges and immunities, but such protections will not necessarily benefit partners. Third-party data access may lead to abusive surveillance, discrimination, persecution, or other harmful consequences, exacerbating vulnerabilities and compromising the principled delivery of humanitarian assistance.

Furthermore, messaging and social media platforms may be unable or unwilling to **contextually tailor** their services to the privacy and security needs of humanitarian operations, such as by ensuring anonymity, no retention of message content and minimal retention of metadata, end-to-end encryption, user data ownership, minimal information-sharing with third parties, and open source app codes.[60] Humanitarians' use of existing platforms may give a false sense of security to affected populations, while programming, testing and maintaining a separate humanitarian platform require significant capacity and skill, and will likely reach far fewer people.

In addition, the widespread availability and use of mobile technology and social media has led to a proliferation of **misinformation**, disinformation, online propaganda and hate-speech. Consequences have ranged from community mistrust to escalations of violence.[61] Chatbots can sow **mistrust** where they are anthropomorphized, cannot discern user intent or respond empathically, or where a community prefers human interaction.[62] Finally, in contexts with low electricity, connectivity, smartphone accessibility or digital literacy, individuals may not have access to mobile apps, chatbots or social media, limiting their utility and potentially widening the **digital and gender divides**.

Large-Scale Contact Tracing: Promise and Peril During the COVID-19 Response[63]

Location-tracking smartphone applications alerting users to possible COVID-19 exposure gave rise to both hopes of containing its spread as well as privacy and personal liberty concerns. Some initiatives adopted data protection by design strategies to enable technology in a Do No Harm manner. For example, the Decentralized Privacy-Preserving Proximity Tracing (DP-3T) protocol and the Exposure Notification System API jointly developed by Apple and Google provided open-source, opt-in, anonymized and decentralized methods of alerting individual users to possible contact with the virus via Bluetooth, which senses proximity to other cell phones, rather than tracing users' locations. However, many mobile apps collected, aggregated and centrally stored biometric and geolocation data to perform large-scale contact tracing, quarantine monitoring and enforcement, and epidemiological modelling with little oversight or privacy safeguards. This practice raised concerns of mass surveillance and unauthorized data access, social control, discrimination, and persecution of marginalized populations, all of which could outlast the initial public health emergency.

C. DIGITAL CASH TRANSFERS

1. What are Digital Cash Transfers?

Digital cash transfers are transfers of electronic cash or vouchers. Electronic cash, such as mobile money, pre-paid cards, and bank transfers, can be exchanged for cash or spent without restrictions, while electronic vouchers, sent through smart cards or mobile phones, can be used for approved goods and vendors.[64]

2. Opportunities

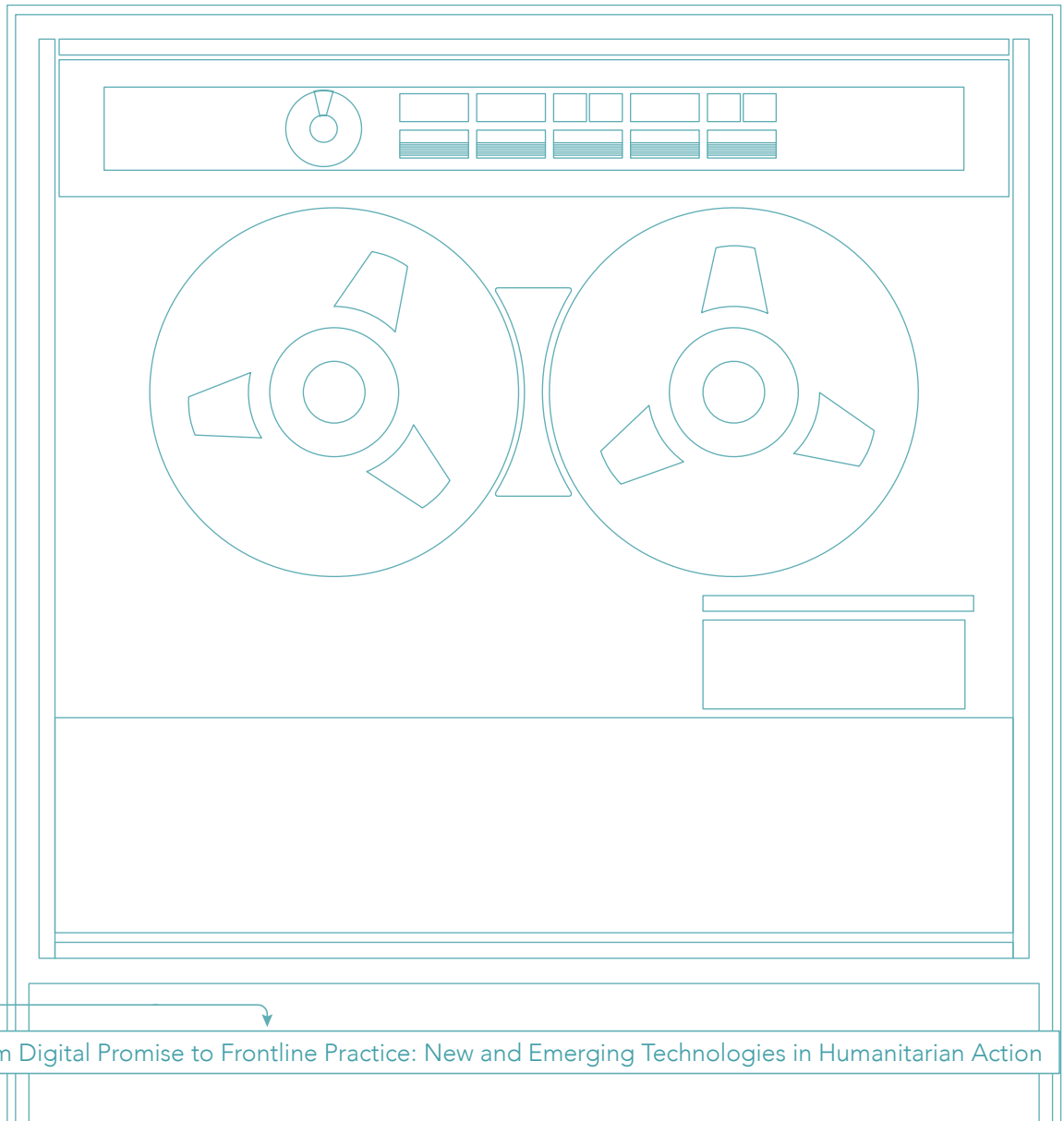
Following the shift from in-kind to cash-based humanitarian assistance, digital cash is increasingly replacing traditional cash transport and delivery. Digital cash can empower individuals while facilitating more **agile, transparent, traceable and cost-effective** humanitarian action.[65] Digital cash transfers give people agency to meet their needs, with greater discretion than non-digital alternatives. They reduce the cost and increase the speed and flexibility of cash delivery, support local markets, and promote transparency and accountability to clients and donors. They foster inclusion by granting access to financial systems and are increasingly scalable due to the ubiquity of mobile phones. They mitigate the risks of carrying physical cash, and of face-to-face contact, such as during the COVID-19 response.

"Navigating the Shift to Digital Humanitarian Assistance" – International Rescue Committee[66]

In 2015, the International Rescue Committee (IRC) set out to deliver 25 per cent of its material assistance in cash and to increase digital payments by 2020. In 2018, over a third of its country-operations delivered digital cash. The IRC first ensured organizational buy-in, requiring a cultural shift in some country offices. It introduced transition tools, including master service-level agreements with digital cash providers for payment mechanisms to be quickly deployable. It developed staff capacity and skills via trainings and hires from the private sector. Each country assessed network coverage, mobile network operator capacity and client access to technology and digital literacy. Pilots in several country offices demonstrated that: (1) early relationship-building sped up project implementation; (2) documenting lessons was invaluable to future projects, particularly in view of high staff turnover; (3) project success was more likely when both humanitarian and private sector parties were agile and committed to adapting approaches to humanitarian needs; and (4) clear roles, communication channels and planning were essential. Key challenges included: lack of precedent for collaboration with mobile network operators in the humanitarian space; low digital literacy among clients, particularly marginalized groups; unequal access of women to mobile phones; poor network coverage; and private actors' Know Your Customer requirements.

3. Challenges

Challenges[67] related to digital cash largely overlap with those applicable to mobile apps (see Section II.B.). In particular, transfers may require processing **personal and sensitive data**,[68] such as names, phone numbers, biometrics, Know Your Customer data and metadata. Private sector partners, including financial institutions and mobile network operators, may access or use this data for non-humanitarian purposes like checking beneficiaries for creditworthiness or against designated person lists. They may retain or share it to comply with local law enforcement and legislation, which may lack robust data protection standards. Protections afforded to international organizations with privileges and immunities may not be granted to partners and data may be subject to unauthorized access. These challenges may result in discrimination based on prior aid receipt, profiling and surveillance of users, or other harms, and compromise the **humanitarian principles**. Informed consent may be absent where beneficiaries do not fully understand the extent and risks of data processing or lack alternatives to accessing aid, or where function-creep erodes prior consent. And some contexts may be **unsuited for cash assistance**, such as where goods are locally unavailable or disproportionately priced, as much of personal protective equipment was during the COVID-19 response;[69] where the support of local authorities is lacking; or where there is a high risk of market inflation.[70]



D. CRISIS MAPS AND DASHBOARDS

1. What are Crisis Maps and Dashboards?

Crisis maps and dashboards gather, analyse and display key data during a crisis. They employ web scraping, crowdsourcing, remote sensing, satellite imagery analysis, geographic information systems (GIS), data analytics and/or AI. **Web scraping** systematically extracts content from websites.[71] **Crowdsourcing** enables large numbers of people to report or record information.[72] **Remote sensing** acquires images of earth through sensors commonly mounted on satellites, airplanes or drones.[73] **Satellite imagery** analysis combines images with other data points, such as places of interest or demographics.[74] **GIS** ads spatial or geographic precision to raw data.[75] And **data analytics** combine and analyse information typically comprising large volumes of diverse data (Big Data).[76]

2. Opportunities

Crisis maps and dashboards can facilitate better **data-driven decision-making** across the humanitarian programme cycle. By integrating data from different sources, they provide a more holistic picture of needs, incidents, and the unfolding of a crisis in real-time. These tools can improve crisis prediction and anticipatory action, needs assessment and early warning, donor buy-in, resources mobilization, and accountability to affected people and donors. Crowdsourcing can save time and resources and build community trust and legitimacy.

Crisis Maps and Dashboards in the COVID-19 Response

Fusing different methods of data collection, analysis and visualization enabled a rapid global understanding of the spread of COVID-19. Several projects emerged almost immediately: Johns Hopkins tracked and visualized cases at the country and sub-country levels;[77] and HealthMap scraped media sources to show the outbreak's time-sequenced evolution.[78] UN initiatives included WHO's dashboard of case updates by countries,[79] WFP's Hunger Map LIVE showing outbreaks by income group,[80] the United Nations High Commissioner for Refugees (UNHCR)'s platform for temporary measures and protection impact,[81] and UNFPA's Population Vulnerability Dashboard.[82] In collaboration with Inter-Agency Standing Committee (IASC) partners, OCHA launched an interactive dashboard with an inter-agency overview of COVID-19 impact on humanitarian contexts.[83] The tool merged data on cases, funding, humanitarian access, and sector-specific operational data to show how needs were changing and where additional action was needed.

The Humanitarian Open Street Map Team[84]

Detailed maps of roads, buildings and other key infrastructure are critical to assess needs, direct resources and deliver aid in an emergency. Since 2010, Humanitarian Open Street Map Team volunteers have edited satellite images to create detailed, life-saving maps. More than 400,000 community mappers have mapped over 85 million buildings and more than two million roads. Microsoft AI systems have been used to supplement human capacity by predicting features and speeding up the initial identification. After the 2015 Nepal earthquake, rescue teams struggled to direct efforts due to landslides, rockfalls and road collapses. Within hours, more than 4,000 Humanitarian Open Street Map Team volunteers and partners identified damaged roads and neighbourhoods, displaced persons camps and helicopter landing zones.

3. Challenges

Challenges posed by crisis maps and dashboards are similar to those described under Section II.A. In particular, **open, accurate and timely data**, data interoperability, and consistent data collection and verification are critical to avoid errors that may lead to arbitrary, perhaps automated, decisions. **Data responsibility and data protection**[85] risks include function-creep, a lack of transparency and informed consent, reidentification of anonymized data, tensions between data minimization and model efficacy, and non-humanitarian use of data by third parties. Crowdsourcing may degrade information quality and compromise its chain of custody.

E. BIOMETRICS AND DIGITAL IDENTITY

1. What are Biometrics and Digital ID?

Biometrics identify individuals by their unique biological or behavioural attributes, such as fingerprints, facial characteristics, and voice, iris or retina patterns.[86] Biometrics are automated via technical processing and authenticated through biometric scanners. **Digital identity** (ID) verifies a unique identity based on electronically captured and stored credentials and characteristics, which may include biometrics.[87] Identity can be foundational/ legal, used to prove who a person is, or functional, used to authenticate a participant without necessarily revealing their legal identity.[88]

2. Opportunities

Identity is a human right.[89] Yet over one billion people lack proof of identity, nearly half of them children.[90] Biometrics and digital ID present a number of opportunities for the humanitarian sector,[91] while placing "individual **identity and dignity** at the heart of humanitarian action."[92] Biometrics and digital ID can facilitate access to humanitarian assistance, basic services, livelihood opportunities and participation in financial systems and economic and political life. They can help restore health, residence or ownership records; enable freedom of movement; and protect against disappearance, locate the missing, and reconnect families. They are harder to lose or forge than non-digital identification, minimizing the risk of fraud and corruption and supporting programme legitimacy. And they require fewer resources to verify, increasing processing speed and efficiency.

Biometric Refugee ID in Thailand – IRC, iRespond and ID2020 Alliance[93]

In 2018, the IRC and iRespond piloted the use of biometric IDs in Thailand's Mae La camp, where many refugees had lived for three decades with little to no legal identification. The programme sought first to provide better access to healthcare, and then to facilitate livelihood opportunities through digital bills of health and education. The key challenge was to ensure people could control their data and protect it against unauthorized access. Mobile devices could function as "digital wallets", accessible only to them. For those without mobile devices, data was stored in internal IRC repositories that could be accessed and deleted upon data subject request.

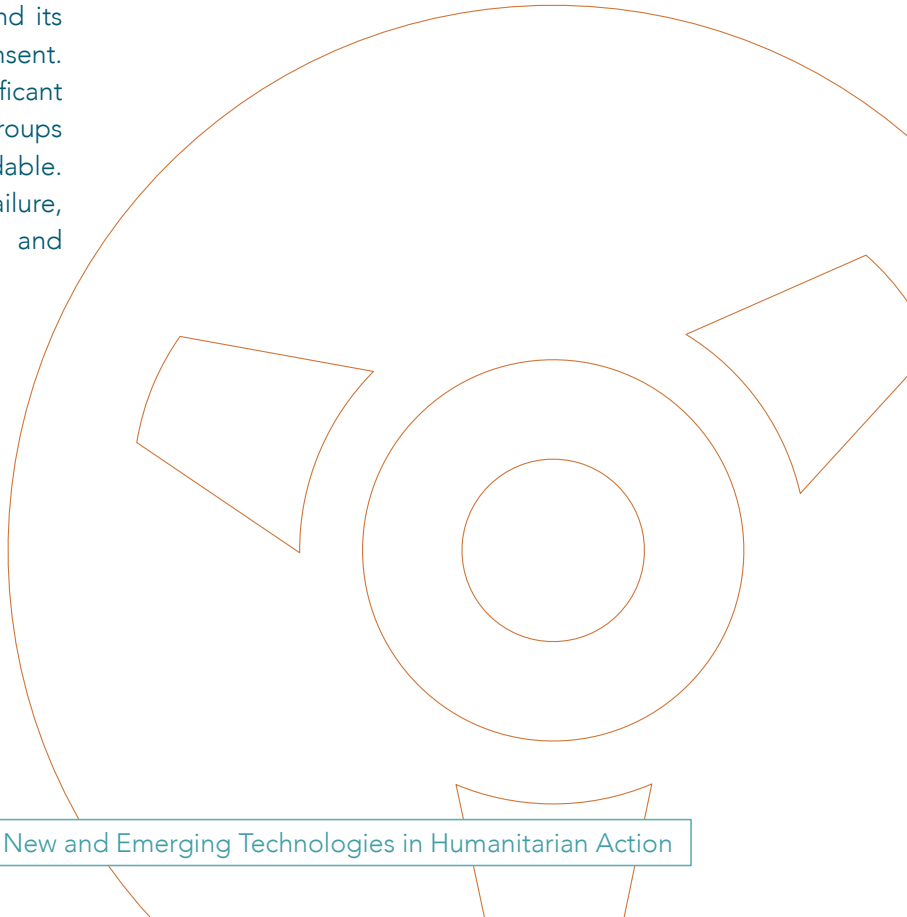
The project was supported by the ID2020 Alliance,[94] a public-private partnership that promotes ethical digital ID both globally and in humanitarian and development contexts. The ID2020 Alliance, which includes partners such as Accenture, Microsoft, Visa, MasterCard, Mercy Corps, CARE, Kiva, and the Rockefeller Foundation, promotes digital ID that is: privacy protecting and allows individuals to control access to their data; portable and persistent across time and jurisdictions; and interoperable between institutions. Approaches include: (1) ensuring that data controls include encrypted, anonymized digital IDs that can only be unlocked by the owner; (2) combining biometrics with blockchain for secure storage and verification; and (3) limiting storage to owners' portable "digital wallets" without reliance on centralized databases.

3. Challenges

Biometrics and digital ID raise significant challenges in humanitarian contexts, including **data responsibility and data protection**[95] challenges described in Sections II.A., B. and C. Biometrics and digital ID contain uniquely personal and sensitive data, requiring robust safeguards to ensure individuals' control over their data as well as adequate data protection, privacy and security. While industry partners may be best equipped to build a secure data infrastructure, they may use biometric data for non-humanitarian purposes. Governments have promoted biometrics in part as an outgrowth of counter-terrorism agendas and may demand access to humanitarian data for reasons of law enforcement and national security. Non-state actors may seek unauthorized access to biometric data, including through cyberattacks. Such third-party access can lead to harms, including digital refoulement,[96] discrimination and persecution,[97] and compromise the **principled delivery of humanitarian assistance**.

Further, individuals may lack full understanding of the extent and risks of data processing or alternatives to accessing aid, and data may be used beyond its original purpose, undermining informed consent. Biometric systems are also susceptible to significant **error rates**, such as where fingerprints of certain groups (e.g., manual workers) are less accurate or readable. **Technical malfunctioning** may lead to system-failure, particularly in low-connectivity environments and where equipment and backup systems are poor.

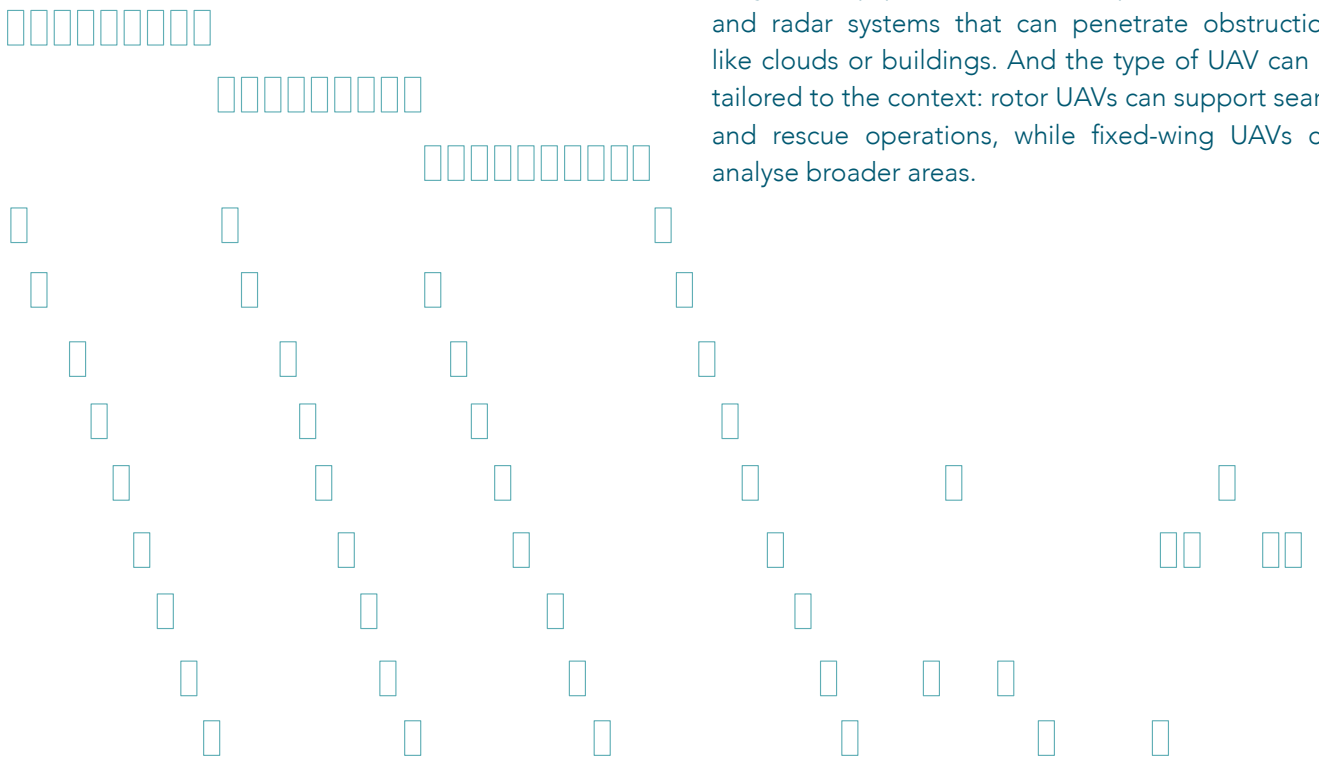
For digital ID to be effective, it must be privacy-preserving, user-controlled, persistent and portable.[98] **Portability** enables people to prove their identity across service providers by selectively accessing and sharing a variety of digital credentials. This feature requires **interoperable** systems that are recognized and trusted across geographic and institutional borders. A lack of interoperability cannot only limit the utility of digital ID, but also widen the **digital divide** by excluding marginalized communities from accessing rights, benefits and services. Portability and interoperability require sustained cross-sector **collaboration** to reach agreement, secure commitments and align incentives on ethical and technical ID standards (see ID2020's Certification Mark[99]). They further require funding and implementation of programmes demonstrating proof of concept; and legal and regulatory frameworks to govern these systems and ensure appropriate privacy protections. Ultimately, biometrics and digital IDs should improve people's lives, not add complexity or burden for people affected by or responding to humanitarian crises.



F. UNMANNED AERIAL VEHICLES

1. What are UAVs?

A **UAV** is an aircraft that operates without a pilot, either steered remotely or flown autonomously on a programmed route.[100] While UAVs vary greatly in size, flight capacity, complexity and price, those available to humanitarians are typically light-weight, low-cost systems that require limited training and cover short distances.[101] Fixed-wing drones can cover longer distances and carry heavier loads, but require open space for landing and take-off, while multi-rotor drones have shorter flight times and distances and can hover and vertically take off and land.[102] Hybrid drones have both wings and rotors and can fly horizontally as well as take off and land vertically.



2. Opportunities

The global civil UAV market was valued at $5 billion in 2019 – up from $2.8 billion in 2017 – and is expected to rise to $14.5 billion by 2028.[103] In humanitarian action, UAVs present a number of opportunities.[104] They enable **earlier, faster and more efficient** needs assessment and response planning, implementation and monitoring. Their cameras and sensors can quickly capture on-the-ground images for analysis and use for rapid response as well as long-term monitoring. To a lesser extent, UAVs can also support search and rescue operations; spread public messages; temporarily restore connectivity; and deliver aid, especially lightweight essentials.

UAVs have several **advantages** over other data collection methods. They can fly on-demand and at lower cost than satellites and airplanes, enabling repeated use in fast-changing environments. They can fly close to the ground and provide imagery with higher resolution, accuracy and detail. They can carry a broad range of equipment, from smartphones to infrared and radar systems that can penetrate obstructions like clouds or buildings. And the type of UAV can be tailored to the context: rotor UAVs can support search and rescue operations, while fixed-wing UAVs can analyse broader areas.

Disaster Mapping in Malawi – UNICEF[105]

In 2019, Cyclone Idai caused an estimated $2.2 billion in damage and affected more than 1.8 million people.[106] *Collaborating with the Malawi Department of Disaster Management Affairs and the Red Cross, UNICEF used UAVs to rapidly map flooded areas, assess needs and inform the response. Government partners provided local leadership, coordination and data on affected areas, while technology partners supplied cloud-based and offline software solutions for aerial imagery analysis. Local partners contributed on-the-ground expertise and consultants supplemented staff capacity. Emergency exemptions in UAV regulations enabled flexible flight operations. Community engagement dispelled concerns over the apparent ability to identify individuals: aerial imagery was collected at a 90-degree angle, unable to identify faces or defining characteristics even when collected close to the ground with high resolution cameras.*

Medical Aid Delivery in the Dominican Republic – WeRobotics[107]

In 2019, a cross-sector consortium led by Dominican Republic Flying Labs and WeRobotics tested localized approaches to medical drone delivery in the mountainous inland areas of the Dominican Republic. The aim was to enable clinicians and logisticians in the country's health care system to operate UAV delivery systems without requiring expert or vendor-maintained operations, and to understand how such systems might be operated routinely in the future. More than 100 flights over a six-week period transported a variety of medicines and lab samples, with clinicians as the primary operators. The key innovation was embedding an autonomous delivery model within the country's existing health care system, operated and supported by local actors as part of their everyday activities.

3. Challenges

Using UAVs in humanitarian settings gives rise to a diverse set of challenges.[108] Many countries **lack regulations** on UAVs,[109] which can delay their deployment and require ad hoc agreements with local authorities. Existing regulations may **limit flights** by altitude, distance and proximity to urban areas or airports, or prohibit cargo dropping. Exemptions are essential, as humanitarian operations are often located near airports and logistics centres. Streamlined processes for flight permissions and fast-track options for humanitarian applications are equally important. The Humanitarian **UAV Code of Conduct** provides useful guidance on the safe, responsible and effective use of UAVs in humanitarian contexts.[110]

Despite decreasing complexity and cost, UAVs require adequate **equipment, capacity and skill**. Unlike satellites, UAVs depend on timely proximity to trained pilots. Spare parts may be unavailable, and drone companies may void warranties where UAVs are repaired locally. Liability insurance is essential to protect against injury or property damage from collision or mechanical failure. Large batteries cannot be transported on passenger aircraft, and short battery life limits flight performance. Aid deliveries are typically limited to lightweight cargo and short distances, requiring extensive infrastructure to be scalable. Large area mapping may be better carried out by satellites or airplanes in place of many UAV flights, where lower resolution imagery suffices.

Data processing remains one of the main challenges for realizing the full potential of UAVs, which can produce thousands of images with vast data volumes. This can result in difficulties and delays in transferring, processing and analysing the data, especially where electricity, connectivity and data processing platforms and skills are lacking. Finally, data collection by UAVs can present **data responsibility, including data protection**,[111] challenges, such as where privacy and trust concerns result from UAVs' ability – even if only apparent – to capture activities people want to keep private.

G. BLOCKCHAIN

1. What is Blockchain?

Blockchain is a distributed, decentralized ledger technology.[112] The **ledger** is a database that stores information, such as cash transactions, "smart" contracts and digital credentials, in **blocks** of data. It is distributed as many identical copies exist and **decentralized** as it is controlled by its users rather than a central authority. Blocks of data are time-stamped, authenticated via pseudonymized digital signatures, verified by users, and cryptographically locked together in a **chain** that contains the entire history of data blocks, making it auditable and next to immutable. Blockchains can be public or private, and either permissionless or permissioned, such that only a select group can contribute to and validate transactions on the blockchain.[113]

2. Opportunities

Global blockchain spending is estimated to rise from $1.5 billion in 2018 to $18 billion in 2024.[114] In humanitarian action, blockchain may enhance information **accuracy, transparency and traceability** and **reduce transaction cost and time** by removing the need for a third-party intermediary.[115] Blockchain may support the verification of identities; make the journey of humanitarian goods transparent; support digital cash programmes by making funding streams and gaps transparent and reducing intermediary costs; and enable crowdfunding and microfinancing through digital currencies or decentralized funding platforms. Data privacy may be increased by leaving block headers visible to all participants, while only those with permission can access underlying information. And blockchain's decentralized nature may enhance security due to the lack of a "single point of failure or compromise" for potential attackers.[116]

Collaborating for a Comprehensive Blockchain Approach – UNICEF[117]

Through a comprehensive blockchain approach, UNICEF (1) funds open source blockchain projects through the UNICEF Innovation Fund; (2) develops blockchain applications; (3) builds capacity; and (4) collaborates across agencies. In 2019, UNICEF launched the first cryptocurrency-denominated venture fund within the UN, which accepts, holds and distributes cryptocurrency and through which UNICEF has invested in more than 10 companies using bitcoin and ether, with donors able to trace funding flows via blockchain. UNICEF's internal projects include Digicus, a prototype built by the Kazakhstan Country Office to automate and monitor vendor payment and management through blockchain-linked smart contracts. They also include ProCoChain, an initiative to map, connect and manage connectivity in schools around the world in the context of the Giga initiative to connect every school to the Internet, a collaboration with the International Telecommunication Union (ITU). Blockchain-based prototypes are being explored in the context of Giga to increase transparency and accountability of funding streams, capture internet speeds on a transparent ledger, and manage the relationship with internet service providers based on a set of rules (i.e., smart contracts). Together with the United Nations Development Programme (UNDP) and WFP, UNICEF also developed The Atrium, an inter-agency platform that allows UN entities to experiment with blockchain applications and share lessons learned.

Blockchain-Based Cash Programmes for More Agile and Effective Assistance – WFP[118]

Building Blocks was launched by WFP and partners in 2017 to deliver aid to Jordan's Zaatari and Azraq refugee camps. Through WFP's blockchain system, which was integrated with UNHCR beneficiaries' biometric data, identities could be verified via iris scan at points of purchase. The system then authorized the transaction, released digital money on e-cards, and updated the account, providing WFP with a complete transaction record while saving on bank fees. Together with UN Women, WFP used this biometrics-based blockchain system to assist Syrian women in cash-for-work programmes, granting access to funds or supplies at WFP-contracted supermarkets. During the COVID-19 response, WFP deployed blockchain in Cox's Bazar in Bangladesh, allowing refugees to purchase goods using e-cards containing non-personally identifiable ID codes.

3. Challenges

Blockchain applications in humanitarian settings present various challenges.[119] Humanitarian uses remain relatively **new and untested**, with limited regulatory and ethical frameworks. Blockchain development and testing require significant time and financial, technical and human **resources**. Safe and effective use requires **connectivity, digital literacy** and user-friendly applications. And early bitcoin applications created a lingering **scepticism** of cryptocurrency cashflows.

Further, blockchain may raise **data responsibility, including data protection**, challenges, such as those described in Sections II.C. and E., when integrated with biometric or digital cash transfer systems. In addition, blockchain's distributed and immutable nature poses several challenges, including: it may conflict with the duty to process as little personal data as possible (data minimization) and to retain it only as long as necessary (data retention); it may make it difficult to comply with a data subject's right to data rectification and deletion; it may provide numerous entry points for cybersecurity breaches; and if encryption should ever fail, perhaps due to advances in quantum computing, personal and sensitive data could be irreversibly exposed.[120]

Fundamentally, it must be determined whether blockchain is the **correct solution** to an existing problem. Blockchain may be uniquely useful to track assets and transactions over time, when numerous actors need to collaborate, where a record of transactions that is difficult to alter is required, and where no effective central authority exists.[121] Other purposes may be better satisfied by a centralized database, such as where the integrity of information is not in question due to sufficient trust between participants or transactional integrity and auditability.[122] Ultimately, specific use cases for blockchain in humanitarian contexts remain largely to be determined.

H. INTERNET OF THINGS

1. What is the Internet of Things?

The internet of things (IoT) is a network of connected devices that transmit real-time data for better data-driven decision-making.[123] Devices range from phones and computers to thermostats and health trackers. Sensors in the devices convey information, such as temperature, air or water quality, location, or seismic activity, to a mobile phone to alert of potential risks, or to a data processing platform to analyse and visualize the data and make it useful for decision-makers.

2. Opportunities

In humanitarian contexts, IoT can improve early warning, create operational efficiencies, and save lives by providing urgently needed **on-the-ground information**.[124] Smart thermometers can monitor the temperature of medicines and vaccines during transport and storage. Sensors can be placed on bridges to alert of floods; on water pumps or wastewater tanks to measure usage; in homes to detect household smoke emitted by fires for cooking, heating and lighting; and on medical devices to collect, transmit and monitor health data. SIM-card enabled devices can alert individuals and responders via mobile phone even in low-connectivity environments, facilitating potentially life-saving interventions. And data transmitted to computers for analysis and visualization can be translated into vital remote decision-making tools. Owing to its great potential for use in networks analytics, IoT will likely become increasingly relevant for humanitarian logistics, rapid assessment and monitoring in the future.

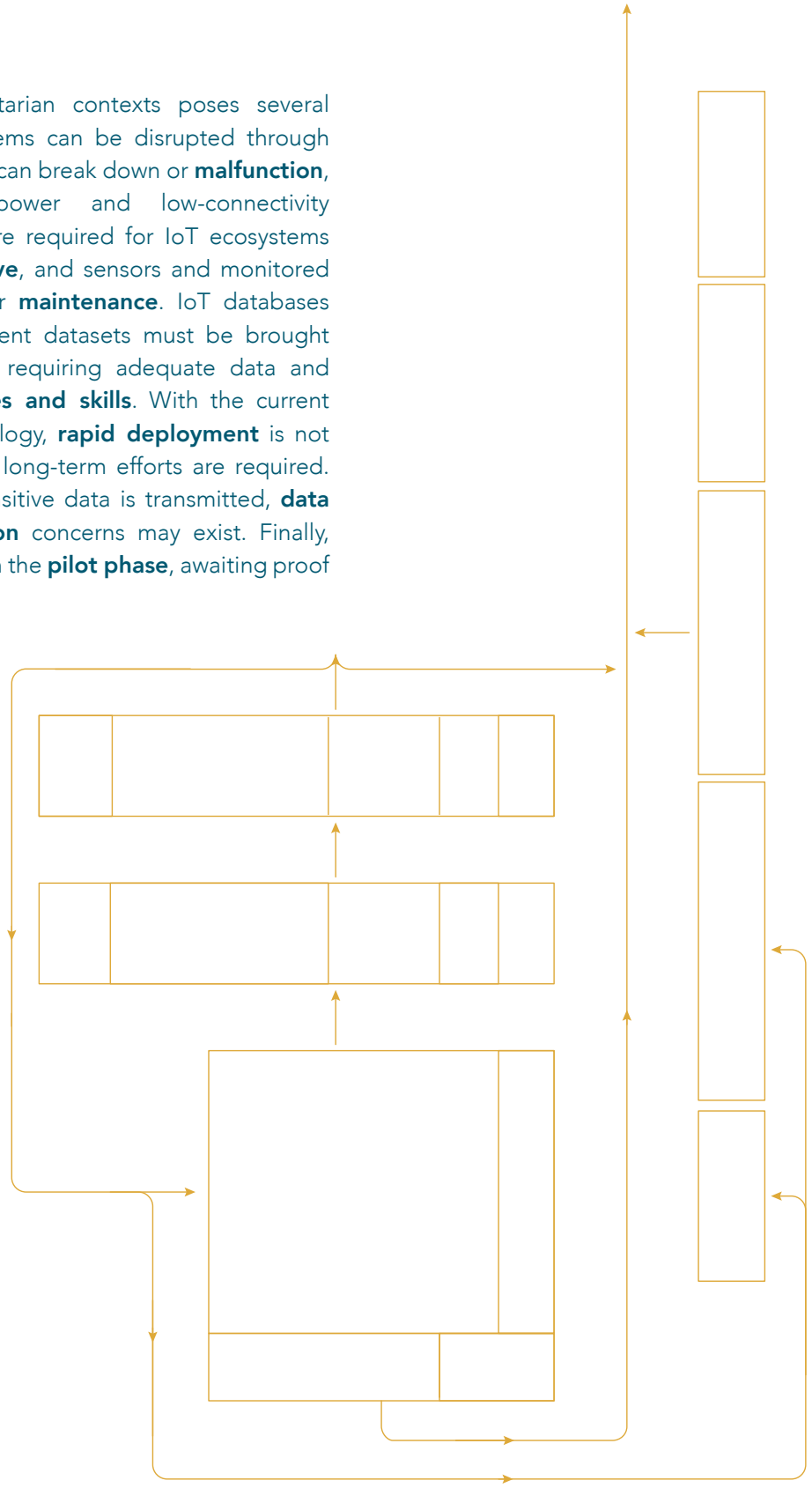
Protecting Vaccines Through IoT-Enabled Cold Chain Management – International Organization for Migration and Nexleaf[125]

Monitoring and managing temperature-controlled supply-chain (or cold chain) equipment is critical to vaccine safety and effectiveness. As vaccines must typically remain between 2°C and 8°C, they are put at risk by frequent power outages and equipment malfunctions in rural clinics and displaced persons settlements. Seventy-five per cent of freeze-sensitive vaccines are exposed to freezing and in low- and middle-income countries, 56 per cent of cold chain equipment is non-functional or poorly functional.[126] *Nexleaf's ColdTrace is a wireless remote temperature monitoring solution that can identify refrigerator failures, alert decision-makers to problems and verify the efficacy of repairs. ColdTrace is operational in more than 17,000 clinics across 26 countries, protecting the vaccine supply of one in ten newborns globally.*

The International Organization for Migration (IOM) and Nexleaf are collaborating to install ColdTrace devices in health clinics that assist migrants and refugees in over 30 countries. In case of a power outage or temperature fluctuation, ColdTrace sends an SMS-alert to IOM focal points, activating response protocols that prevent vaccine wastage. Where connectivity allows, data is sent to a cloud for analysis to aid strategic decisions. To strengthen vaccination services affected by COVID-19, Nexleaf and IOM, aided by Centers for Disease Control and Prevention (CDC) funding, expanded their partnership to remote areas of Kenya and Tanzania, using Nexleaf relationships with the ministries of health and IOM vaccination capacity to build strong cold chain capacity in refugee camps and surrounding areas. This partnership is expected to grow, covering vulnerable migrant populations in more countries and contributing to the global COVID-19 vaccination efforts.

3. Challenges

Using IoT in humanitarian contexts poses several challenges.[127] IoT systems can be disrupted through cyberattacks, and they can break down or **malfunction**, particularly in low-power and low-connectivity environments. Hardware required for IoT ecosystems may be **cost-prohibitive**, and sensors and monitored objects require regular **maintenance**. IoT databases are complex, as different datasets must be brought together immediately, requiring adequate data and data science **capacities and skills**. With the current state of sensor technology, **rapid deployment** is not yet feasible and more long-term efforts are required. Where personal or sensitive data is transmitted, **data privacy and protection** concerns may exist. Finally, many projects remain in the **pilot phase**, awaiting proof of concept and scaling.



I. 3D PRINTING

1. What is 3D Printing?

Additive manufacturing, or three-dimensional (3D) printing, uses "a computer-controlled machine to add successive layers of material to create a three-dimensional object" with the help of a computer-aided design and drafting program.[128] In its basic form, 3D printers build objects out of plastic filaments or other materials like nylon or sponge-like structures by heating, extruding and cooling them.[129] There are also printers for materials such as metal, ceramic, carbon fibre, silicon, concrete or human and animal cells; but they are typically industrial size and require greater financial investment and technical skill to operate.[130] 3D printers available to humanitarians are typically consumer-grade and off-the-shelf.

2. Opportunities

The logistics of humanitarian action account for an estimated 60-80 per cent of the cost of humanitarian assistance.[131] 3D printing enables **earlier, faster, more tailored and localized** humanitarian action by manufacturing goods rapidly and locally where they are needed most. 3D printers have printed humanitarian goods ranging from sanitation items like latrine-cover hinges to medical disposables like umbilical cord clamps. There are also a number of experimental uses, including the printing of prosthetics, human organs, tissues and food.[132] During the COVID-19 response, 3D printers produced parts for personal protective equipment.[133]

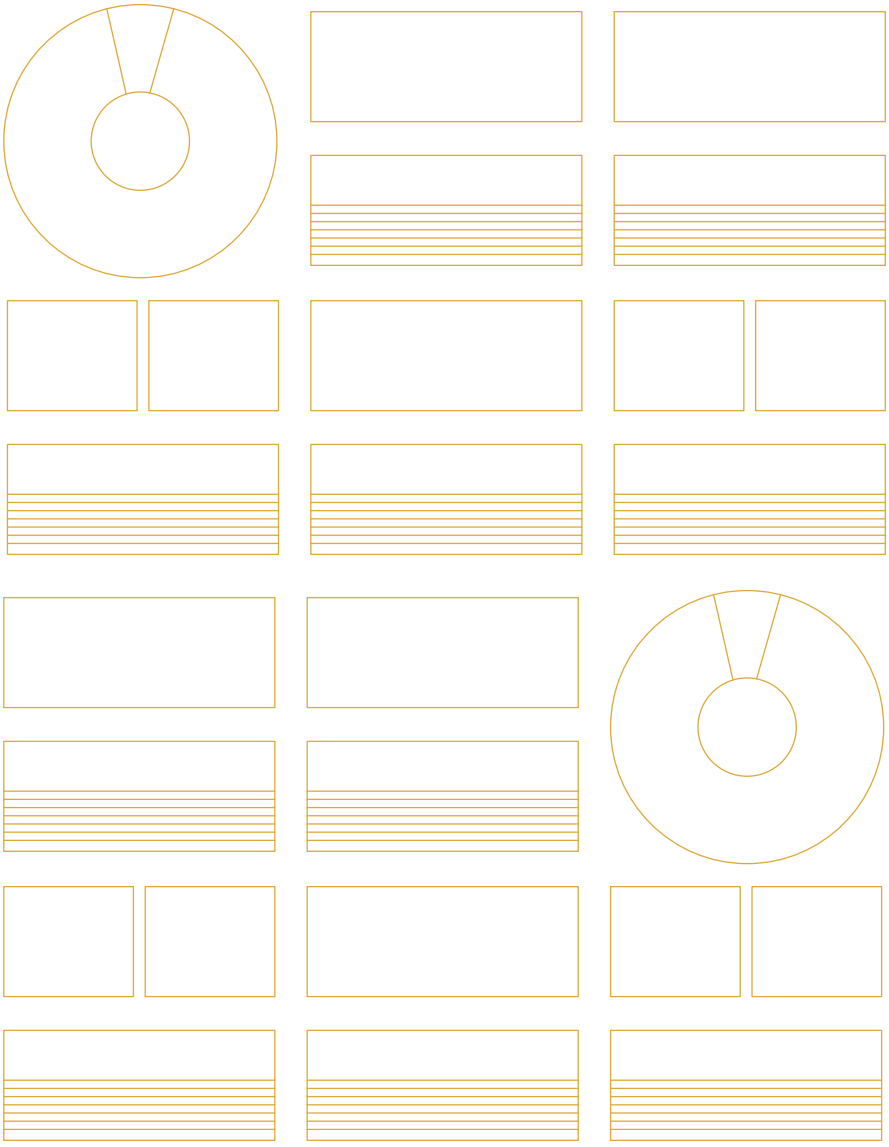
3D printing has several **advantages** over traditional procurement methods.[134] By prototyping and producing goods locally, 3D printing can save transportation cost and time while increasing flexibility and customization. It can empower communities by generating job opportunities, addressing livelihood needs and increasing local ownership, as basic 3D printers are relatively affordable and easy to install and operate. Many designs for 3D printers are open source, facilitating the development of similar, derivative and supporting products.

3D Printing for a Faster, More Tailored and Localized Response – Field Ready[135]

Field Ready works to transform logistics in humanitarian crises through technology, design and community engagement. After the 2015 Nepal earthquake, Field Ready used 3D printers to fix leaking waterpipes. After the 2010 Haiti earthquake, it quickly and cheaply printed umbilical cord clamps to prevent infections in mothers and children. Field Ready's teams combine humanitarian and technical expertise to identify needs that can be met by 3D printing, as well as the appropriate materials and designs. Field Ready supports "maker communities" by training and collaborating with local populations. In Nepal, the organization teaches hospitals to fix medical equipment, reducing demand for foreign goods and saving cost and time. When a fuse box caused a broader electrical problem in a hospital in Kathmandu, replacement parts that normally cost $1,700 and take four weeks to deliver were printed within three hours at a cost of $0.50.

3. Challenges

There are a number of limitations to 3D printing in humanitarian settings.[136] 3D printers are ideal for augmenting local capacity by rapidly producing customized prototypes, moulds or replacement parts. But they are presently **not fast enough** to go beyond small-batch manufacturing, and therefore unlikely to replace traditional mass production processes. Further, end-to-end processes from concept-to-print have not been streamlined. While the cost of 3D printing has decreased, printers and plastic filaments remain cost-prohibitive in some instances. Concerns have also arisen about environmental impact, waste generation and toxicity. While basic 3D printers are relatively easy to operate, **advanced skills** are needed for computer-aided design and drafting programming and for designing safe and interoperable parts. Producing certain products, such as medical equipment, may require **regulatory approvals**. Other **technical challenges** include the printers' susceptibility to breaking down, their sensitivity to weather and temperature extremes, and their need for a steady power supply.



III

ENABLERS AND GUARDRAILS: FROM PROMISE TO PRACTICE

The previous section lays out the opportunities and challenges associated with specific technology applications with the potential to transform humanitarian action. This section considers the **overarching efforts** needed in the humanitarian sector to address these challenges and realize the potential of technology to protect and improve the lives of the most vulnerable.

The Secretary-General's **Roadmap for Digital Cooperation**, launched in 2020, proposes a series of steps and mechanisms to pave the way towards more effective global digital cooperation.[137] It calls for (1) universal global connectivity by 2030, with a special emphasis on emergency situations; (2) the creation of digital public goods, such as open source software, open data, open AI models, and open standards; (3) digital inclusion; (4) digital capacity-building; (5) the protection of human rights in the digital era; (6) global cooperation on AI; (7) the promotion of trust and security in the digital environment; and (8) the creation of a more effective architecture for digital cooperation.

Interviews with more than 80 humanitarian and technology experts identified seven priorities for the humanitarian sector that are consistent with the Roadmap for Digital Cooperation. The experts delineated the following **enablers** for unlocking technology's potential in humanitarian action:

ENABLERS OF NEW AND EMERGING TECHNOLOGIES IN HUMANITARIAN ACTION

INCLUSION AND LOCALIZATION

Bridge the digital divide and pursue local approaches to connect and empower communities and individuals and ensure that no one is left behind

PEOPLE-CENTRED DESIGN AND LEADERSHIP

Pursue demand-driven, contextually tailored strategies to identify the most effective high-tech, "low-tech" or "no-tech" solutions to existing problems

DATA, CAPACITY AND SKILLS

Ensure the "basics" are in place for better data-driven decision-making, including adequate data, IT infrastructure, technical skills and human capacities

DATA RESPONSIBILITY AND THE HUMANITARIAN PRINCIPLES

Do No Harm, respect the humanitarian principles and ensure adequate data responsibility, including data protection

COLLABORATION AND COORDINATION

Form sustained partnerships among humanitarians and across sectors to consolidate efforts, create synergies and leverage resources effectively

LAW AND POLICY

Take a rights-based approach that enables technology deployments while ensuring respect for international law, human rights and ethical standards

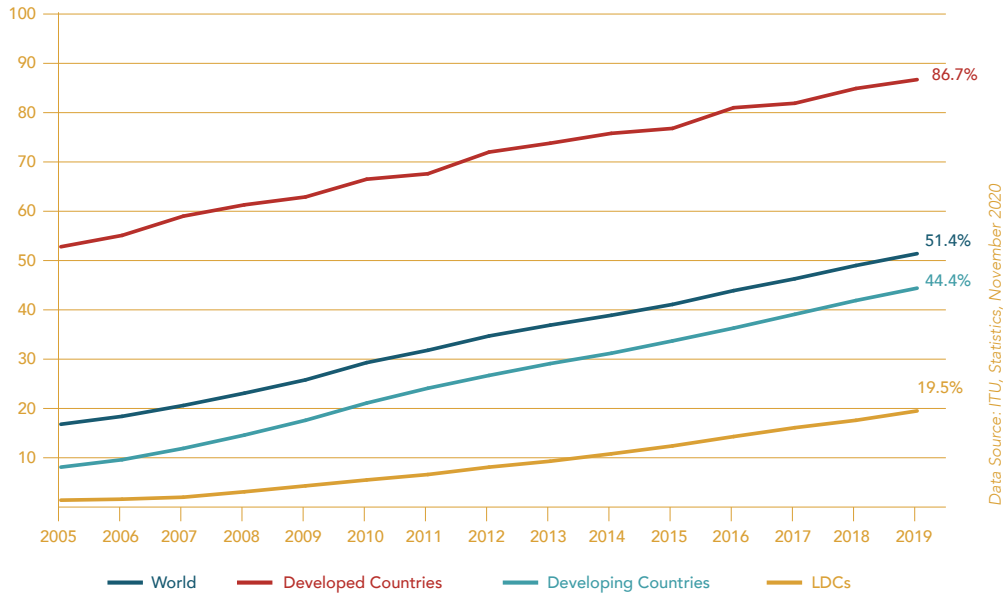
INVESTMENT AND SCALING

Measure impact and make sustainable investments, including in research and development, to generate scalable, long-term technology gains

A. INCLUSION AND LOCALIZATION: EMPOWER COMMUNITIES AND BRIDGE THE DIGITAL DIVIDE

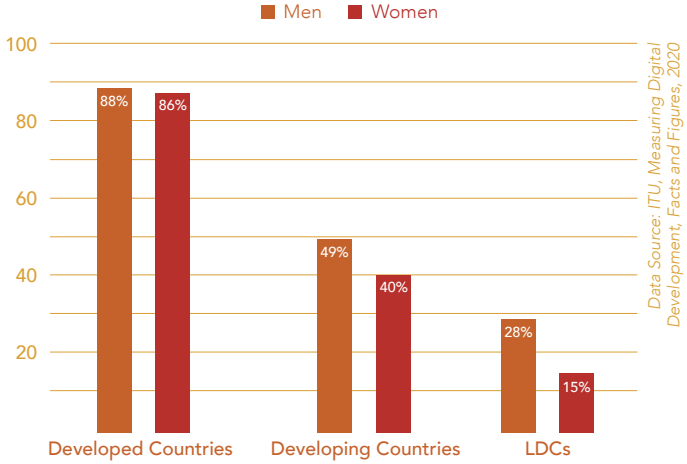
Technology has, in many instances, facilitated greater inclusion through access to information, aid and livelihood opportunities. And yet, equal access to assistance, protection and information is difficult to achieve in the digital space, partly due to a **digital divide** "along gender, geographical, economic, age and other identities that intersect with existing vulnerabilities."[138] Most technology solutions require, at a minimum, access to basic technology, electricity and connectivity. While such access has increased significantly in recent years, in 2019, only 19 per cent of those in least developed countries (LDCs) used the internet,[139] and globally some 840 million people remained without access to electricity.[140]

INDIVIDUALS USING THE INTERNET (%)

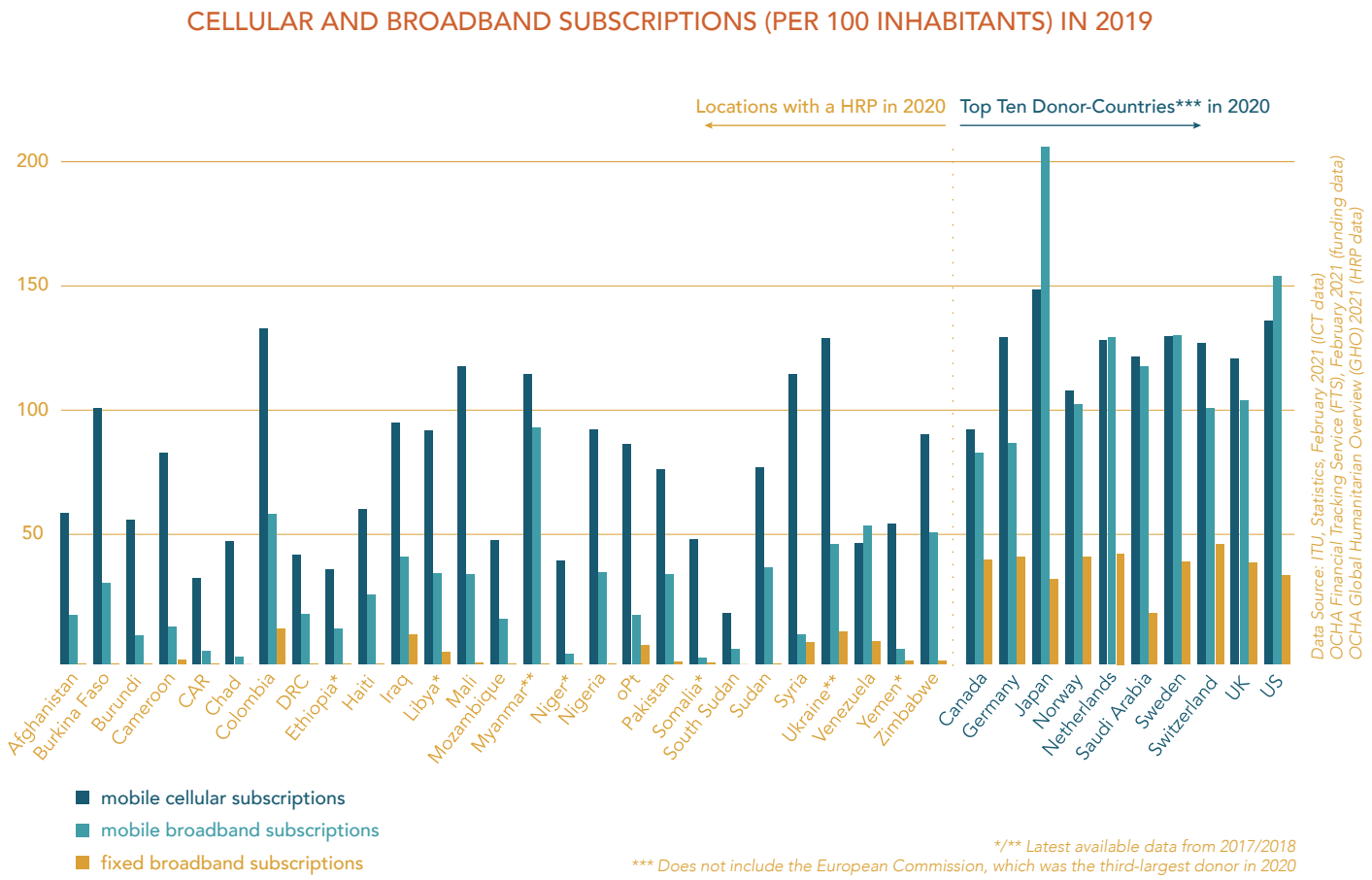


Applying a gender-lens reveals further disparities (see Chart). And for refugees, research in three locations (Jordan, Rwanda and Uganda) showed that over two thirds were active mobile phone users but, except in Jordan, only about a third had used the mobile internet and 13-47 per cent fewer women than men owned a mobile phone.[141] Affordability and charging were noted as key access barriers.[142]

INTERNET USE BY MEN AND WOMEN IN 2019 (%)



A comparison of mobile phone and broadband subscriptions in **key donor countries** and locations with a **Humanitarian Response Plan** (HRP) reveals a stark digital divide:



The data also demonstrates significant **differences across humanitarian contexts**, from largely connected settings to near-zero internet connectivity environments. Such variations, as well as differences in security concerns and access restrictions – e.g., among natural disaster and armed conflict settings – are determinative of the viability of a technology solution in a humanitarian setting.

"The New Face of Inequality" – COVID-19 and the Digital Divide

Unequal access to technology during the COVID-19 pandemic created gaping disparities in people's ability to access healthcare and pursue education and livelihood opportunities. A UNICEF study found that at least 31 per cent of schoolchildren could not be reached by remote (internet, TV or radio-based) learning programmes, primarily due to lacking equipment or remote learning policies.[143] More than 70 per cent of those students lived in rural areas and over 75 per cent came from the poorest 40 per cent of households. Only 47 per cent of low-income countries used internet-based instruction, compared to 95 per cent of upper-middle-income countries. Further, millions of small retailers struggled to meet the sudden digital demand due to lacking access to technology and the internet, with severe implications for economic recovery, particularly in Latin America, South East Asia and Africa.[144] United Nations Secretary-General António Guterres stressed, "the digital divide is now a matter of life and death for people who are unable to access essential health-care information. It is threatening to become the new face of inequality, reinforcing the social and economic disadvantages suffered by women and girls, people with disabilities and minorities of all kinds."[145]

The Digital Divide in the Philippines Following Typhoon Haiyan in 2013[146]

In the aftermath of Typhoon Haiyan, researchers concluded that uneven connectivity and digital literacy among affected people contributed to a fragmented recovery and exacerbated socio-economic inequalities. Affected people from low socio-economic backgrounds lacked internet and other media access as well as digital literacy, contributing to a slower recovery than that of middle-income families able to use digital tools and manoeuvre within the media landscape.

Furthermore, there are stark **differences within contexts** between those with access to connectivity, technology and digital literacy and those without. Overreliance on digital technology can exacerbate inequalities, such as where digital early warnings, incident reporting opportunities, chatbots or cash transfers reach only certain groups. Affected people will not have equal ability to transmit or receive information required to access assistance or services, or to translate technology into livelihood opportunities. Less connectivity and accessibility also means less data about affected populations, which can lead to biases and digital discrimination, such as where AI relies disproportionately on data related to a certain gender, race, or ethnicity. Gender biases may be heightened due to women's lack of access to technology. And lacking connectivity can prevent humanitarians from employing technology-based solutions in the response.

> "The digital divide is now a matter of life and death for people who are unable to access essential health-care information. It is threatening to become the new face of inequality, reinforcing the social and economic disadvantages suffered by women and girls, people with disabilities and minorities of all kinds.

The importance of **connectivity** cannot be overstated, both as a distinct and emerging field and a fundamental enabler across sectors. Information is a basic need in humanitarian response,[147] and connectivity increasingly predicates access to traditional assistance. Accordingly, accelerated "discussions on connectivity as part of emergency preparedness, responses and aid" to "ensure that every person has safe and affordable access to the Internet by 2030" are priorities of the Roadmap for Digital Cooperation.[148]

Realizing the benefits of technology in humanitarian action requires empowering communities and increasing **local ownership** over the response. Local and regional experts can provide superior leadership and knowledge of circumstances, environments and communities; leverage pre-existing partnerships; and generate job opportunities for local professionals. They can better assess and understand local needs and help guarantee the longevity of a pilot project through local capacities and maintenance upon completion. Local participation in the design, development and use of new and emerging technologies can tailor solutions to local contexts, increase their impact and minimize risks, including developer bias and digital discrimination. These benefits can improve community engagement, strengthen legitimacy, credibility and trust, and support the sustainable and effective deployment of technology solutions.

> In order to ensure that every person has safe and affordable access to the Internet by 2030 the United Nations will accelerate discussions on connectivity as part of emergency preparedness, responses and aid.

FACILITATING CONNECTIVITY THROUGH DIGITAL COOPERATION IN HUMANITARIAN CONTEXTS

A "Platform of Hope" – NetHope[149]

NetHope is a consortium of 60 non-profits that partner with technology companies to develop solutions to humanitarian and development challenges. In Venezuela, NetHope provided emergency telecommunications services to humanitarians and affected people, connecting over 150,000 migrants as of December 2018. After Hurricane Maria in Puerto Rico in 2017, NetHope facilitated Wi-Fi connectivity for responders and communities and launched a Facebook page that reached over 1.3 million users with critical information. In Syria, NetHope installed Wi-Fi hotspots and charging stations along migration routes and in refugee camps. Microsoft and Cisco provided cyber security tools and Google created an online information hub for refugees. In West Africa in 2014-2015, NetHope provided equipment and connectivity solutions to Ebola-affected countries.

"Timely, Predictable and Effective ICT Services" – Emergency Telecommunications Cluster[150]

One of 11 IASC-designated humanitarian response clusters, the Emergency Telecommunications Cluster (ETC) comprises a global cross-sector network of organizations led by WFP. It facilitates connectivity for humanitarians, assesses communities' needs, and provides other ICT services in emergencies. The ETC has responded to 35 emergencies in contexts such as Bangladesh, Central African Republic, Libya, Nigeria, Syria and Yemen.

Connecting Schools Around the World – Project Giga (ITU and UNICEF)[151]

Giga is a global initiative to connect every school to the internet and link young people to information and opportunity. In partnership with governments and industry, Giga has mapped 800,000 schools in 15 countries. Giga supports efforts to build connectivity, digital infrastructure and affordable financing models. In the COVID-19 response, Giga supported telework, tele-health, tele-education and financial services solutions.

Support for, investment in, collaboration with, and a **transfer of power** to local and regional actors is vital for empowering communities and creating lasting benefits of new and emerging technologies. User-centric needs assessment, capacity-building efforts, digital literacy programmes, and equal access to opportunities for local actors are fundamental building blocks. Most technology projects are led by foreign experts and employ foreign company expertise, which can lead to top-down, and technocentric approaches. More impactful and sustainable technology projects require radical inclusion. Lingering racist mindsets and any practices that may exacerbate any form of inequality must be openly addressed, challenged and overcome. In humanitarian settings, the promise of the Fourth Industrial Revolution will likely not depend on the technology itself, but on who gets to define the problem, build the solution, and deploy the technology to implement it.

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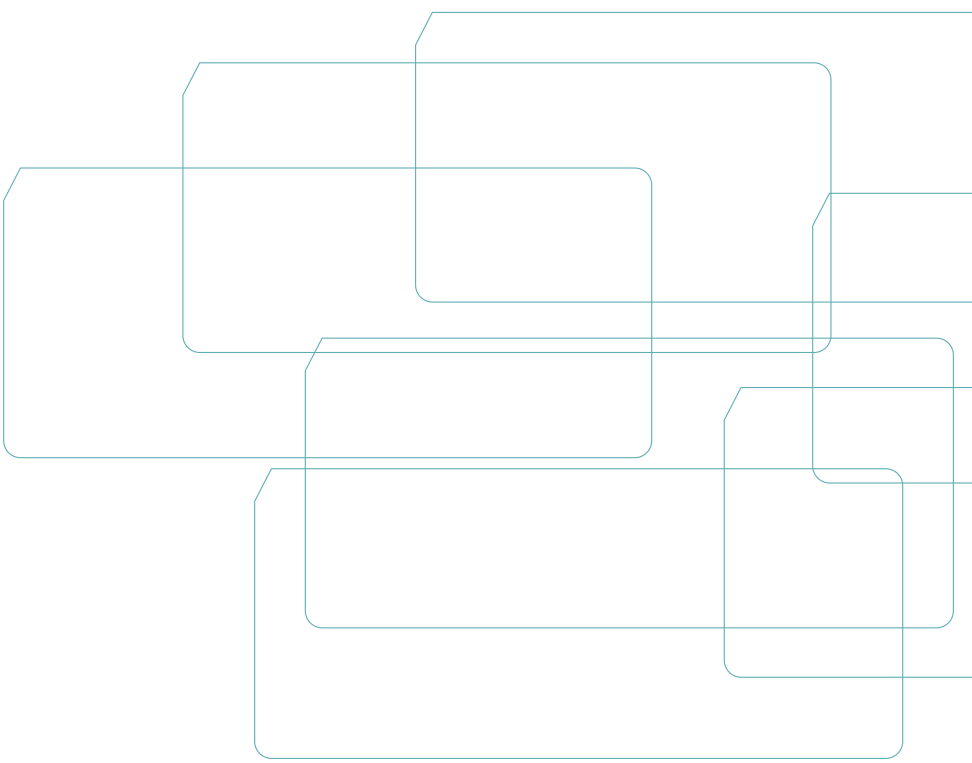
Shifting Power from the Global to the Local – WeRobotics[152]

WeRobotics facilitates a global network of 30+ Flying Labs across Africa, Latin America and Asia and the Pacific, uniting 170 local leaders and 196 partners. Flying Labs are set-up and run exclusively by local actors to serve as knowledge hubs that build on existing local expertise in drones, data and AI. Flying Labs are self-financed, work across sectors and autonomously determine which challenges to work on. Increasingly, actors within these hubs train each other to strengthen local expertise and drive inclusion, diversity and equal opportunity. In 2019 and 2020, Flying Labs and WeRobotics co-facilitated 80 local solutions and trained more than 720 professionals. WeRobotics aims to make FlyingLabs.org an independent entity and to grow the network to more than 40 Flying Labs by the end of 2021.



B. PEOPLE-CENTRED DESIGN AND LEADERSHIP: WORK WITH AND FOR USERS

A successful technology solution requires, first and foremost, the **clear identification of a problem**. Technology is often looked to as an omnipotent fix, but while technology can expedite a functioning business process, it cannot fix its underlying flaws. For example, where better data analysis is needed, adequate quality and quantity of data must first be available. The "hype-cycle"[153] around new technologies can spark a rush to launch pilot projects that are shelved once quick impact scaling proves difficult. Such a supply-driven model, while well-intentioned, requires reconsideration. Only where a problem, current modes of addressing it and potential improvements are clearly identified can a technology solution reach its full potential.

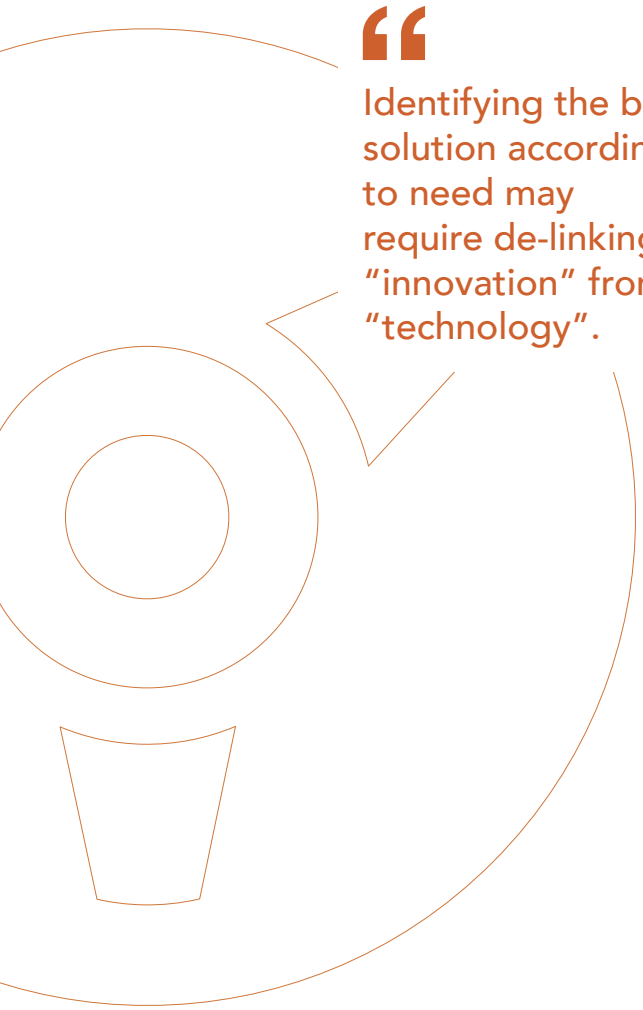
A problem and its solution must be identified through a **people-centred, needs-driven approach**. Top-down approaches to technology deployment risk stripping away time and capacity from overburdened teams while losing sight of the problem at hand. End-user research, including context-specific information needs and preferences, digital literacy levels, access to technology and programme perception by affected communities, should inform the assessment of the need for a technology solution and its likely impact.

The Imagine, Design, Execute and Assess Journey for the Non-Profit – NetHope[154]

The Imagine, Design, Execute and Assess (IDEA) Journey Resource Guide, launched in partnership with Microsoft, is designed to give non-profits the information necessary to accelerate their digital transformation. NetHope's social impact accelerator begins with an organization identifying a challenge that would benefit from digital transformation. Where external resources become necessary, NetHope offers change management services and connects organizations to consultancy and implementing partners, donors, technology companies and peers. Through its Center for the Digital Non-Profit, NetHope provides digital ability and skills assessments.

"Technology is often looked to as an omnipotent fix, but while technology can expedite a functioning business process, it cannot fix its underlying flaws.

To define the appropriate response to a problem, all possible solutions warrant consideration, **from high-tech to "no-tech"**. Sometimes a community is better served by a bridge than by a drone-delivery system, by radio-based early warning than by machine learning, or by better procurement contracts than by 3D printing. Identifying the best solution according to need may require de-linking "innovation" from "technology". The most innovative approach may not employ cutting-edge technology, instead adapting an existing solution to a new problem or addressing an existing problem through a new process. Further, complementing a human solution with technology will typically generate better results than replacing it in a siloed, online/offline approach.



> "Identifying the best solution according to need may require de-linking "innovation" from "technology".

Innovation by Phone Surveys: Mobile Vulnerability Analysis and Mapping Project – WFP[155]

Mobile Vulnerability Analysis and Mapping, or mVAM, uses phone surveys to monitor food security and nutrition and provides users with free, near real-time information. Launched in 2013 to bridge access constraints in the Democratic Republic of the Congo and Somalia, it was rolled out across 15 countries by the end of 2019. During the COVID-19 response, WFP accelerated scaling efforts, aiming to expand mVAM to 40 countries. mVAM's phone surveys complement traditional face-to-face interviews, which require more resources and logistics and are subject to access and security constraints. The collected data flows into Hunger Map Live, which provides near real-time food security estimates in over 90 countries. mVAM ensures data reliability via representative sampling, stratification and key informants across large sample populations. To correct for biases due to unequal mobile phone ownership and penetration, WFP profiles by demographics and socio-economic status and monitors trends over time. Results are weighed by population and phone ownership and triangulated with other information to avoid errors.

Boda Boda Talk Talk: "An Idea That Worked" – Internews (South Sudan)[156] *and UNHCR (Uganda)*[157]

Among displaced people in protection of civilians sites in South Sudan, Boda Boda Talk Talk (BBTT) and radio are among the preferred information sources. Internews uses quad bikes with audio equipment to share pre-recorded information at listening points. When the Bidibidi refugee settlement was established in Uganda in 2016, quickly becoming one of the largest in the world, UNHCR adapted BBTT to meet local information needs and improve feedback loops with humanitarians through recordings and live messages. After seeing initial successes, UNHCR and IRC collaborated to expand the number of drivers and speakers across the settlement.

Once a solution is deemed to have a tech component, it must undergo a thorough **risk analysis** with respect to legal, ethical, security and capacity considerations. Doing No Harm (see Section III.D.) in the digital space means first to analyse and assess, and then to mitigate potential harms.

Strong leadership at all levels is paramount. A clear vision of the challenge, solution, necessary capacities and decisions to be based on the technology can set realistic expectations, guide staff at headquarters and in the field, generate buy-in from donors, and support successful implementation. At the operational level, transparency around decision-making and shifting priorities can give direction to the design and deployment of the technology and ensure integration with existing programmes.

Finally, humanitarian actors should test, iterate, and only then scale technology, **avoiding experimentation in an emergency context**.[161] Technologies are often developed once an emergency is underway, increasing risk (see Section III.E.). Expectations of quick-impact prototypes can also derail needs-driven solutions. Pro-actively designed solutions should be tried and tested before an emergency's onset. Small-scale pilots in non-emergency contexts can facilitate adjustments of a technology to a particular context. The transparent sharing of lessons learned, and the willingness to apply them, can support the effectiveness and scaling of future projects.

Risk, Harms & Benefits Assessment Tool – UN Global Pulse[159]

The Risk, Harms & Benefits Assessment Tool is a two-step data privacy, protection and ethics compliance mechanism for minimizing risks and maximizing gains of data innovation projects. It is meant to be undertaken prior to a project or upon changes to one, by a diverse team of experts and representatives of affected groups. Step one is an initial risk assessment to determine the need for a more comprehensive analysis. Step two is a detailed measurement of the likelihood, magnitude and significance of a project's positive and negative impact, providing a balancing framework for the risks and potential harms of data misuse and non-use.

Data Protection Impact Assessment – International Committee of the Red Cross (ICRC) and Brussels Privacy Hub[160]

A Data Protection Impact Assessment (DPIA) is used to analyse and mitigate risks related to data processing throughout the lifecycle of a project. A DPIA can inform decisions such as the extent of information collected about affected people; sharing data with local NGOs or authorities; replacing physical files with cloud-based storage; or displaying pictures of missing persons online. Steps include: (1) determining whether a DPIA is necessary, based on the extent of potential risks; (2) identifying the DPIA's scope, team, process and timeline; (3) describing the project and mapping data flows, including the type and purpose of data collection and use; who will have access to the data; and data retention, anonymization and security measures; (4) consulting stakeholders; (5) identifying risks, threats and vulnerabilities; (6) assessing the likelihood and severity of risks; (7) identifying technical, operational, organizational and strategic mitigation measures; (8) proposing recommendations; (9) implementing recommendations; (10) auditing the implementation of the DPIA; and (11) updating the DPIA if the project changes or new risks emerge.

C. DATA, CAPACITY AND SKILLS: ENSURE THE BASICS ARE IN PLACE

Once a problem is defined, its solution is determined to have a tech component, and a risk assessment has been carried out (see Section III.B.), adequate data and the skills and means to use it safely and effectively become the next fundamental building blocks for successful technology deployment.

Many new and emerging technologies require large quantities of **open, accurate and timely data**. Open data is difficult to obtain in humanitarian contexts, where connectivity is low, situations are fluid, access and security constraints persist, and time and resources are limited. Undisclosed origins of open data can lead to incomplete, erroneous or overlapping data sets. Data interoperability, data standards and consistent, ethical data collection methods (see Section III.D) are also essential. Despite efforts across humanitarian organizations, collective strategies and data collection methods remain sparse. Data from a vast array of sources, on a wide range of topics and in many different formats proves difficult to integrate. Storage takes place in myriad local databases and cloud servers. Scaled-up capacity and skills are necessary to perform data cleaning, methodical storage in central repositories, and other data engineering tasks.

Systematic data processing grounded in resilient and responsive administrative systems is the basis for the effective interpretation and maximum utility of data for humanitarians. For the UN, the ***Data Strategy of the Secretary-General for Action by Everyone, Everywhere*** *stipulates, among other things, the need to build and nurture capabilities, including data analytics and data management, and to foster strong enablers, including people and culture, data governance and strategy oversight, partnerships, and technology environments.*[162]

Data-sharing is fundamental to obtaining the data volumes required for tools such as AI, ML and predictive analytics. But siloed approaches within and across organizations can prevent the full utilization, or even awareness, of existing data. Secure and interoperable data sharing platforms, with protections for personal and sensitive data, are essential for better data-driven decision-making.

Data Sharing in Humanitarian Action – OCHA Humanitarian Data Exchange[163]

The number of datasets in the Humanitarian Data Exchange (HDX) soared from around 800 at inception in 2014 to over 18,000 by January 2021, spanning every active humanitarian crisis. In 2020, more than 1.3 million users accessed the platform, compared to 600,000 in 2019. To facilitate data standardization across different organizations, the Humanitarian Exchange Language (HXL) was created. HXL makes it possible to merge data across spreadsheets and identify mistakes by adding semantic hashtags to the tops of spreadsheet columns. As of July 2020, over one hundred organizations were using HXL on HDX. HDX also introduced the Data Grids to evaluate the completeness of data across contexts according to 6 categories (affected people; coordination and context; food security and nutrition; geography and infrastructure; health and education; and population and socio-economy) and 27 sub-categories. Sharing personally identifiable information is prohibited on the HDX, while sensitive, non-personal data may be shared under some conditions through HDX Connect, which enables sharing of metadata, as well as the underlying data bilaterally upon request.

In a global landscape shaped by the proliferation of both vast data volumes and **cybersecurity** threats, humanitarian actors must adopt and implement comprehensive cybersecurity strategies to better protect their organizations and the data and dignity of beneficiaries.[164] Private-sector companies are generally best equipped to provide a secure data infrastructure. However, the use of data for non-humanitarian purposes by such actors may pose protection threats and bear reputational risks. Data transfers to partners should only take place where adequate data protection is ensured, including through written data-sharing agreements.

Cloud computing *enables "on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications, and services)" that can be public, private, operated for a specific community, or a hybrid model.*[165] *Clouds can make data processing easier, faster and more flexible and cost-efficient, but data leakage, unauthorized access, and other risks must be analysed, assessed and mitigated. Potential safeguards include (1) a thorough risk assessment and cancellation of the project in case of undue risk; (2) due diligence by the service provider to ensure data protection compliance; (3) contractual data protection language; and (4) ensuring respect for any privileges and immunities.*[166]

Adequate **skills and capacities** are foundational in exploiting the potential of new and emerging technologies. The Roadmap for Digital Cooperation notes, "Achieving real and sustained progress in the various dimensions of digitalization requires skills development and effective training, in particular in developing countries."[167] Humanitarians should hire skilled professionals and upgrade existing skills, both to partner across sectors and to develop technology solutions in-house. Recruitment structures must enable the hiring and retention of technical experts, and comprehensive training programmes can upskill existing staff. Internal processes to prevent institutional memory loss are important in light of high staff mobility. Digitally literate humanitarians can not only articulate the need for data and technology; but know how to use it safely and effectively to improve humanitarian response.

Training a Cadre of Digitally Literate Humanitarians – OCHA Centre for Humanitarian Data[168]

The Centre for Humanitarian Data works to increase digital literacy of non-technical humanitarians, bridge the gap between technical staff and decision-makers, and increase demand for, and collection of, better data. A 2019 survey by the Centre of over 1,200 respondents from 111 countries showed that 98 per cent work on tasks related to data and 70 per cent work with data all the time. Respondents viewed collecting primary data and assessing and improving the quality of data as the primary challenges. The Centre's digital literacy programme includes training courses and online resources. As a founding member of the Data Literacy Consortium,[169] *the Centre also works with NGOs, governments and UN agencies to share resources and best practices.*

Unlocking the potential of new and emerging technologies for humanitarian action requires a secure, networked and trusted data ecosystem. Only through **systematic and common approaches**, and adequate tools for collecting and processing high quality, clean and reliable data, can data reach its full potential in the form of basic statistical analysis and more advanced technological applications.

Collaborative Humanitarian Data Tools – The Data Entry and Exploratory Platform[170]

The Data Entry and exploratory Platform is an open-source suite of collaborative data tools for humanitarian actors. It enables customizable and user-friendly data collation and analysis, tagging and filtering of information, and export to a variety of formats, accommodating both structured and unstructured data. The platform can be deployed in a private server environment and its data is encrypted and visible only to certain users. Launched as a cross-sector collaborative in 2015, the platform has supported joint analysis in humanitarian contexts including sudden-onset emergencies in Mozambique, complex emergencies in Libya, Nigeria and Yemen, and mixed migration flows in Venezuela.

D. DATA RESPONSIBILITY AND THE HUMANITARIAN PRINCIPLES: FIRST, DO NO HARM

The duty to **Do No Harm** and the **humanitarian principles** of humanity, neutrality, impartiality and independence are the guiding lights of humanitarian action, including in the digital realm. These principles are central to establishing and maintaining access to, and trust with, affected communities, while avoiding negative consequences of humanitarian activities, including data collection and use. To Do No Harm in the digital space, humanitarians need to analyse, assess and mitigate potential harms (see Section III.B.).

A fundamental prerequisite for community trust is that data is **used solely for humanitarian purposes**. However, data is often controlled by or shared with financial institutions, technology companies, mobile network operators, or other industry partners. These actors may use information for non-humanitarian purposes, such as checking beneficiaries for creditworthiness or against designated person lists, or retain metadata for law enforcement purposes. Governments may demand access to data. And non-State actors may obtain it through cyberattacks and for malicious purposes.

Third-party data access may lead to abusive surveillance, censorship, discrimination, online harassment or persecution, compromising the humanitarian principles and the duty to Do No Harm. The risk that authorities might pressure humanitarian organizations to share data for non-humanitarian purposes like migration control or fighting terrorism, and the subsequent potential harm to affected communities and principled humanitarian assistance, were recognized in the International Conference of Privacy and Data Protection Commissioners' Resolution on Privacy and International Humanitarian Action.[171] Further, the Resolution of the International Conference of the Red Cross and Red Crescent on Restoring Family Links, adopted by all parties to the Geneva Conventions in 2019, urges States and the Movement "to cooperate to ensure that personal data is not requested or used for purposes incompatible with the humanitarian nature of the work of the Movement…"[172]

Humanitarian actors must take all feasible precautions to ensure that beneficiary data is not used or shared for non-humanitarian purposes. Appropriate legal, organizational and technical safeguards must be in place to protect **data security**, including against unauthorized access. **Data transfers** to partners should only take place where data protection is ensured, including through written data-sharing agreements. Further, all relevant actors should respect the neutrality, impartiality and independence of a **humanitarian cyberspace**.[173]

THE HUMANITARIAN PRINCIPLES[174]

HUMANITY
Human suffering must be addressed wherever it is found. The purpose of humanitarian action is to protect life and health and ensure respect for humanitarian beings.

NEUTRALITY
Humanitarian actors must not take sides in hostilities or engage in controversies of a political, racial, religious or ideological nature.

IMPARTIALITY
Humanitarian action must be carried out on the basis of need alone, giving priority to the most urgent case of distress and making no distinctions on the basis of nationality, race, gender, religious belief, class or political opinions.

INDEPENDENCE
Humanitarian action must be autonomous from the political, economic, military or other objectives that any actor may hold with regard to areas where humanitarian action is being implemented.

DO NO HARM[175]

Data responsibility is mutually reinforcing of the duty to Do No Harm and the humanitarian principles and interconnected with the basics of data processing described in Section III.C. Data responsibility in humanitarian action is the "**safe, ethical and effective** management of personal and non-personal data for operational response, in accordance with established frameworks for **personal data protection**."[176] Data responsibility requires actions to ensure data protection, data privacy and data security, as well as strategies to mitigate the risks while maximizing the benefits of data management.

IASC PRINCIPLES FOR DATA RESPONSIBILITY IN HUMANITARIAN ACTION[177]

ACCOUNTABILITY
Adequate measures are in place to uphold and monitor adherence to the principles on data responsibility

CONFIDENTIALITY
Appropriate organizational safeguards and procedures ensure the confidentiality of sensitive data in line with applicable standards, policies and legal requirements

COORDINATION AND COLLABORATION
As appropriate and in line with the humanitarian principles, data management meaningfully includes humanitarian partners, authorities, affected people and other stakeholders

DATA SECURITY
Adequate organizational and technical safeguards are in place to prevent, mitigate, report and respond to security breaches

DEFINED PURPOSE, NECESSITY AND PROPORTIONALITY
Data management has a specified purpose consistent with relevant mandates, rights and freedoms, and is relevant, limited and proportionate to that purpose

FAIRNESS AND LEGITIMACY
Data is managed in accordance with the humanitarian principles and organizational mandates and based on legitimate grounds

HUMAN RIGHTS-BASED APPROACH
Data management is designed and implemented in ways that respect, protect and promote human rights

PEOPLE-CENTRED AND INCLUSIVE
Affected people are included, represented, and empowered to exercise agency through data management whenever the operational context permits

PERSONAL DATA PROTECTION
Data management adheres to applicable data protection laws and policies

QUALITY
Data is relevant, accurate, timely, complete, up-to-date, interpretable and, where possible, disaggregated, in line with its intended use and as appropriate within the given context

RETENTION AND DESTRUCTION
Sensitive data is only retained as long as necessary for the specified purpose or as required by law or donor audit regulations; data is subject to a retention schema and data sensitivity is periodically reassessed

TRANSPARENCY
Data management offers meaningful transparency towards stakeholders, including information about the data management activity, its purpose, intended data use and sharing, and limitations and risks

Under the **fairness and legitimacy** principle, data management must be in line with an organization's mandate and be based on legitimate grounds, such as data subject consent; the best interest of the data subject; the public interest in furtherance of the organization's mandate; or the vital interests of data subjects unable to decide about data management themselves.[178] For personal data, consent is typically the preferred, but often not a viable, legal basis, such as where security, access or logistical constraints make it impossible, or where consent is invalid because no alternative to accessing aid exists, or a data subject cannot fully understand the technology or its associated risks.[179]

The **transparency** principle requires that data be managed with meaningful transparency towards data subjects, including information about the data management activity, its outputs, purpose, intended use and sharing, and limitations and risks.[180] Clear guides to the use of technologies – presented in a manner appropriate for local audiences – are important to ensure transparency as well as voluntary and informed data subject consent whenever possible.

The **purpose specification** principle requires that data be processed for a specific purpose. Any further processing of data beyond its original purpose must be compatible with the initial purpose or have an independent legitimate basis. In addition, data processing must be **relevant, limited and proportionate** to that purpose. And, while humanitarian data may be retained indefinitely as long as its sensitivity is periodically reassessed and a retention scheme is in place, personal and sensitive data should only be **retained** as long as necessary for the specified purpose or as required by applicable law or donor audit regulations.[181] There is an inherent tension, however, between data minimization obligations and certain technologies, such as AI, predictive analytics or chatbots, for which efficacy increases with growing data volumes, in turn decreasing the risk of system-bias and discrimination. Such tensions must be carefully assessed at the pre-design stage of a technology application (see Section III.B.), and appropriate risk mitigation measures must be taken.

Data management should be based on **quality** data that is relevant, accurate, timely, complete, up-to-date and interpretable in line with its specified purpose.[182] This requires sufficient open data and data engineering skills (see Section III.C.). To ensure **accountability**, humanitarians should put in place policies, mechanisms and adequate capacities to uphold and review compliance with data responsibility principles.[183]

Humanitarian organizations must adhere to applicable data protection laws, or to their own data protection policies if they enjoy privileges and immunities. **Personal data protection**[184] is grounded in International Human Rights Law (see Section III.F.) and includes the right to be informed about and object to the processing of one's personal data, and to access, correct or delete it. Integrating data protection by design and by default in data and technology solutions is a powerful tool to ensure respect for rights and dignity when processing information, as well as individual agency, accountability and trust.

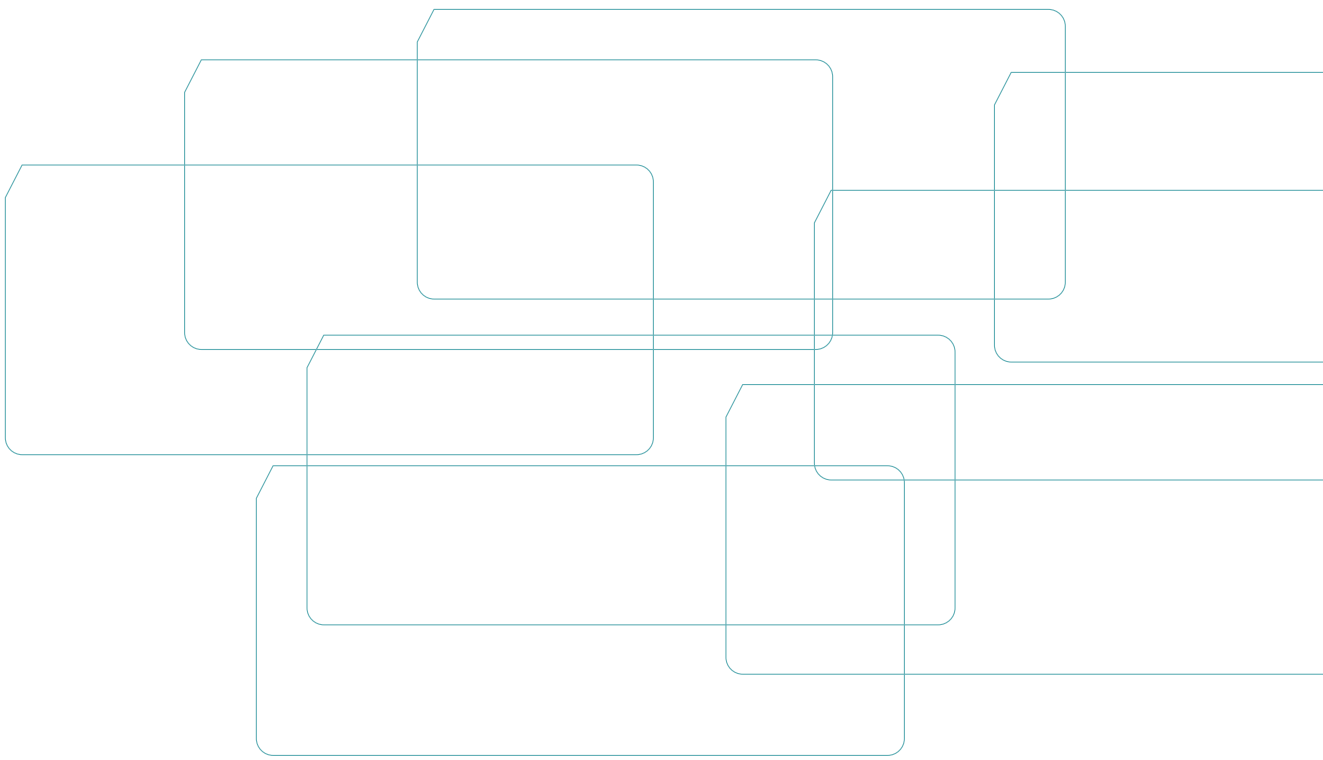
Resources Related to Data Responsibility and Data Protection in Humanitarian Action

- IASC Operational Guidance on Data Responsibility in Humanitarian Action[185]
- OCHA Data Responsibility Guidelines[186]
- ICRC and Brussels Privacy Hub Handbook on Data Protection in Humanitarian Action[187]
- UN High Level Committee on Management Personal Data Protection and Privacy Principles[188]
- UN Secretary-General Data Strategy for Action by Everyone, Everywhere[189]

Finally, efforts are needed to fully address potential harms from **demographically identifiable information**,[190] such as aggregated data on ethnicity, gender, age, occupation, religion and location. This data can enable the identification of groups and is at the heart of many new and emerging technologies. The responsible management and protection of personal and sensitive data, including demographically identifiable information, are vital for effective data processing and fundamental to the protection of people affected by humanitarian crises.

The Humanitarian Data and Trust Initiative[191] *– ICRC, OCHA Centre for Humanitarian Data, Switzerland*

The Humanitarian Data and Trust Initiative was launched by the ICRC, the Centre for Humanitarian Data and Switzerland to maximize the benefits of humanitarian data and technology while minimizing the risks of doing harm. The initiative includes three pillars: (1) policy & dialogue; (2) research & development; and (3) education and outreach. It aims to translate data responsibility and data protection policies and principles into collective action among humanitarian organizations, states, civil society, academia and the private sector to accelerate the responsible deployment of data-related technologies, develop shared principles and guidelines around responsible data management, and build trust between parties through strategic dialogue and transparency.



E. COLLABORATION AND COORDINATION: FORM LASTING PARTNERSHIPS

It is well understood that the only way to achieve the Sustainable Development Goals and meet increasing demand for humanitarian assistance is through partnerships. Yet, strengthening partnerships with governments and traditional humanitarian actors is not enough. The Roadmap for Digital Cooperation notes, "Digital cooperation is a multi-stakeholder effort and, while Governments remain at the centre, the involvement of the private sector, technology companies, civil society and other stakeholders is essential."[192]

Partnerships often form to develop a quick-impact solution in an unfolding crisis. While a natural consequence of the need for immediate action and readiness to adapt in a crisis, this pattern bears considerable risk. The capacities, expertise and protocols needed to execute a project while protecting the privacy and security of affected populations may not be in place; governmental approvals may be missing; the solution may not have been tested in that context; its positive impact and protection risks may be unclear; and community mistrust may emerge without prior engagement. **Pre-existing, sustainable partnerships** can overcome these risks, enable better data preparedness,[193] and lead to the safe and successful implementation of a solution.

> "Digital cooperation is a multi-stakeholder effort and, while Governments remain at the centre, the involvement of the private sector, technology companies, civil society and other stakeholders is essential.

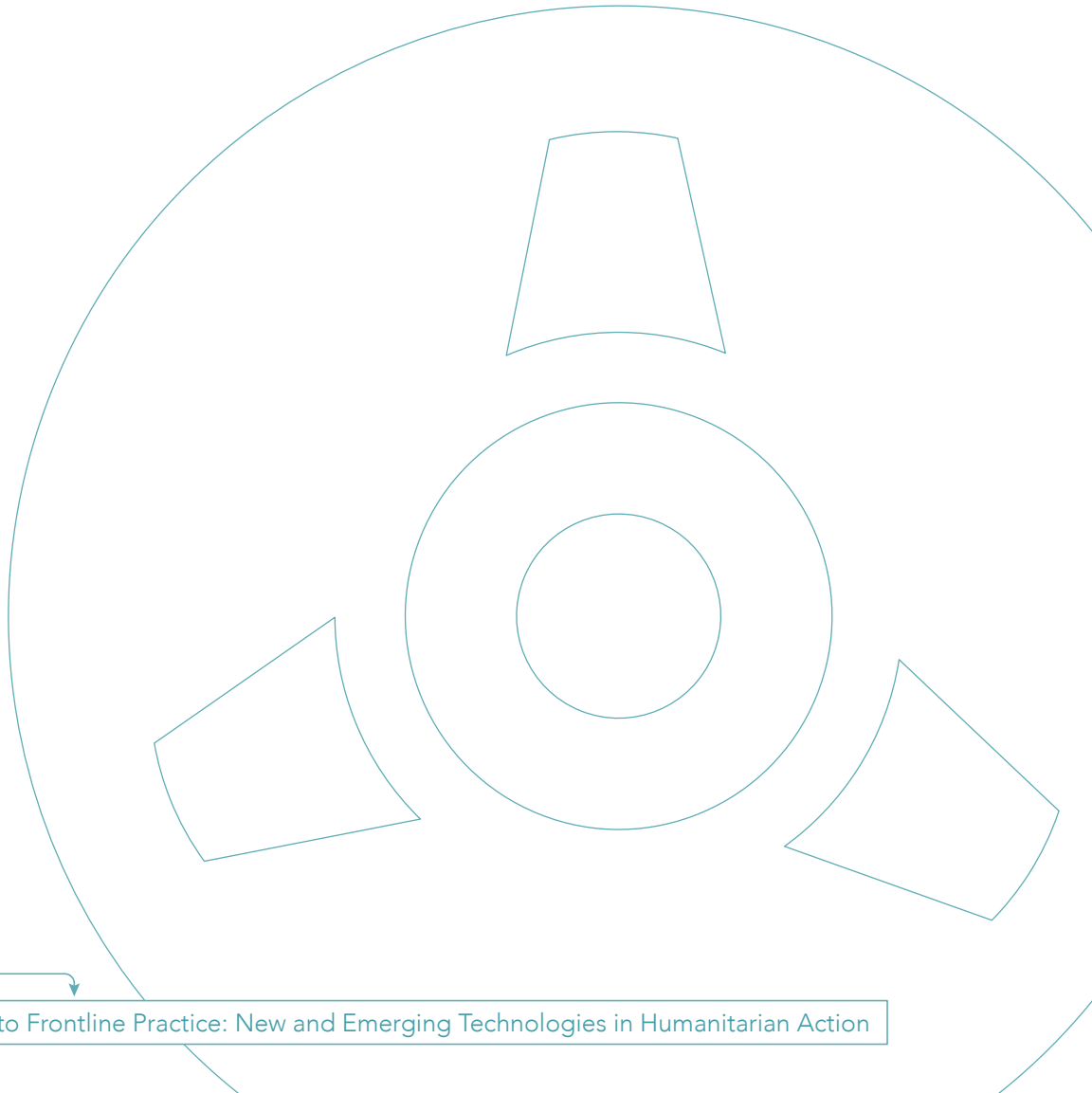
Finding the right partner is key. Governments can provide leadership and capacity, donor support and legitimacy. Humanitarians can contribute expertise and insights on needs and challenges. The private sector can supply funding, data and technology solutions. And local and regional partners can contribute essential on-the-ground knowledge and front-line leadership. Collaborating across sectors at the international, regional, national and local levels maximizes synergies and helps to close individual actors' "knowledge gaps".[194] Increased **clarity on roles and activities** in the humanitarian innovation space would help actors identify their ideal partners.

Public-Private Partnerships[195]

Reflecting the increasing influence of the private sector on humanitarian operations, public-private partnerships (PPP) warrant similar commitment and long-sighted diplomatic efforts as government partnerships. PPPs typically involve the provision of funding, technology and technical advice and support; the joint development of technology solutions; and data sharing and collaboration. Common challenges in PPPs include reputational risk; technology effectiveness; data sensitivity and use; uncertainty about new data sources; intellectual property; and dependency and deference. Five steps can aid in overcoming these challenges: (1) defining shared goals; (2) performing robust due diligence;[196] (3) carrying out risk-benefit assessments;[197] (4) framing the relationship through adequate agreements;[198] and (5) designing technology responsibly.[199] Humanitarians play a vital role in facilitating PPPs that Do No Harm and comply with the humanitarian principles.

Partnerships are grounded in **common challenges and expectations**, requiring a clear articulation of each partner's core objectives at the outset. Approaches will differ depending on the main humanitarian objective of fundraising, operational collaboration, public messaging, or regulatory development, and the private sector objective of revenue generation, philanthropy, or a combination. Once challenges are articulated, milestones, capacity and integration of technology and humanitarian expertise can be jointly explored and elaborated, always keeping a focus on end-user need. A solid understanding of partnering organizations is critical to determine realistic approaches, capacities and timelines.

Shared frameworks on data responsibility, data ownership, intellectual property rights and vetting of subcontractors should be established at the outset of any partnership, guiding the design, development and deployment of a technology solution. A common risk assessment can identify potential threats to affected communities as well as mitigation measures and safeguards. It is imperative that humanitarians voice protection concerns and work with private sector partners to determine the safest, most appropriate solution. Overarching framework agreements can facilitate due diligence processes for future collaborations.



F. LAW AND POLICY: TAKE AN ENABLING, RIGHTS-BASED APPROACH

Employing technologies responsibly and effectively requires both a rights-based approach to their design, development and deployment, as well as an enabling legal and regulatory environment.

International Human Rights Law protects, among other things, the right to life, liberty and security of person; the right to equality and non-discrimination; the right to privacy, freedom of expression and personal identity; and the right to share in scientific advancement and its benefits.[200] Inherent to these human rights are both negative and positive obligations of States to refrain from their violation, and to actively protect and fulfil them, including through legislative, judicial, administrative, educational and other appropriate measures.[201] Linked to these rights is the right to personal data protection (see Section III.D.), which derives from the right to privacy and, in some instances, is recognized as a self-standing fundamental right.[202]

The **Signal Code** is an effort to identify the human rights people have to information during disasters.[203] It enumerates the following rights: the right to access information during a crisis; the right to be protected from threats and harms resulting directly or indirectly from the use of ICTs or data pertaining to oneself; the right to have personal information be treated consistently with internationally accepted legal, ethical and technical data protection and privacy standards; the right to agency over the collection, use and disclosure of personally identifiable information; and the right to rectification and redress of harms caused by demonstrably false, inaccurate, or incomplete data.

While it is generally accepted that **human rights exist online**, the Secretary-General has called for further efforts to clarify how human rights apply in the digital space, for Member States to place human rights at the centre of regulatory frameworks and legislation on new technologies, and for technology leaders to take concrete actions to protect the right to privacy and other human rights online, with the Guiding Principles on Business and Human Rights providing useful guidance.[204]

Further, while many States recognize that **International Humanitarian Law** applies to cyber operations during armed conflict, further reflection is needed to identify ways of reducing the potential human cost of cyber operations and to work towards consensus on the interpretation of International Humanitarian Law in cyberspace.[205] It should also be understood that hospitals and other critical civilian infrastructure are to be safeguarded, not only during armed conflicts, but at all times.[206]

Select Resources and Initiatives on the Security and Stability of Cyberspace

- Group of Governmental Experts and Open-Ended Working Group on ICT developments in the context of international security[207]
- Tallinn Manual 2.0 on the International Law Applicable to Cyber Operations[208]
- UN Secretary-General's Roadmap for Digital Cooperation[209]
- Oxford Process on International Law Protections in Cyberspace[210]
- Multi-stakeholder initiatives: Contract for the Web;[211] Global Commission on Stability of Cyberspace;[212] Paris Call for Trust and Security in Cyber Space[213]
- Private sector initiatives: Charter of Trust;[214] Cybersecurity Tech Accord[215]

Laws and regulations not only protect affected people, they are also determinants of **enabling technology** in humanitarian action. For example, rigid import, export and use restrictions can hinder a technology solution from being deployed in an effective and timely manner, particularly in an emergency. Further, enabling

interoperability of technology solutions, such as digital IDs, through appropriate legal and regulatory frameworks and ethical and technical standards is necessary both within and across contexts to ensure that a solution does not stop at the edges of one authority, organization, or territory, particularly in a migration context. Data sovereignty laws impact where data can or must be stored. And prohibitive regulatory requirements or a lack of regulations may prevent a technology from being used at all.

Similarly, shared and cross-sector frameworks on the **ethical use** of technologies such as AI, biometrics, blockchain and UAVs not only prevent harm, but also enable their sustainable and inclusive design, development and deployment. But while there are, for example, currently more than 160 sets of AI governance principles at organizational, national and international level, there is no forum to coordinate and bring these initiatives together.[216]

Finally, strong **data protection** laws are a powerful enabler of technology uptake. Their focus on individual agency and rights makes them people centric. Their focus on rules and remedies puts them at the centre of what it means to be accountable. Their focus on navigating complex technologies involving multiple stakeholders and risk environments makes them key for responsible deployment. By combining all of these elements, these laws are a powerful enabler of trust.

Select Resources and Initiatives on the Ethical use of AI

- UN System Chief Executives Board for Coordination, UN System-Wide Strategic Approach and Roadmap for Supporting Capacity Development on Artificial Intelligence; and High-Level Committee on Programmes, Inter-Agency Working Group on Artificial Intelligence[217]
- UNESCO recommendation for an international standard-setting instrument on the ethics of AI[218]
- UN Secretary-General's Roadmap for Digital Cooperation[219]
- International Conference of Data Protection and Privacy Commissioners' Declaration on Ethics and Data Protection in Artificial Intelligence[220]
- Group of Governmental Experts on Lethal Autonomous Weapons Systems[221]
- The Global Partnership on Artificial Intelligence[222]
- Principles developed by governments, intergovernmental organizations, multi-stakeholder approaches, the private sector and civil society[223]

Strengthening Governance Through Digital Cooperation[224]

The Internet Governance Forum was established by the World Summit on the Information Society in Tunis in 2005 and serves as the main UN platform for multi-stakeholder dialogue on internet governance and digital policy. The UN Secretary-General's High-Level Panel on Digital Cooperation identified a need for strengthened cooperation mechanisms to address emerging challenges from digital technologies, including through more actionable outcomes and follow up, inclusivity and active participation by governments and the private sector; and less fragmentation, inconsistency and overlap. The Secretary-General's Roadmap for Digital Cooperation makes a number of proposals to strengthen the Internet Governance Forum. They include the creation of a multi-stakeholder high-level body to address urgent issues, coordinate follow-up and serve as a link to normative and decision-making bodies; a more focused agenda; high-level segments; stronger links to regional, national, sub-regional and youth initiatives; better integration of programme and intersessional policy development work; an innovative fundraising strategy; and enhanced visibility, including through a stronger corporate identity and improved reporting to other UN entities.

G. INVESTMENT AND SCALING: MEASURE IMPACT AND TARGET LONG-TERM SOLUTIONS

Unlocking new and emerging technologies for humanitarian action requires a sustainable, **long-term investment strategy**. It is often easier to garner support and financial backing for quick impact prototypes than for their lasting integration into programmatic efforts and the administrative systems and human capacities to support them. As a result, many humanitarian innovation initiatives remain pilot projects conducted independently of long-term strategies to meet the needs of affected people.

Humanitarian Research and Development Spending[225]

A report prepared before the World Humanitarian Summit in 2016 highlighted the importance of research and development (R&D) as a driver of innovation. The report found that humanitarians would need to greatly increase annual R&D investment to $75 million to reach the spending of low-tech industries and $1.18 billion to reach that of high-tech industries. The report also highlighted the insufficient quality of ideas and researchers, as well as adoption and scaling, as impediments to R&D spending in the humanitarian sector. However, it also concluded that similar bottlenecks in other sectors had not prevented long-term impact or return on investment if overcome through adequate and sustainable R&D financing.

Sustainable funding must grow to meet ambition and demand, requiring: (1) Leadership by at least one strong facilitating actor, often with funding; (2) an enabling ecosystem or backbone infrastructure; (3) continual investment throughout the innovation funnel, including adoption; and (4) strong evidence of an innovation's effectiveness.[226]

Investment should be driven by a thorough assessment of a technology's **impact on the needs** of vulnerable populations, requiring thorough pre-deployment and after-action reviews; continuous monitoring using measurement and evaluation metrics that include localization, power-shifting, and adherence to legal and ethical standards; and the transparent sharing of lessons learned. Feedback loops with affected communities are essential to determine a solution's effectiveness according to end-user need, and experiences of operational organizations with technology solutions are invaluable.

Integrating data protection in design is an essential part of investment, as it can ensure scalable data protection through appropriate conduct without specific data protection expertise. In the humanitarian space, innovation funding is particularly crucial to systematically **professionalize** the field, and to bring expertise in-house to build teams that not only know their mission, its beneficiaries and ethical implications, but also have the technological savvy to build robust solutions that can sustainably improve data-driven decision-making.

More systematic collaboration within and across organizations to learn from experience would enable more **methodical identification of high-potential use cases** and future approaches, consolidate efforts, and decrease overlap and fragmentation. Developing a catalogue of use-case assessments in close collaboration with field actors would provide insights into what technologies best meet what needs in different contexts, what their risks are and how to best address them. Given that many humanitarian technology projects remain in their pilot phase, further research, monitoring and evaluation is crucial, particularly of the long-term scalability and effectiveness in different contexts.

FUNDING INITIATIVES FOR HUMANITARIAN INNOVATION

Humanitarian Innovation Fund – Enhancing Learning and Research for Humanitarian Assistance (ELRHA) [227]

The Humanitarian Innovation Fund launched in 2011 as one of the first independent grant-making programmes to develop and test innovation in the humanitarian system. Uniquely open to the entire humanitarian community, it funds, supports and manages projects at every stage of the innovation process. The Humanitarian Innovation Fund has supported over 150 innovation projects, including WFP's mVAM Mobile Voice Technology for Food Security Data,[228] the IFRC's Improving Menstrual Hygiene Management in Emergencies,[229] and Translators Without Borders' Words of Relief.[230]

Humanitarian Grand Challenge – U.S. Agency for International Development, U.K. Foreign Commonwealth & Development Office, Ministry of Foreign Affairs of the Netherlands, Grand Challenges Canada[231]

The Humanitarian Grand Challenge identifies and supports innovative solutions involving the private sector and channeling the experiences of affected communities to improve their lives and enhance the response to complex emergencies. The Humanitarian Grand Challenge has funded more than 50 innovators in over 20 countries, with innovations such as telemedicine glasses in the Democratic Republic of the Congo, solar powered water pumps in South Sudan, and a mobile app to verify and secure imagery from conflict-affected areas in Syria.

The Humanitarian Innovation Programme – Norwegian Ministry of Foreign Affairs[232]

The Programme funds innovative solutions to improve humanitarian action. It supports projects led by UN agencies with a humanitarian mandate or Norwegian humanitarian organisations with an international mandate. Support is provided to apply private-sector-expertise to humanitarian challenges, for both early-stage innovation as well as scaling and diffusion of successful pilot programmes, particularly for protection, green humanitarian response, cash transfer programming, and health and sanitation.

Science and Technology for Humanitarian Action Challenges – École Polytechnique Fédérale de Lausanne, ETH Zürich and ICRC[233]

Science and Technology for Humanitarian Action Challenges support project-based research by École Polytechnique Fédérale de Lausanne (EPFL), ETH Zürich and the ICRC to develop innovative technology solutions to humanitarian challenges. They are managed by the EPFL EssentialTech Centre's Humanitarian Tech Hub, jointly established with the ICRC in 2016 to explore science and technology solutions for humanitarian action. Humanitarian Action Challenges grants range from CHF 100,000 to CHF 300,000 and projects last between 6 and 24 months.

IV

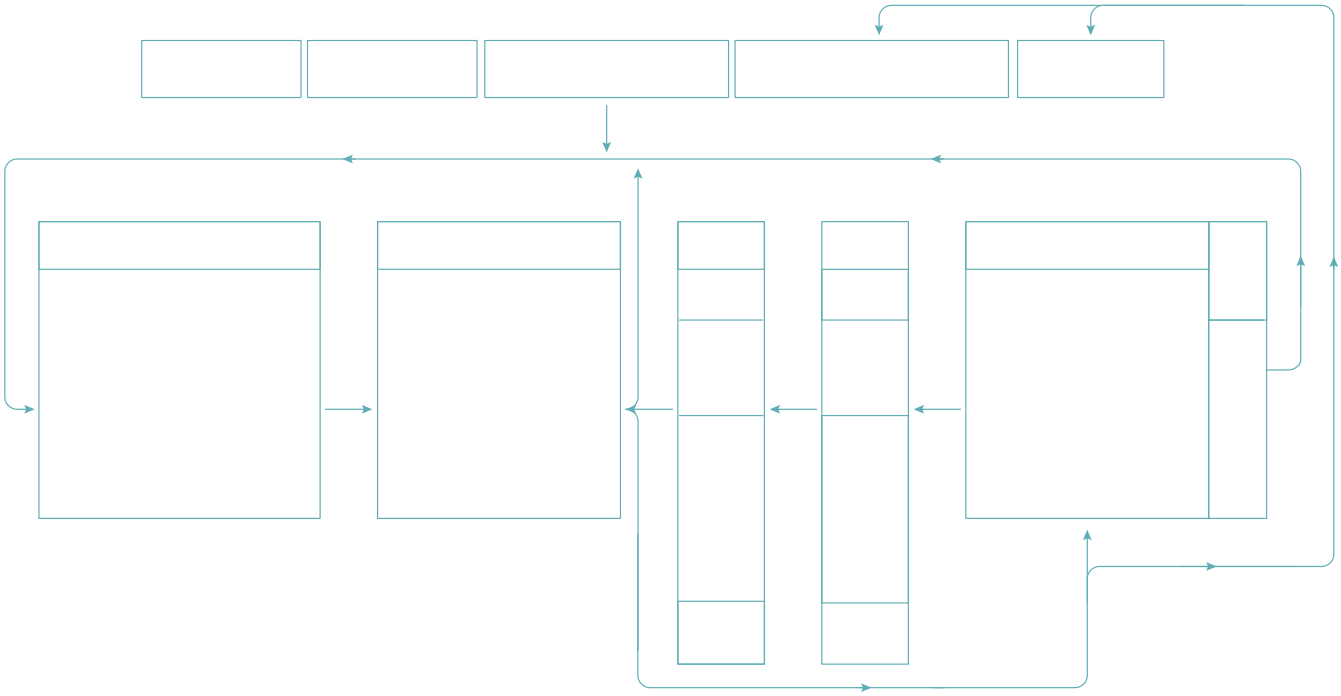
CONCLUSION: THE ROAD AHEAD

New and emerging technologies can help shift humanitarian action **from reaction to anticipation** by enabling earlier, faster, and potentially more effective action. They can generate improvements across the humanitarian programme cycle by supporting stronger, more relevant needs analysis; a more prioritized and people-centred response; and more meaningful and systematic monitoring and evaluation. These improvements could in turn extend stretched capacities further, protecting more people affected by humanitarian crises.

However, concerted efforts are needed to realize the full potential of new and emerging technologies to alleviate humanitarian need. Digital tools don't necessarily lead to better decisions, especially in a sector as political and challenging as the humanitarian one.[234] A **"back to basics"** approach is required to clearly identify problems at the outset according to end-user need, with appropriate solutions located along a spectrum from "no-tech" to high-tech. Decisions should be tied to the problem statement at every step of design, development and deployment, with strong leadership at the strategic and operational levels providing transparency and direction. Consistent data collection methods grounded in secure and responsible administrative systems and technology architectures are imperative. Basic compliance with, and training in, best practice for existing technology is foundational to more advanced solutions. Robust cybersecurity safeguards are needed to protect proliferating data flows from increasing cyberattacks. Adequate skills and capacities must be in place to operate systems effectively and maximize their utility for decision-making.

At the same time, a comprehensive **practice agenda and strategy** are needed for humanitarians' safe, systematic and effective use of technology. Strong data responsibility, including data protection, must ensure that technology respects rights and dignity and remains people-centric, accountable and trusted. Doing No Harm in the digital sphere presupposes that potential risks are analysed, assessed, and mitigated. Regulation and governance must catch up with technology to enable its deployment while protecting people's rights. Multi-stakeholder partnerships should be built pre-emptively and fostered sustainably, grounded in shared ethical frameworks and common understanding of challenges and expectations. Better coordination within and across humanitarian organizations on roles in the digital sphere can consolidate a fragmented landscape, decrease overlap and maximize collective outcomes. Long-term investments can enable further research into high-potential use-cases and sustainable integration into programmatic efforts. Advances in connectivity, digital literacy and access to basic technology for vulnerable populations must grow to connect people to information and services and bridge the digital divide. And increased support for local actors can facilitate a gradual power-shift towards local communities.

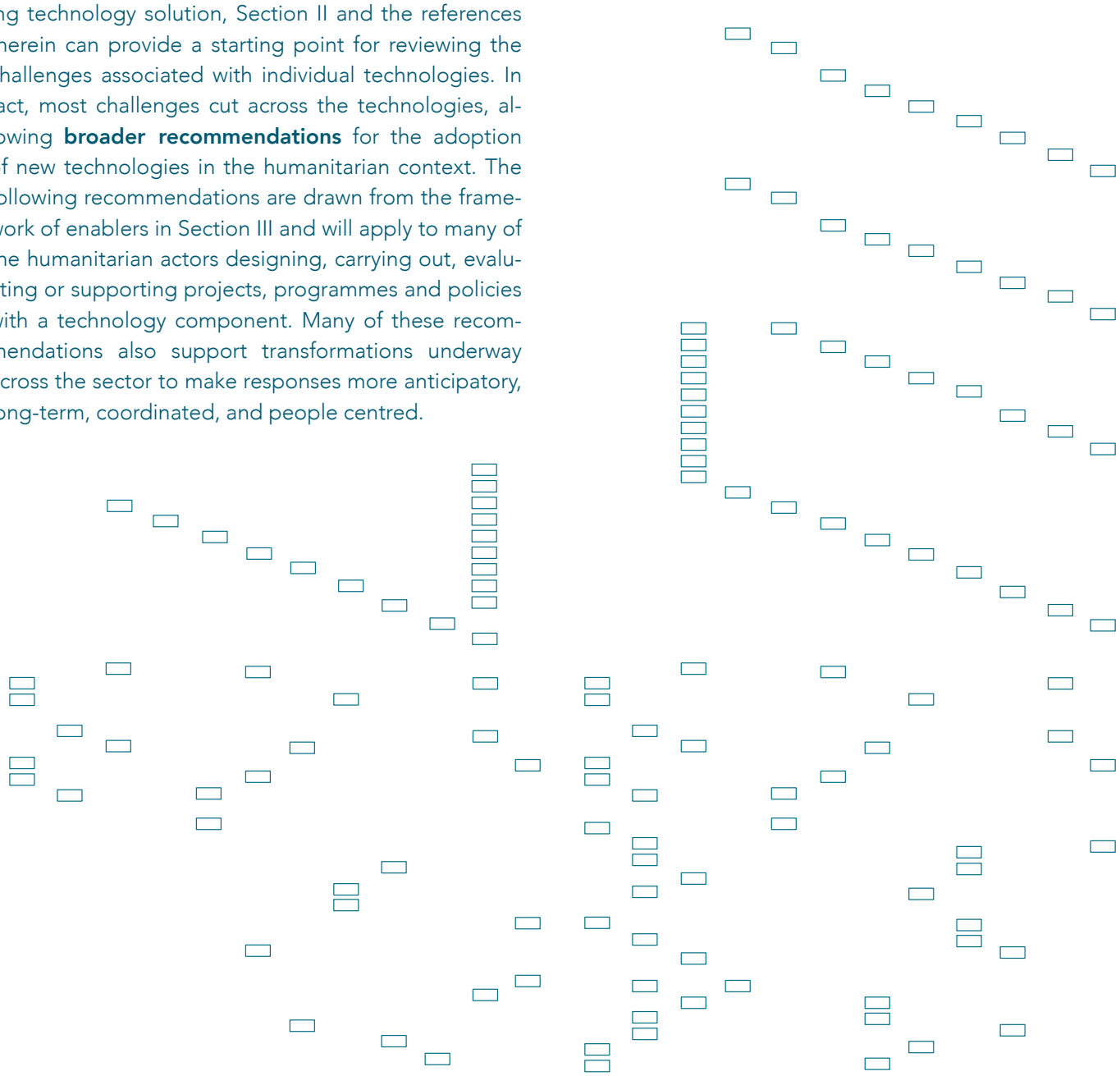
Such converging efforts could support a **transformation of the humanitarian system** to become less "defined by an array of binary oppositions: humanitarian—development, international—local, state-centric—state-avoiding, refugee—migrant, host—guest."[235] Needs would increasingly be projected, rather than assessed. Linking prediction to anticipatory funding and risk insurance would enable vulnerabilities to be met faster or even prevented. Humanitarian assistance would become more preventive, improving livelihoods alongside alleviating basic needs. Efforts would be user-driven, locally led and sustainably integrated into local structures and economies. A "digital humanitarian space"[236] would safeguard the rights and protections of people affected by crises. More people would be protected; more lives would be saved. New and emerging technologies can support these transformations, but must themselves be shaped by them, and designed and deployed in responsible, sustainable and inclusive ways.



V

RECOMMENDATIONS

As humanitarians consider adopting a new or emerging technology solution, Section II and the references therein can provide a starting point for reviewing the challenges associated with individual technologies. In fact, most challenges cut across the technologies, allowing **broader recommendations** for the adoption of new technologies in the humanitarian context. The following recommendations are drawn from the framework of enablers in Section III and will apply to many of the humanitarian actors designing, carrying out, evaluating or supporting projects, programmes and policies with a technology component. Many of these recommendations also support transformations underway across the sector to make responses more anticipatory, long-term, coordinated, and people centred.



INCLUSION AND LOCALIZATION EMPOWER COMMUNITIES AND BRIDGE THE DIGITAL DIVIDE	• Enhance **connectivity, access to basic technology and digital literacy** in humanitarian contexts, with special focus on vulnerable and marginalized groups. • Strengthen local partnerships and **transfer power** to local communities through equal access to opportunities, local leadership, investment and capacity-building. • Design pilot projects around their long-term **integration** into programmatic efforts and, where appropriate community-led initiatives.
PEOPLE-CENTRED DESIGN AND LEADERSHIP WORK WITH AND FOR USERS	• Engage with **communities** to assess the need for and effectiveness of a technology solution, including field research on information needs and preferences, digital literacy levels, access to technology, programme perception, and local partners and capacities. • Conduct a thorough **assessment of benefits and risks** to affected communities at the pre-design stage and update it throughout the development process. • Develop and adapt existing technologies to the humanitarian sector and ensure their proper contextual **tailoring, testing, efficacy and safety** before deployment. • Develop common standards, definitions and protections for **research and experimentation**.
DATA, CAPACITY AND SKILLS ENSURE THE BASICS ARE IN PLACE	• Build humanitarians' **digital literacy, capacity and skill** through cross-sector hires and upskilling, recruitment structure adaptations and institutional memory loss prevention. • Build and promote interoperable **data sharing** platforms with adequate protections for personal and sensitive data within and across organizations and sectors. • Adopt comprehensive **cybersecurity strategies** and build secure technical infrastructure, including through private sector collaboration that ensures data protection and privacy.
DATA RESPONSIBILITY AND THE HUMANITARIAN PRINCIPLES FIRST, DO NO HARM	• Adopt and implement robust **data responsibility** policies, processes and safeguards. • Design context-specific **guides** to technologies, providing information on the nature and purpose of data collection as well as opportunity for clarification and objection. • Protect against data use for **non-humanitarian purposes**, including through technical and organizational safeguards and data-sharing agreements with partners. • Respect, and ensure respect for, a neutral, impartial and independent **humanitarian cyberspace**.
COLLABORATION AND COORDINATION FORM LASTING PARTNERSHIPS	• Establish and plan for existing partnerships **prior** to emergencies based on clear roles and responsibilities, joint risk-assessments, skills-integration and sharing of lessons learned. • Coordinate across the UN and the humanitarian sector to **consolidate a fragmented landscape**, decrease overlap and duplication, and maximize efficiencies in resource allocation and the achievement of collective programmatic outcomes. • Facilitate more seamless and sustainable collaboration with the **private sector**, including through the integration of humanitarian and private sector expertise.
LAW AND POLICY TAKE AN ENABLING, RIGHTS-BASED APPROACH	• Promote cross-sector cooperation and multi-stakeholder commitments, as well as domestic **laws and regulations**, to protect the security of cyberspace and human rights in the digital space and ensure data protection and the ethical use of technology in humanitarian action. • Design local laws and regulations that both protect people's rights and **enable technology** deployments, e.g., by establishing interoperability, avoiding prohibitive restrictions and ensuring the independence of humanitarian data.
INVESTMENT AND SCALING MEASURE IMPACT AND TARGET LONG-TERM SOLUTIONS	• Develop a comprehensive **research and practice agenda** for the development, application and scaling of new and emerging technologies in humanitarian action. • Conduct further multidisciplinary research to develop a **catalogue of high-potential use-cases**, with special focus on long-term impact, effectiveness and scalability in different contexts. • Promote the **integration** of pilot projects into long-term, programmatic efforts. • Provide long-term and flexible **funding** for sustainable humanitarian innovation.

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